FACT SHEET

Management Intensive Grazing: Environmental Impacts and Economic Benefits

Conventional Dairy Production Systems Based on Confined-Feeding

Dairy farming in the United States has become increasingly capital-intensive, using management schemes that confine large herds of highly productive dairy cows on a small part of the farm while practicing high-input crop production on most of the land. Large machines harvest the crops and bring them to the cows while other machines haul the cow manure out to the fields to fertilize the soil. Bringing a high-nutrient diet right to the cow allows the animal to use more energy for producing milk rather than expending energy foraging for food and walking back and forth from the milking parlor. This system, known as confinement feeding, allows astounding productivity per cow. However, the costs in terms of money, resource use and environmental impact, are high for such activities as producing crops, hauling feed, purchasing feed concentrates, collecting, storing, and hauling manure, and providing veterinary care to keep cows healthy under crowded conditions. In addition, high levels of production keep milk prices low, which in combination with high production costs, keep profit margins razor thin for most dairy farmers.

When farmers milk more cows than can be maintained with the feed produced on the farm itself, additional feed must be purchased and imported onto the farm to maintain the herd. The imported feed brings with it large amounts of nitrogen (N) and phosphorus (P). Cows excrete 60-75% of the nutrients ingested, although efforts to fine tune animal diets may somewhat reduce the excretion of N and P. Eventually the herd supplies more manure N and P than the farm fields can properly assimilate. The resulting build-up of N and P increases the potential for nutrient loss that can lead to pollution of groundwater, nearby streams and eventually the Chesapeake Bay.

Figure 1: Jersey cows graze on a grass and clover pasture. Grazing fulfills most of their dietary needs, and the grassed pasture limits soil erosion and sequesters carbon, two vital tools for environmental protection. Grazing dairy farmers report that Jersey cows perform better on pasture than the more common black and white Holstein dairy cows.

What is a Management Intensive Grazing (MIG) Dairy Farm?

A few farmers are now trying out a very different approach to dairy production called management-intensive grazing or MIG. On a MIG dairy farm, portable electric fencing is used to subdivide pastures into small areas called paddocks. Cows are moved to a fresh paddock once or twice a day. Grazed forage is the primary source of protein and energy for the cows, eliminating the need for feed crop production and its expensive, energy-demanding infrastructure. By grazing, the cows themselves, rather than machines, harvest the feed and spread the manure. Because the grazing lifestyle is less stressful on cows, veterinary bills are substantially lower than for confined animals. Although a cow under MIG typically produces less milk than one under confined feeding, it requires far less expense to maintain. Research in Maryland and other states indicates that both profitability and life-style quality can rise dramatically for dairy farmers who successfully switch from the confined-feeding system to a MIG production system. The MIG approach aims to maximize the profit on each gallon of milk, rather than maximize the number of gallons produced per cow. Grazing offers an alternative to the current dairy farming "treadmill" in which higher production leads to lower prices and fewer dairy farmers.

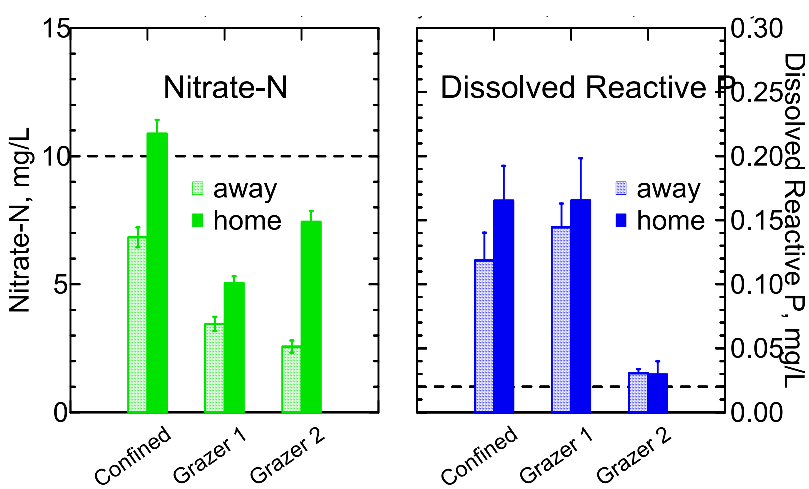

Figure 2: Nutrient concentrations in ground water under six well-managed dairy farm watersheds in Maryland. Nitrate-N levels in the grazed watersheds were well below the EPA standards of 10 ppm for N. However, phosphate levels in groundwater under all watersheds was generally above 20 ppb, a level often cited in surface waters as critical for causing eutrophication. For N, but not for P, the watershed nearest the barns (home) that historically received the most manure had higher N levels than

Environmental Impacts of Grazing-Based Dairy Production

The MIG approach also offers potential environmental benefits. Land on MIG farms is nearly all permanently covered by grass, which improves soil quality and greatly reduces sediment losses compared to cropped fields. Furthermore, soils under pasture accumulate organic matter, a process that not only improves the soil, but also removes carbon dioxide from the atmosphere. Converting cropland to pasture on MIG dairy farms may therefore help counter worrisome changes in the global climate caused by the build-up of carbon dioxide in the atmosphere.

Because very little feed is imported onto MIG dairy farms, this system should result in less potential for pollution from excess nutrient accumulation. Scientists know little about the impacts of the MIG pastures on nutrient losses to ground water and surface water. Researchers in New Zealand and Europe have found high nitrate concentrations in groundwater under grazed pastures, but these pastures were heavily fertilized with N. Research in Pennsylvania using simulated cow urination on soil columns suggested that the uneven distribution of N by cows in "urine spots" might stimulate N leaching. Because these studies did not accurately represent the MIG systems used on Mid-Atlantic dairy farms, new research was initiated in Maryland to determine whether MIG should be considered an environmental

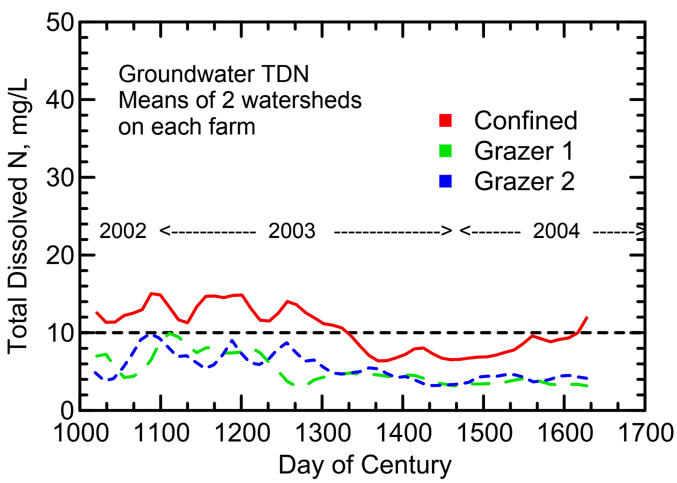

Figure 3: Total dissolved nitrogen in groundwater under confined feeding and grazing-based dairy farms during a one year period. On average, both grazing farms had lower nitrogen concentrations than the confined feeding farm. Six well nests within two watersheds were monitored on each farm.

Best Management Practice for dairy farmers.

Current Research on Water Quality Impacts of Dairy Farming Systems

University of Maryland researchers, in collaboration with the USDA/ARS Pasture Lab in Pennsylvania, are studying the environmental and economic performance of three well-managed farms in central Maryland -- two grazing-based and one confinement feeding-based. The project involves six watersheds, two on each farm. Water is sampled in two streams running through two of the MIG pastures. Groundwater under both pastures and manured cornfields is sampled regularly using 64 piezometers (special monitoring wells that allow sampling the upper meter of groundwater) installed at three or four depths in nests, with three nests of piezometers in each watershed. The project is also studying the nutrient balance and economics of the two management systems by conducting a nutrient audit and a cost-returns analysis of each farm.

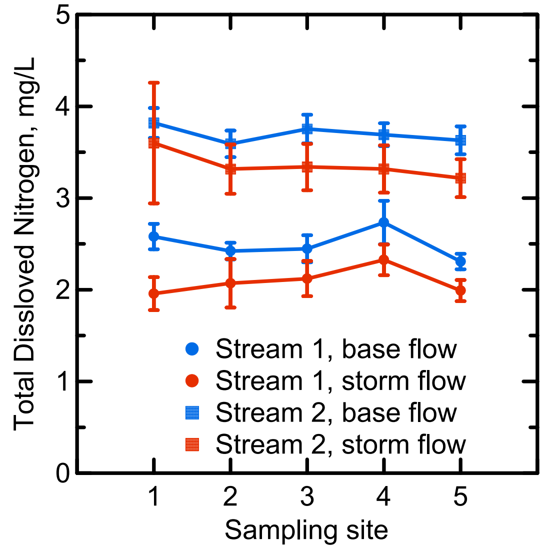

Figure 4: Total Dissolved Nitrogen (TDN) concentrations in base and storm flow for two streams flwoing through MIG pastures. The streams enter the pastures at sampling site #1 and flow across the pasture, each consecutive sampling site being 100 yards farther downstream. The vertical bars show data variation (SEM) for 55 base flow and 12 storm flow sampling dates, 06/01-6/04.

Environmental Effects of Grazed Pastures

Our study has focused on measuring ground and surface water nutrient concentrations in six watersheds within two MIG and one confined Maryland dairy farms. Since May 2001, groundwater has been sampled biweekly from groundwater well (piezometers) installed in transects within active fields and pastures. Surface water samples have been collected biweekly from two streams bisecting one of the MIG farms. All samples have been analyzed for both nitrogen and

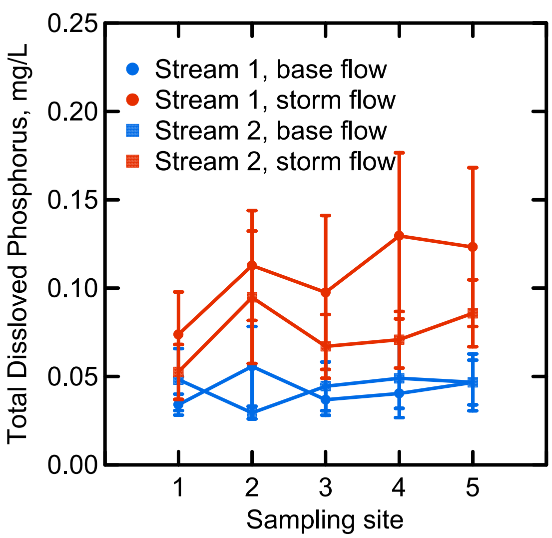

Figure 5: Total Dissolved P concentrations in two small streams flowing through grazed watersheds on a MIG dairy farm during base flow (lower blue lines) and storm flow (upper red lines). The streams enter the pasture at site 1 and each consecutive sampling site is about 100 yards farther downstream. Vertical bars show data variability (SEM).

Groundwater samples from the grazed watersheds had average nitrate concentrations of 4.4 ppm, significantly lower than the average of 8.9 ppm nitrate-N found in groundwater samples from the confined farm watersheds (Figure 3). The EPA water quality standard for nitrate-N is 10 ppm.

Dissolved reactive P concentrations from all six watersheds were well above the surface water critical level of 0.01 to 0.02 ppm. Averages of phosphate-P on the neighboring confined and MIG farms were 0.14 and 0.15 ppm (Figure 2). Concentrations of phosphate-P on the second MIG farm were significantly lower, averaging only 0.03

ppm, possibly due to immobilization of phosphorous by the calcareous geological material underlying that farm.

The surface water monitored on two watersheds in one of the MIG farms was generally within acceptable limits for N during both base and storm flow (Figure 4). Total inorganic N was consistently less than 4 ppm, with approximately 1/3 ammonium and 2/3 nitrate (data not shown). Stream water N concentrations were lower during storm flow than base flow, suggesting dilution with low N surface runoff. Significantly, there was no evidence that streamwater N concentration increased as the streams flowed through the grazed watershed. Streamwater Total Dissolved P concentrations were near the 0.1 ppm level of total P considered critical for eutrophication, although there were significantly higher levels of P during storm flows (Figure 5). Phosphorus concentrations did not increase as the stream flowed across the grazed watersheds, with the exception of stream 1 during storm flow early in the study (data not shown). In that stream, P became elevated after the stream flowed past Sampling Sites 2-4, apparently because during the winters of 2001 and 2002 dry cows "camped" there, trampled the grass, had some access to the stream, and were fed on hay (which imported nutrients into the area). Because the farmer subsequently changed his management of this area, we found little increase in stream water P during storm flows in 2003-2004.

Table 1: Nutrient balance and profitability for one confined feeding and two grazing-based dairy farms.

Farm	Surplus[a] N lbs/acre	Surplus[a] P lbs/acre	AU /acre[b]	Profitability[c]	
				$/CWT	$/acre
Confined	147	13	2.0	3.60	488
Grazer 1	46	6[d]	0.7	6.99	437
Grazer 2	98	14[d]	2.4	4.34	352

Nutrient data: 2001-02. Profit data: grazers: 1996-00; confined: 1998-00.
[a] Calculated from inputs of feed, fertilizer, atmospheric deposition etc. minus outputs as milk and animals sold.
[b] AU/acre= animal unit of 893 lbs/acre, equivalent to 1000 kg/ha.
[c] Profit data compiled by Dale Johnson, Farm Mgt Specialist, WMREC.
[d] Surplus P in 2002 was higher than typical for grazers because severe drought required them to import much more hay than normal.

Profitability and Nutrient Balance

In part, because MIG farmers have much lower costs for feed, infrastructure, machinery labor and veterinary services, their profits per unit of milk (but not necessarily per acre of farmland) are usually higher than those of confined feeding farmers (Table 1). Grazing farms with limited feed importation and year-round vegetative cover can more easily assimilate the nutrients excreted by the cows, cycling these nutrients back into forage, with little risk of environmental degradation.

Conclusions:

- We found no evidence of excessive nitrogen leaching from the MIG watersheds.
- Except for the two grazing watersheds with calcareous geologic material, phosphorus levels in groundwater were relatively high, regardless of farm management system.
- Neither N nor P concentrations were increased as stream water flowed through well managed MIG pastures.
- Under appropriate management, grazing appears to engender no higher risks for nutrient pollution than more conventional dairy systems.
- The benefits of grazing may extend beyond the farm itself, as the conversion of cropland to permanent grass may have implications for global warming and soil conservation, as well as quality of life for surrounding communities. As suburban development continues to encroach on farmland, and dairy farming becomes more economically challenging, MIG provides an alternative that can be both environmentally friendly and financially viable.

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