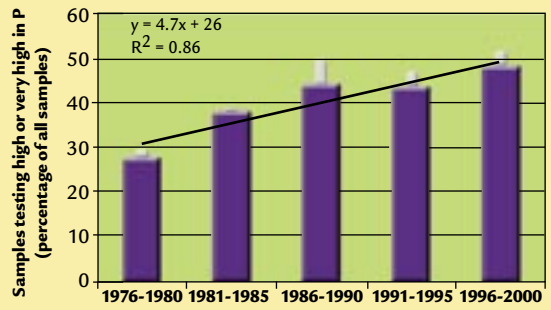
Striking the right balance

Large imbalances of nitrogen and phosphorus can negatively impact your checkbook and the environment

By Karl Czymmek, Quirine Ketterings, Caroline Rasmussen and Larry Chase

Recoverable manure nutrients are not ideally balanced for all crops in all situations. Dairy producers may plan to "bank" manure P in the soil, and then fertilize crops based on N requirements. N is costly and needed in large amounts for corn and grass-hay production. P banking is exhibited by an increase in the number of soil samples testing high or very high in phosphorus (P) over time as is seen for New York (Figure 1). The same is seen in nearby states.

Figure 1. Trends in soil tests show increases in fields testing sufficient or more than sufficient in P.



While increasing soil test P is generally positive in some circumstances, soils can be enriched to the point where soil minerals can't absorb further P additions. Research shows this situation can increase the risk of P losses beyond normal, unavoidable losses that accompany surface application of manure.

The same goes for nitrogen (N): Land grant university guidelines account for expected losses based on application rate, method and timing. But when manure is applied so that rates exceed the crop needs and predicted losses, much of the N may be lost to the environment in one form or another.

Tracking nutrient flow

In 2005, we began a project to assess baseline farm nutrient balances over multiple years on as many New York dairies as possible. An analysis of the nutrient flows onto and off a dairy is essential to quantify current nutrient balances and identify practices that could be more efficient and economical.

Our purpose with the project: To assess dairies' current nutrient status, to measure year-to-year variability and to determine progress when managers make changes.

So far, more than 40 dairies have participated in the mass nutrient balance study. (See Dairy evaluates mass nutrient balance, page 23.) We collected information from financial, crop and animal nutrition records. We used acres of legumes, percent legume in the stand, yield and crude protein content to estimate the amount of N fixed by legumes, if present in the rotation.

A software tool, used to assess whole-farm nutrient balance, quantifies imports through feed and fertilizer purchases, nitrogen fixation from legumes, animals and bedding purchased, as well as exports of milk, animals, crops and manure from a dairy.

Already the mass nutrient balance study has turned up an important piece of preliminary information: Within and across all production levels, dairy farms vary widely in how much total N and P they use per 100 pounds of milk produced.

For example, Figure 2 shows that some farms bring in 1.5 pounds of N in the form of feed, fertilizer and N fixation per hundredweight of milk produced. Compare that to other dairies that import around 2.5 to 3 pounds of N per hundredweight of milk produced.

Looking at P reveals a similar situation. Some dairies bring in 0.15 pounds of P in the form of feed and fertilizer per hundredweight of milk produced. Others use 0.35 to 0.4 pounds P per

FYI

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■ **For information on mass nutrient balance and to access a spreadsheet, go to http://nmsp.css.cornell.edu/projects/massbalance.asp**

hundredweight.

The bottom line: Across all production levels, some producers use about half the N and P that others use to produce the same amount of milk.

Learning from balances

Understanding the differences between these dairies can help identify ways to improve dairy farm economics and reduce nutrient losses to the environment at the same time. The balances can indicate potential areas for taking action to reduce imports or become more efficient with nutrients already on a dairy. There are two main areas where dairies can address nutrient-use efficiency:

1. Purchase fewer nutrients in the form of feed or fertilizer.

2. Once on the dairy, use nutrients more efficiently so that costs are offset and losses are reduced.

Many dairies have made substantial reductions in P feed and fertilizer purchases over the past few years while maintaining or increasing production. According to an unpublished University of Vermont study, average manure P level has decreased over several years, suggesting that many producers have reduced ration P levels, saved money and reduced environmental risks.

> ***Across all production levels, some producers use about half of the N and P that others use to produce the same amount of milk.***

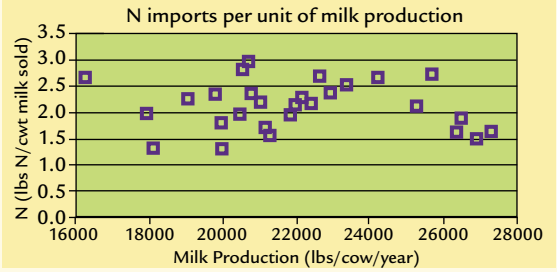
Cornell nutritionists are looking for ways to adjust cattle rations on the N side. (See Understanding nitrogen use in dairy cattle, page 36.) It would be helpful if dairies can sustain milk production yet feed less N in an economical ration, resulting in lower N levels in manure.

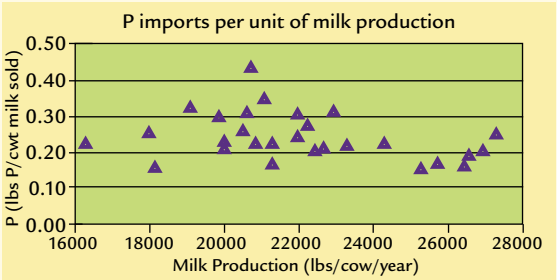
Additional questions we hope to answer as the mass nutrient balance study progresses include:

- Are the dairies that use the least nutrients per hundredweight economically sustainable?
- How do they do it? Are there common practices on these dairies that can easily be adopted by others?
- How does expansion or increased land base change the balance?

We plan to work with producers and their advisers to generate balances for three consecutive years and see what opportunities there are to make changes.

Figure 2. N and P imports per unit of milk production for 27 New York dairies





Significantly more nutrients typically come onto dairy and livestock farms as purchased feedstuffs and fertilizer than leave as animal products and crops. Losses could be substantially reduced if dairies imported fewer nutrients to begin with or exported more nutrients in marketable products – as long as it's practical and economical.

Knowing a dairy's mass nutrient balance is one step toward improving our understanding of nutrient movement onto, within and away from a dairy. For our mass nutrient balance project, we need to include more dairies for multiple years so we can quantify the impact of best management practices on overall balances. ▮

Acknowledgments

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Cornell University, Cornell Cooperative Extension, Soil and Water Conservation Districts and the Upper Susquehanna Coalition collaborate on the mass nutrient balance project.

Dairy evaluates mass nutrient balance

Bill and Penney Cook operate Aurora Ridge Dairy, Aurora, N.Y., with their partner, Jason Burroughs. The dairy consists of 1,500 dairy cows and 2,000 acres of corn for silage and alfalfa/grass hay. It's earned a well-deserved reputation of being well-managed and productive.

The Cooks and Burroughs first learned about the concept of "mass nutrient balance" in the early 1990s when they participated in a project with Cornell researchers trying to better understand the flow of nutrients into, within and away from dairies.

The partners are aware of public concerns about the potential impact of dairy farm nutrients, and they're interested in finding ways to reduce any environmental impact. So last year when Caroline Rasmussen, mass nutrient balance project manager, approached Bill Cook about the project, he was willing to take another look at his dairy's mass nutrient balance. He would learn how his 2004 results compared to the 1993 mass nutrient balance study, and the study results would provide direction for what nutrient areas Aurora Ridge could work on next.

Study results

Compared to the 1993 mass nutrient balance, Cook learned the following from the 2004 study:

- Like virtually all dairies, Aurora Ridge continues to import more phosphorus (P) than it exports annually. But the dairy's P use has become much more efficient because it has cut the balance per acre by about 50%.

This makes sense to Cook: The dairy is exporting much more P in milk due to increased milk production while cutting back on P use in dairy rations and crop fertilizer over the years.

- On the nitrogen (N) side of things, the 2004 data indicated the N balance per acre was a little higher than it had been in 1993.

Cook wanted to learn more about how mass nutrient balance figures are calculated, what the numbers may indicate and, especially, what profitable opportunities exist to use N differently.

"I called a meeting at the farm that included our crop and herd managers, nutritionist and crop consultant, as well as Cornell research and Extension faculty, to discuss our farm mass balance data and to look at potential areas of improvement," Cook says.

"As a result, we are getting more conservative with protein in the ration. We are willing to do this so long as we can continue to have high milk production. So far it's working."

On the crop side, Aurora Ridge Dairy is also looking at ways to make better use of nitrogen from manure and sod.

"The mass balance concept is always in the back of our minds now when we make decisions that affect nutrient use, especially in terms of nitrogen," Cook says.

To track progress annually, the dairy plans to calculate a farm mass nutrient balance each year, as long as it makes sense.

"There is a lot more to learn about how to manage a farm mass nutrient balance, but there is a body of evidence indicating that dairy farms do have extra nutrients that can be lost to the environment, and we need to find ways to reduce those losses," Cook says. "Bringing fewer nutrients to the farm in the first place and using the nutrients that are on the farm more efficiently seems like good places to target."

By Karl Czymmek

Kelly Thomas, office manager for Aurora Ridge Dairy, was instrumental in helping to collect the information needed to develop the dairy's mass balance.

Environmental goals in words

Aurora Ridge Dairy's environmental mission statement reads:

- Aurora Ridge Dairy will strive to be excellent stewards of the soils, water and air. We will farm in a manner that utilizes the natural advantages of these soils to grow high quality forages, utilizing nutrients produced by the dairy. We will work hard to control nutrients, pathogens and odors from leaving our dairy.
- We are aware that every decision we make as managers has an impact on the environment. We will make every effort to make environmentally informed decisions.
- We will work to maximize and reuse our inputs. We will recycle as much of the material that comes onto the farm as possible, including the paper, plastics, metals, oils and tires.
- We will keep the farm buildings and properties clean, neat and well repaired.
- We will work to have the farm blend in with the natural beauty of the area.
- We are committed to meet and exceed environmental regulations to protect the health of our families, employees and neighbors.
- We will move forward preserving and improving soil productivity, recycling nutrients for crop use, recycling other consumables, and considering any technology that helps to reuse inputs. We will especially consider technologies that will have a positive impact on our neighbors.
- We are committed to continual improvement in everything that we do.

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