Wisconsin Farm Research Summary

No. 5, July, 2000

Summaries of research from the Program on Agricultural Technology Studies

How Wisconsin Dairy Farmers Feed their Cows: Results of the 1999 Wisconsin Dairy Herd Feeding Study

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Introduction

The Wisconsin dairy industry has seen dramatic changes over the last 20 years (Jackson-Smith and Barham, 2000). Overall, dairy farm numbers have been cut in half since the early 1980s, and the average size of remaining herds has increased by more than 60 percent (from roughly 40 cows to over 65 cows per herd). Despite these changes, most dairies are still single-family businesses, relying on household members for virtually all their farm labor requirements (Buttel et al., 2000). In 1998, state statistics suggested that over 70 percent of Wisconsin dairy operations were milking between 30 and 99 cows, and that these herds produced approximately 62 percent of the state's milk. At the same time, there are growing numbers of relatively large dairy operations in the state, many of which milk cows in new parlor/freestall facilities and use a wide range of modern dairy production technologies and management practices. Farms with over 100 cows account for just 11 percent of all herds, but produce over one-third of the state's milk.

Wisconsin dairy farms have been under serious pressure in recent years (Frank and Vanderlin, 1999). Increasing costs of production, competition from large farms in the western and southern states, volatile milk prices, and pressure from non-agricultural development have discouraged the entry of new young dairy farmers and made survival increasingly difficult for the many operators. In addition, growing public concern about the environmental impacts of agricultural activities has led to state and federal efforts to develop new rules for the storage, handling and use of manure on crop fields. The loss of nutrients (like nitrogen and phosphorus) from farm fields and barnyards to Wisconsin's surface and groundwaters has attracted particular public attention.

Feeding practices are one area where farmer management can have an impact on both their bottom line and nutrient losses. University scientists and extension staff are constantly working on new dairy feeding technologies and management practices. However, there has been relatively little information available about what farmers are already doing, which makes it difficult to target public programs to the kinds of dairy feeding systems farmers actually use in a state like Wisconsin. The 1999 Wisconsin Dairy Herd Feeding Study was designed to help us better understand the range of feeding practices used by representative farmers, and to ensure that future research and extension efforts are relevant to the problems of typical dairy farms in the state.

In recent years there has been also been growing interest in the cycling of nutrients – particularly phosphorus – on Wisconsin dairy farms. While a good body of research has examined the storage, handling, and utilization of manure on the state's cropland, there is relatively little understanding of the nutrients in the feedstuffs typically fed to milk cows in the state, and about how dairy diets are supplemented with imported feeds to attain desired nutritional levels. The 1999 Wisconsin Dairy Herd Feeding Study also collected samples of feedstuffs and manure from the participating farms. This report summarizes results from the analysis of the feed and manure samples collected during the on-farm interviews. Samples were taken to determine what the phosphorus content of typical dairy herd diets was in Wisconsin and to quantify the potential for reducing dietary phosphorus levels under real-life farmer conditions. Specifically, the results have allowed us

to estimate the phosphorus content of particular feeds on each participating farm and to compare those to national averages and to "book values" often used to generate dietary recommendations for milk cows. Finally, we have used the feed and manure samples to examine the relationships between the different feeding practices used by dairy farms in the study, on the one hand, and the observed levels of phosphorus in the diet and manure, on the other.

Nutrients in Dairy Rations and the Phosphorus Issue

Most dairies in Wisconsin continue to produce most of their own livestock feed and use their land base to recycle manure nutrients through crops. However, to remain economically viable, many dairies are increasing herd size and some adapt by importing more of their feed. In some situations, the amounts of manure nutrients generated by the dairy herd exceed field crop requirements. This can lead to phosphorus build-up in the soil and losses to surface or ground water resources.

As most farmers are aware, there have been increasing efforts by state and federal environmental agencies to regulate farming practices thought to affect water pollution. In recent years, the particular focus of these regulatory efforts has been to reduce the amounts of phosphorus from agricultural activities that is lost to streams, lakes, and rivers. Proposed rules limiting the land application of livestock manure to soils that are already high in phosphorus may cause serious problems for farmers who do not have adequate cropland to safely dispose of manure phosphorus.

While most of the public discussion of phosphorus has focused on the amount and disposal of *manure* (relative to available cropland), recent research at the USDA Dairy Forage Research Center (DFRC) has indicated that dietary practices may be equally important. Specifically, traditional dairy herd dietary recommendations may include more phosphorus than dairy cows can actually utilize. The excess phosphorus is then excreted in manure and makes it more difficult for farmers to find enough cropland for safe and efficient nutrient cycling. In the DFRC studies, dietary phosphorus in study cows was actually reduced by 25 to 30% below recommended rates without sacrificing milk production, quality, or animal well being (Satter and Wu, 1999). Because most of the excess phosphorus is excreted by the cow, the manure from these "low-phosphorus" diets contained significantly lower levels of phosphorus (very little phosphorus is excreted in urine).

This part of the overall study provides an important opportunity to learn about the nutrient composition of typical dairy diets in Wisconsin. The results challenge some commonly held beliefs about what producers are feeding. We believe that only with a sound understanding of current farm characteristics, practices, and problems can a responsible public policy strategy for managing agricultural phosphorus runoff be developed. We hope that this information will help us get ahead of the curve by developing alternative feeding strategies that give farmers more options for adapting to new environmental rules.

Methods

In the spring of 1999, a total of 98 on-farm interviews were completed with randomly selected dairy farms across the top 17 dairy counties in Wisconsin (see Table 1). These counties represent over half of all the herds, cows, and milk produced in the state. They also provide a diverse cross section of the different types of dairy operations producing milk in the late 1990s. A short list of farmers to contact in each county was drawn randomly from the state list of dairy producers maintained by the Department of Agriculture, Trade, and Consumer Protection. Then, selected farmers in each county were called randomly until a set number of farmers (proportionate to that county's contribution to the state total number of dairy herds) agreed to participate. In general, over half of those contacted in each county were willing to be interviewed. Each on-farm interview lasted roughly 90 minutes and involved both a structured interview and the collection of feed and manure samples from the barn.

During the face-to-face structured interviews, quantitative and qualitative information was gathered about a number of topics, including:

a) General farm characteristics (scale of operation, breeds, nature of milking and housing facilities, the use of various production technologies and management practices),

b) Dairy herd feeding practices (how and what cows are fed, the importance of different factors and sources of information in determining rations, the use of hired consultants

and forage testing services, and details regarding the feeding of phosphorus in dairy herd diets),

c) The farm's cropping activities (acres operated, acres of specific crops raised), and

d) Information about farm operator demographics and their plans for the future.

During the on-farm interviews in the spring of 1999, farm operators were asked if the lactating herd was subdivided into different feeding groups. Then, the types and amounts of feed being fed *on the day of the interview* (sometime between January and March, 1999) were recorded for each separate feeding group in the milking herd. Samples of each feed component were collected, brought back to the university, and analyzed for dry matter (DM) and total phosphorus (P) content. Freshly deposited feces were sampled from the barn floor and analyzed for total P. Dietary phosphorus levels were calculated by the proportionate combination of feed components DM and associated phosphorus content. (More detailed information about analytical methods can be obtained from the authors.)

Table 1. List of Important Wisconsin Dairy Counties Included in the Study.

Name	Region	Number of Dairy Cows, 1997	*State Rank*	Dairy Cows per Sq. Mile	*State Rank*	Number of Dairy Herds, 1998	*State Rank*	1997 Milk Production (1,000 pounds)	*State Rank*
Barron	C/NW	34,500	*14*	40.0		654	*8*	548,550	*13*
Chippewa	C/NW	45,000	*6*	44.5		799	*4*	684,000	*8*
Clark	C/NW	61,000	*1*	39.5		1,234	*1*	974,050	*1*
Marathon	C/NW	60,500	*2*	49.8		1,143	*2*	963,800	*2*
Brown	NE	33,000	*15*	62.4	*5*	413	*16*	564,300	*11*
Calumet	NE	24,000		75.0	*2*	322		405,600	
Fond du Lac	NE	43,000	*7*	59.5		613	*10*	735,300	*6*
Kewaunee	NE	26,500		77.3	*1*	414		421,350	
Manitowoc	NE	40,000	*8*	67.6	*3*	524	*12*	700,000	*7*
Outagamie	NE	37,000	*11*	57.8		470	*14*	617,900	*10*
Shawano	NE	38,500	*9*	43.1		667	*7*	635,250	*9*
Dane	SC/SW	52,000	*4*	43.3		623	*9*	904,800	*3*
Dodge	SC/SW	49,500	*5*	56.1		688	*6*	777,150	*5*
Grant	SC/SW	53,000	*3*	46.2		849	*3*	874,500	*4*
Green	SC/SW	38,000	*10*	65.1	*4*	603	*11*	554,800	*12*
LaFayette	SC/SW	36,000	*12*	56.8		496	*13*	529,200	*14*
Vernon	SC/SW	36,000	*13*	45.3		794	*5*	518,400	*15*

Note: State rankings listed only for those included in the top 20 (top 5 for cows per square mile).

Results

Dairy Farm Enterprise Characteristics

In Table 2 the mean herd size and size distributions of our sample are compared to the results of a much larger 1999 Wisconsin Dairy Farm Poll conducted at the same time of year, and with published statistics from the Wisconsin Agricultural Statistics Service (WASS). The average herd in our study milked 66.7 cows (the median – or point where half the farms milked more and half milked less – was 55 cows). Roughly three-quarters of the farms participating in our feeding study milked between 30 and 99 cows, while 4 percent of our respondents milked over 200 cows. The typical farm shipped roughly 60 pounds of milk per cow per day.

The sample of farms we interviewed appears to be quite representative of the Wisconsin dairy farm sector as a whole. The average herd size, herd size distributions, and productivity in our feeding study are very close to those reported in our 1999 PATS survey of over 800 dairy farms, and to published state statistics from WASS. If anything, our sample had a slight overrepresentation of larger herds and underrepresented the smallest operations.

Table 3 displays information about the dairy facilities and technologies used on surveyed farms. It is apparent that the vast majority of the farms in our sample milk their cows in traditional stanchion or tie-stall barns. Among the 10 percent who use some type of milking parlor, 8 percent have a pit parlor (ranging from double 4 through double 12 configurations) and 2 percent have flat barn parlor systems. Just over 13 percent reported having freestall housing facilities, though a few of these used a combination of stanchion barns, loose housing, and freestall buildings. Most of the herds in the study reported calving fairly evenly throughout the year. Roughly 16 percent used some type of seasonal calving system, with twice as many emphasizing spring calving. Only one respondent reported the use of fully-seasonal calving, suggesting that virtually all respondents had at least some calves born throughout the year.

Table 3 also summarizes the use of a set of selected dairy herd management practices. Almost two thirds of respondents in the study keep production records on individual cows in their milking herd and balance feed rations on a regular basis. Less than a third of the farms utilize Total Mixed Ration (TMR) machinery, and about 1 in 6 were using rBST

Table 2. Herd Size and Productivity of Dairy Farms in 1999 Dairy Herd Feeding Study, and Comparison with State Averages.

Characteristics	1999 Dairy Herd Feeding Study	1999 WI Dairy Farm Poll (PATS)	WASS estimates (1998)
Mean herd size	**66.7**	75.5	59.5
Median herd size	**55.0**	55.0	55.0
Percent of herds by size class:			
1-29 cows	**12.2**	12.3	18.7
30-49 cows	**28.6**	28.3	31.7
50-99 cows	**45.9**	42.9	38.7
100-199 cows	**9.2**	12.9	8.5
200+ cows	**4.1**	3.6	2.4
Mean production level (lbs. milk shipped / cow / day)	**57.4**	59.5	*(N/A.)*
Median production level (lbs./cow/day)	**60.0**	60.0	*(N/A.)*

(or Posilac®) on any of their milking cows at the time of the interview. Management Intensive Rotational Grazing (MIRG) – defined as relying on pasture for the forage ration of the milking herd during grazing months and moving cows to fresh pastures at least weekly – was used on 17 percent of the operations. Relatively few respondents milk their cows three-times a day. While roughly half of the respondents had a computer in their home, just over a third of the farms used their computer to keep records for their farm operation.

Overall, the sample of farms included in the Wisconsin Dairy Herd Feeding Study generally had similar facilities and followed typical management practices when compared to the results of a larger statewide mail survey of Wisconsin Dairy farms conducted around the same time. This reinforces the fact that the feeding study results have general applicability for farms throughout the state.

Table 3. Milking Facilities and Use of Various Dairy Production Practices.

Practices	1999 Dairy Herd Feeding Study	1999 WI Dairy Farm Poll (PATS)
Milking Facility		
Uses stanchion or tie stall barn with pails	**12 %**	13 %
Uses stanchion or tie stall barn with pipeline	**78 %**	74 %
Uses parlor milking facility	**10 %**	13 %
(flat barn parlor)	**(2 %)**	(2 %)
(pit parlor)	**(8 %)**	(11 %)
Housing Facilities for Milking Herd		
Uses stanchion or tie-stall barn exclusively	**87 %**	81 %
Uses freestall barn exclusively	**6 %**	14 %
Uses both stanchion/tie-stall and freestall barns	**7 %**	5 %
Combined: Uses both freestall and parlor facility	**9 %**	12 %
Use of Production Practices and Technologies		
Keeps production records on individual cows	**64 %**	56 %
Balances herd rations at least 4 times a year	**69 %**	66 %
Uses Total Mixed Ration (TMR) machinery	**31 %**	29 %
Uses rBST (Posilac) on at least some milking cows	**17 %**	15 %
Uses Management Intensive Rotational Grazing	**17 %**	23 %
Milks cows 3 times a day	**2 %**	3 %
Owns and uses a computer for farm record-keeping	**36 %**	32 %

Crop Enterprise Characteristics

Almost all the dairy farms in our sample (and throughout Wisconsin) operate significant tillable cropland as part of their enterprise. This is one of the features of dairy farming in Wisconsin that distinguishes us from the large dairy farms in the western and southwestern states. The results in Table 4 summarize the percent of respondents who have different types of farmland on their operation, and the average number of acres in each category for those with each type. All but two of our respondents operated some tillable cropland. When you include operated land that was either owned or rented, the typical dairy farm in our study operated roughly 240 acres of tillable land in 1998. Just over half of the respondents indicated that they had some tillable land that was used just for pasturing in 1998, with an average of 18 acres used for this purpose. Only one respondent had land enrolled in the CRP or WRP program in 1998. Most farms had additional woodland, swampland, or land used for buildings an barnyards, with an average of 71 acres used for these purposes. Overall, the typical dairy farm in our sample operated 315 acres in 1998, most of which was cropped or grazed to some extent.

Table 4: Size of Farm Operations and Crops Grown.

	Percent of respondents with any in category	Average acreage of those with any in category
Size of farming operation (owned or rented)		
Acres of tillable land used to grow crops or hay	97 %	240
Acres of tillable land used as pasture only	56 %	18
Acres of tillable land in CRP or WRP	1 %	5
Acres of other types of land in operation	98 %	71
Total acres in farm operation	100 %	314
Acres of specific crops raised in 1998		
Alfalfa or other hay	100 %	126
Corn for grain	85 %	69
Corn for silage	92 %	35
Soybeans	30 %	40
Oats, barley and other small grains	23 %	23
All other crops	10 %	19
Total acres of cropland planted in 1998	97 %	240
Average acres of cropland per milk cow	97 %	3.7

The data in the bottom half of Table 4 suggest that alfalfa and corn are the most common crops grown on Wisconsin dairy farms. All respondents with cropland reported growing some alfalfa or other hay in 1998, and over 90 percent grew some corn. Hay comprised roughly half of the total acres of crops raised (with an average of 126 acres harvested), while 69 acres of corn for grain and 35 acres of corn for silage were planted on farms raising those crops. Soybeans were raised by 30 percent of the dairy farms; these operators planted an average of 40 acres of soybeans in 1998. Oats, barley and small grains were raised by 23 percent of respondents.

Finally, when we compare the amount of cropland planted to the number of milk cows in the dairy herd, we see that the typical dairy farm had 3.7 acres of cropland per milk cow in 1998. 80 percent of the farms in the study had between 2 and 6 acres of cropland available per milk cow. As farmers seek to manage the manure nutrients from their cows, having sufficient cropland on which to spread dairy manure is becoming increasingly important. Our initial analysis of the survey results suggests that – if they were to spread manure on all their cropland – most dairy farmers in the sample appear to have ample farmland to dispose of manure nitrogen easily, but a significant group might have trouble finding enough land to utilize phosphorus.

Summary of Feeding Practices

As indicated above, almost all respondents raised significant amounts of crops as part of their dairy enterprise. In order to find out how important purchased feeds are on Wisconsin dairy farms, we also asked about where farmers usually obtained most of their forages, grains, and protein for their dairy herd rations. The results are illustrated in Table 5.

Not surprisingly (given the large acreages devoted to hay and corn silage production), 86 percent of the farms in the sample raised all of the forages that they were feeding to their milking cows, and another 12 percent raised most of their forages. Only two of the 98 farms in the study opted to purchase all of their forages. Two thirds of the farms also raised all of their grains, with another 16 percent raising most of their grains. Compared to forages, a larger group (15 percent) indicated that they buy all or most of their grains. Finally, only 19 percent of respondents were able to raise most or all of their protein (usually soybeans). The vast majority of dairy farms (70 percent) relied on purchased sources of protein in their dairy herd rations.

Table 5. Source of Various Dairy Feeds.

Where feed is usually obtained:	**Forages**	**Grains**	**Protein**
We usually raise all of our own	86 %	68 %	7 %
We usually raise most of our own	12 %	16 %	12 %
We raise some, but buy most	0 %	4 %	5 %
We don't raise any and buy all	2 %	11 %	70 %
(total)	100 %	100 %	100 %

The most detailed segments of the on-farm interviews inquired about practices used to feed milking dairy cows. Some statistical results of those interviews are highlighted in Table 6. Overall, the findings suggest that there is considerable diversity in the ways that farmers feed their dairy cows.

As mentioned above, during the interview, farmers were asked to reconstruct the types and amounts of feed that they were feeding their cows that day. At one point in the interview, farmers were also asked "what consideration was most important in your decision to feed these particular ingredients." Farmers reported that maximizing milk production and using feeds that could be raised on the farm as central to their decision-making. The relative costs of feedstuffs was less important.

Just over half of the study farmers fed different rations to various groups of milking cows in their herd. Most of the time, groups of cows were separated – for feeding purposes – according to their production level or stage of lactation. Less frequently, cows were separated based on the age of the milk cow. The ability to separate feeding groups is related to the size of the herd and the type of facilities available. For example, larger herds with freestall barns (or other group feeding facilities) are not as able to feed different rations to individual cows as are farmers with tie-stall or stanchion barn facilities.

Sources of Information about Feeding Dairy Cows

Farmers were also asked where they got information about what to feed their dairy cows. The results in Table 7 suggest that personal experiences and advice from veterinarians were most commonly listed as important or very important sources of feeding information. Advice from reading books and articles, talking to other dairy farmers, and advice from people who sell feed were important to roughly half of the farmers. Consultants and university or county extension staff were the least likely to be listed as important sources of information.

Interestingly, when farmers were asked to list which single source was the "most important" to their feeding decisions, almost two-thirds reported relying on their own experience as a dairy farmer. Advice from consultants, people who sell feed, and veterinarians were each listed as the most important source of feeding information by roughly 8-10 percent of the sample. Books and articles, talking to other dairy farmers, and advice from extension or university employees were rarely cited as the *most* important source of feeding information.

Table 6. Feeding Strategies among Wisconsin Dairy Farms.

Question	Percent of sampled farms
What consideration was most important to you when deciding to feed these particular ingredients?	
The balance of feeds that maximizes milk production	44 %
Whether or not I can produce the feed on my own farm	40 %
The relative cost of different feed sources	16 %
Do you usually feed different groups of lactating cows different rations in the winter?	
Yes, Separates different groups of lactating (any)	52%
Separates by production level	(44 %)
Separates by stage of lactation	(20 %)
Separates by age of cow	(5 %)

Table 7. Sources of Information about Feeding Practices.

Sources of information used to make decisions about what to feed dairy cows	Percent of farmers indicating source was **"important**" or **"very important"**	Percent indicating source was the **"most important"**
Your own experience as a dairy farmer	95 %	63 %
Advice from your veterinarian	66 %	8 %
Advice from reading books and articles	52 %	3 %
Talking to other dairy farmers	49 %	2 %
Advice from the people who sell you feed	48 %	9 %
Advice from an independent consultant	27 %	10 %
Advice from county extension agent or university	26 %	2 %

Table 8 expands on the role of feed consultants in the Wisconsin dairy industry. It is apparent that the vast majority (78 percent) of dairy farmers utilize some type of feed consultant. Most of these "feed consultants" are people who work in feed mills or are other types of feed dealers, who offer ration balancing advice and other nutritional recommendations to their customers. About 12 percent of the farms reported the use of an *independent* feed consultant, and another 6 percent considered their veterinarian to be their feed consultant. About 5 percent of respondents said that they get feed advice from their dairy cooperative.

Among those who use feed consultants, virtually all buy feed from the person they get advice from. Additionally, very few actually pay directly for the consulting advice. Although feed dealers presently may be the best equipped to work with farmers on herd nutrition issues, and farmers may be disinclined to pay independent consultants for this type of advice, the survey responses highlight potential conflicts of interest in which the salespeople may be inclined to recommend feeding (and purchasing) more than is minimally required in order to maximize sales of their products. As will be noted below, this is particularly a challenge when determining appropriate levels of supplemental nutrients (like phosphorus).

Table 8. Use of Consultants for Making Feeding Decisions.

	Percent
Percent who use any type of feed consultants (combined)	78%
Description of consultants (percent of those using consultant) [1]	
Feed dealer or consultant working at feed mill	79 %
Independent consultant	12 %
Veterinarian for feed consulting	6 %
Consultant working for dairy cooperative	5 %
Relationship to consultant (percent of those using consultant)[1]	
Usually pays their feed consultant	15 %
Usually buys feed from their feed consultant	95 %

Note: [1] = percentages may not total 100 since more than one response was allowed.

Overall, farmers do not appear to be dissatisfied about the types of information they have available to them for deciding herd feed rations. Table 9 reports that almost half of the respondents were very satisfied (and most of the rest were somewhat satisfied) with the information they have on feeding their dairy cows. Given the high levels of satisfaction among farmers, it is likely that public efforts to disseminate new feeding information or to encourage changes in feeding behavior (to reduce potential nutrient problems) face an uphill battle. Unless farmers perceive dairy herd feeding to be a problem, they are unlikely to take the time to investigate new sources of information.

Use of Specific Feeding Practices

One way to ensure that dairy herds receive the appropriate balance of nutrients from their ration is to test their forages for nutritional value. This is particularly important given that most Wisconsin dairy farmers raise almost all the forages they feed to their cows. The interviews included several questions related to forage sampling and analysis. As reported in Table 10, it is apparent that roughly three-quarters of the farmers in our study tested the forages that they were feeding. Generally speaking, they relied on their feed consultants (usually someone from their feedmill or a feed dealer) to submit the forage samples to a lab for analysis. Among those who had forages tested, 38 percent interpreted the results themselves. Roughly a third had their test results interpreted by a nutritionist, feed consultant, or feed dealer. The rest (27 percent) interpreted the results together with their consultants.

As mentioned at the outset of this report, a particular interest of the researchers was to increase our understanding of the factors considered by farmers as they determined how much phosphorus to include in their dairy herd's diet. Most farmers reported that they did feed some supplemental phosphorus to their dairy cows. However, relatively few were aware of how much (or what percent) phosphorus they were feeding in a typical ration. Among those able to identify a targeted level (usually the farms which had computerized ration balancing worksheets available), an average of 0.52 percent phosphorus was fed. When asked how they decided upon the percent P included in their herd ration, almost all of those responding indicated that it was the amount recommended by their consultant, feed mill, or nutritionist. It appeared that few of the study farms incorporated specific information about their own farms' forage or soil test phosphorus levels when deciding how much supplemental phosphorus to purchase. Most supplemental feed phosphorus was fed as mono- or di-calcium phosphate included in purchased grain, protein or mineral mixes.

Table 9. Satisfaction with Existing Dairy Herd Feeding Information Sources.

	Percent
How satisfied are you with the information you have on feeding your dairy cows?	
Very satisfied	46 %
Somewhat satisfied	47 %
Indifferent	6 %
Somewhat unsatisfied	1 %

Table 10. Forage Sampling and the Use of Supplemental Phosphorus in Dairy Diets.

	Percent
Forage sample analysis	
Percent who tested forages they are feeding this winter for nutritional value	72 %
Who sent in the forage samples? (% of those who tested)	
Sent in forage samples myself	8 %
Consultant took forage samples and sent in for me	64 %
Who interpreted the results of forage analyses? (% of those who tested)	
I did myself	38 %
I did together with consultant, nutritionist, or feed dealer	27 %
Nutritionist or feed consultant did	23 %
Feed dealer did	12 %
Factors related to determining phosphorus levels in dairy cow diets	
Do you usually feed your milk cows supplemental phosphorus?	
Yes	80 %
No	8 %
Not Sure	12 %
What percent phosphorus is usually included in a typical dairy cow ration?	
(Not sure)	(71 %)
Average for those who reported a value	.52

Farm Operator Characteristics and Plans for the Future

Some brief characteristics of the farm operators included in our sample are presented in Table 11. The average dairy farm operator was 43 years old, and had been operating their farm for nearly 20 years. Most of the respondents grew up on dairy farms. These results are typical of the finding of much larger mail surveys of Wisconsin dairy farms.

Although Wisconsin has witnessed significant declines in dairy farm numbers over the last decade, most of the farms in the study plan to continue dairying for at least 5 more years. Among those who expect to stay in business, respondents report plans to increase their average herd size to roughly 90 cows in the year 2004. About a quarter of the respondents indicated plans to buy more feed from off the farm in the near future, while an equivalent group suggested they would expand their cropping operation to help feed their increased cow numbers. Roughly one of five farms reported that they were likely to hire a nutritional consultant in the next five years. If these are independent consultants (not tied to a feed dealership), this would represent a significant increase in the use of private nutritionists in the state. (Recall from Table 8 that independent consultants are currently used by only 12 percent of our sampled farms.) About one in six farms plan to build a new freestall or parlor milking facility in the next five years. Given current adoption rates, the number of operations with such facilities in Wisconsin could be expected to virtually double over that time frame.

Table 11. Characteristics of Farm Operator and Future Plans for Dairy Operation.

Average age of respondent	43 years old
Average number of years operating this dairy farm	19 years
Percent who grew up on a dairy farm	88 %
Percent who plan to exit dairying in next 5 years	12 %
Average size of dairy herd in 2004 expected by those not exiting	86.7 cows
Percent "likely" or "very likely" to make the following changes in their operation over the next 5 years (among those not exiting)	
Expand the cropping operation	26 %
Buy more feed from off the farm	23 %
Hire a nutritional consultant	19 %
Build a new freestall barn	15 %
Build a new milking parlor	14 %

Results of Feed and Manure Sample Analysis

Sample analysis results

Of the 98 surveyed farms, 93 provided feed samples that generated reliable data on dry matter and phosphorus content. Of these 93 farms, half (n=47) were feeding all their lactating cows approximately the same diet. The other half (n=46) reported that they divided their lactating herd into 2 or 3 separate feeding groups. Approximately 70% of the surveyed farms said they were self sufficient in forage (alfalfa and corn silage) and grain (corn and oats) production.

On all 93 farms, approximately 89% of the apparent dry matter (DM) and 74% of the phosphorus intake was derived from forage and grain (Table 12). Most of the remaining 11% of the DM and 26% of the phosphorus fed to the dairy herd was imported in the form of protein supplements, mineral mix and soybean meal.

Table 12. Relative Amounts of Forage and Grain Fed on Wisconsin Dairy Farms (n=93).

	Mean	Std. Dev.	Minimum	Maximum
Forage (hay + silage)				
Dry Matter (DM) fed (lbs./cow/day)	26.5	7.6	9.0	48.8
% of total DM	59%	13	17%	94%
Phosphorus (P) fed (oz./day)	1.2	0.4	0.3	2.5
% of total P	42%	16	8%	90%
Forage + grain				
Dry Matter (DM) fed (lbs./cow/day)	40.8	10.2	14.2	104.5
% of total DM	89%	9	51%	100%
Phosphorus (P) fed (oz./day)	2.1	0.8	0.6	6.5
% of total P	74%	19	27%	100%

The average phosphorus content of forages and grain fed to dairy cows in Wisconsin are similar to national averages (Table 13). These phosphorus concentrations, especially for alfalfa, are higher than the National Research Council's (NRC) published book values that are used to formulate dairy diets (Berger, 1995). Variability in P content of alfalfa and corn silage appears to be slightly higher in the Wisconsin than the national sample.

These feed phosphorus values indicate that there is more phosphorus present in much of the forage and grain we feed in Wisconsin than the published dietary guidelines previously thought. These results are similar to those of a broader national study that has argued for a reconsideration of traditional phosphorus diet recommendations. One implication of this is that the computer software (or book values) used to balance rations might need to be revised to avoid the feeding of excess phosphorus.

Total phosphorus fed in typical dairy herd diets

The analysis of feed samples suggested that the typical dairy producer was feeding roughly 0.41 percent phosphorus in their dairy herd diet. Since the level of phosphorus that cows require increases with milk production, it is possible to compare levels fed on our study farms with the amounts recommended by the NRC for similar producing cows.

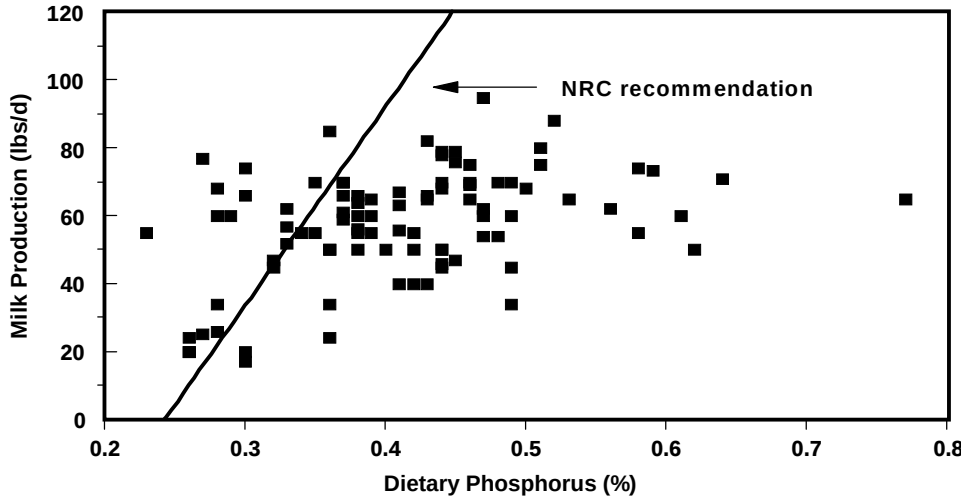
The results of our study farms are compared to NRC guidelines in Figure 1. Initially, it appears that most (80%) of the 93 dairy producers included in this study feed P in excess of the NRC recommended amount. The dots to the right of the diagonal line in Figure 1 reflect farms that are feeding more phosphorus than the NRC thinks is required for a given level of milk production. On the other hand, 20% of the surveyed farms feed less than what the NRC recommends (i.e.19 farms have dietary phosphorus levels and associated milk responses to the left of NRC recommendations). These results indicate that NRC recommends excessive dietary phosphorus levels, and corroborate recent experimental results at the Dairy Forage Research Center in Madison that lower amounts of phosphorus could be fed without reductions in milk production (Satter and Wu, 1999).

Table 13. Comparison of the Feed P Contents in Wisconsin and in the U.S.

	Wisconsin Survey			U.S. Survey[1]		
Feed	Samples	Mean	Std. Dev.	Samples	Mean	Std. Dev.
		P (% of DM fed)			P (% of DM fed)	
Alfalfa	170	.28	0.07	4096	.30	0.06
Corn silage	79	.24	0.08	8197	.23	0.06
Corn grain	63	.31	0.05	912	.32	0.07
Soybean meal	12	.64	0.07	148	.72	0.28

[1] Adapted from Berger, 1995.

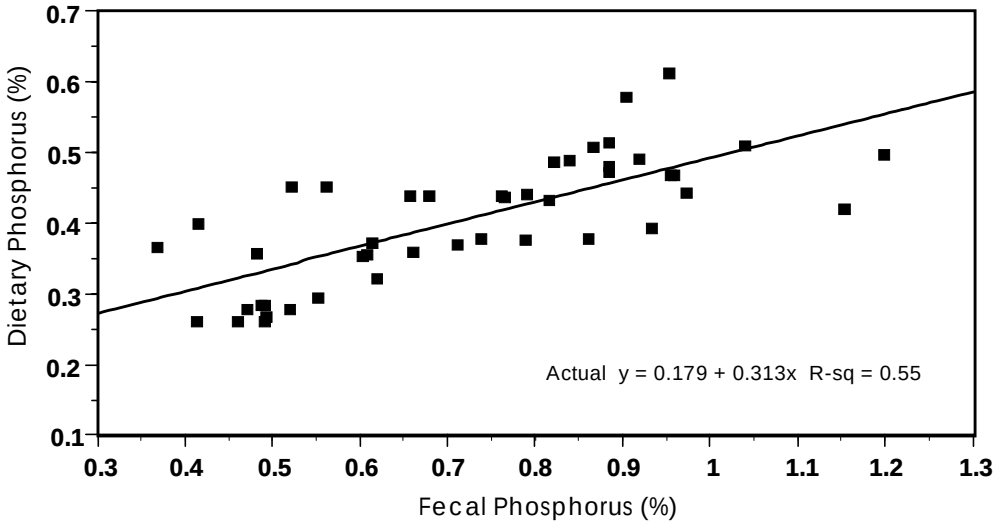
Figure 1. Relationship between Diet P Content and Milk Production, 93 Wisconsin Dairy Farms.



What does this all mean?

For the study herds that fed their dairy cows similarly as a single group (roughly half, or 47 respondents), there is a good relationship between fecal phosphorus and the amount of phosphorus fed (see Figure 2). These are similar results to those found among herds fed similarly under experimental conditions at the Dairy Forage Research Center. The strong relationship between phosphorus in the diet and levels in the manure indicates that (1) fecal phosphorus can be used as an estimator of the amount of phosphorus that is fed, and vice-versa, and (2) manure phosphorus content will vary considerably, depending on the amount of phosphorus a farmer feeds.

Figure 2. Relationship between Fecal Phosphorus and Dietary Phosphorus on 47 Dairy Farms in Wisconsin (Dairy Farms that Feed Entire Herd Similarily).



This latter point is important since it suggests that farmers may be able to reduce the phosphorus in their manure by adjusting the amounts of supplemental phosphorus in the diet. This can make it easier to balance manure P with a farm's crop nutrient requirements. According to proposed state and federal nutrient management guidelines, manure applications to cropland will be restricted to amounts that satisfy a crop's P requirement. It can also save farmers money that they might be spending on excess phosphorus supplementation.

Summary

Most Wisconsin dairy farmers grow almost all of the forages and grains that they feed, while purchasing their supplemental protein, mineral, and mixed feed products. When deciding upon a particular feeding plan, they rely heavily on their own expertise and on advice from people from whom they buy their supplemental feeds – typically nutritionists or consultants working with feed mills, dairy cooperatives, and other feed dealerships. At present, only about one in ten farms reports the use of independent nutritional consultants. In general, farmers seem content with the amount and type of information they get concerning dairy herd nutrition.

The average P contents of forages, especially for alfalfa, are higher than the book values used to formulate dairy diets. This underestimation of the phosphorus content of forage may lead to overestimation of supplemental P needed to achieve a certain level of dietary P and milk production. Most dairy producers feed phosphorus well in excess of what is needed for the levels of milk production that they attain. Results from this study and recent research findings indicate that much lower amounts of phosphorus could be fed to Wisconsin dairy cows without reductions in milk production. Lower phosphorus in the diet means less manure P that has to be recycled through cropland. This can help many farmers conform to new environmental regulations that aim to restrict manure application based on the phosphorus requirement of their crops.

Endnotes

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Acknowledgements

Appreciation is extended to Dr. Larry Satter, Dairy Nutritionist, USDA Dairy Forage Research Center, for his assistance in the design in the survey and interpretation of results. Also, to USDA-CSREES National Research Initiative Agricultural Systems Research Program (Grant No. 9703968) for partial funding of this study.

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