

## **Animal Agriculture and the Environment**

### **Overfeeding increases feed costs, and reduces your ability to survive environmental regulations**

*by Dr. Katharine Knowlton, Department of Dairy Science, and Scott Sink, Department of Agricultural and Applied Economics, Virginia Tech*

As we discussed in our article in last month's Virginia Dairyman, we conducted a survey in the fall of 1998 to determine average nitrogen and phosphorus intake on Virginia dairy farms. We obtained feed samples and herd information from thirty-three farms in Rockingham, Franklin, and Augusta counties and calculated nutrient intake, actual requirements, and degree of overfeeding of nitrogen and phosphorus in these herds. This article focuses on the economic implications of our findings, and the survey results regarding nitrogen intake.

#### ***Economic and environmental impact of overfeeding***

Our survey indicated that most farms in Virginia overfed phosphorus relative to current published requirements (see last month's article for details). Overfeeding phosphorus directly increases phosphorus excretion, increasing potential phosphorus losses from farms. Potential phosphorus losses could be reduced from the survey farms by an average of 45% if rations were formulated according to current published requirements.

The impact on net farm income of overfeeding phosphorus depends upon the regulatory conditions affecting the farmer. If the farmer is not under phosphorus-based nutrient management, and applies manure without regard to its phosphorus content, the only impact of feeding excessive phosphorus is on their feed bill (Table 1). By generating least cost rations and then increasing dietary phosphorus by replacing limestone with dicalcium phosphate, we calculated the impact of overfeeding phosphorus on the feed bill of farms in our survey. We assumed a 100 cow herd, and average milk yield of either 50 lbs/cow/d (the minimum observed on our study), 60 lbs/cow/d (the average), or 85 lbs/cow/d (the maximum).

These farms increased their feed bill by \$800 to \$1050/year by feeding P at .49% of dietary DM (average on the study) vs. the cows true requirements, depending on milk yield and feed intake (Table 1). With P at .55% of dietary DM, the feed bill was increased by \$1460 to \$1570/yr, and at .6%, feed costs were increased by about \$1900 to \$2080/yr. The farmers feeding phosphorus at the highest level observed in our study (.65%) increased their feed bill by \$2600 to \$2800/year relative to feeding at the cows' true requirements.

**Table 1. Increase in annual feed costs of a 100 cow herd relative to P at true dietary requirement<sup>1</sup>**

Milk yield, lb/d	Req't	Increase in feed cost, \$/100 cows/yr			
		0.49	0.55	0.6	0.65
50	.	\$ 912.50	\$ 1,460.00	\$ 1,898.00	\$ 2,591.50
60	.	\$ 1,058.50	\$ 1,569.50	\$ 2,117.00	\$ 2,701.00
85	.	\$ 803.00	\$ 1,460.00	\$ 2,080.50	\$ 2,810.50

<sup>1</sup>Assumes replacement of limestone (\$164/ton) with dicalcium phosphate (\$350/ton) to increase dietary P while maintaining a constant dietary calcium content.

While these increased feed costs are significant, the cost of excess phosphorus supplementation are much greater if phosphorus-based nutrient management is required. Maryland regulations require all farmers to implement phosphorus-based nutrient management plans by the year 2005. Virginia poultry operations are required to implement such plans by 2001. Most livestock farms produce more manure phosphorus than their crops require, and phosphorus-based plans will require that the excess manure be exported so that excess phosphorus is not applied and allowed to accumulate.

For the farmer under mandatory phosphorus-based nutrient management, the costs of overfeeding phosphorus and increasing phosphorus excretion include the increased feed bill, the cost of exporting manure in excess of what can be applied to land, and the cost of purchased nitrogen fertilizer to meet the needs of crops (limiting manure application to crop phosphorus needs results in under-application of nitrogen relative to crop needs).

A study at Virginia Tech examined dairy and dairy/poultry operations of different sizes, estimated potential phosphorus losses, and simulated net farm income under different policy scenarios. One of the policy scenarios was a restriction on phosphorus applications to that taken up by the crop harvested. In this study, the policy limiting phosphorus application was the only policy with any impact on phosphorus losses from dairy and dairy/poultry operations of varying sizes. Phosphorus losses were reduced by 28 to 43% by this policy, but net farm income was dramatically affected, falling by 11 to 23%. The reduced net farm income was due primarily to the increased cost of purchased nitrogen fertilizer to meet the nitrogen requirements of crops. The reduction in net farm income are likely underestimated in this study, as it was assumed farmers could dispose of excess manure off the farm at no charge.

For farmers under phosphorus-based nutrient management, the increased acreage required to land apply manure will be the most immediate and obvious concern. We calculated the impact of phosphorus intake on acreage required to land apply manure with a spreadsheet predicting P excretion as the difference between phosphorus intake and phosphorus in milk, retained in body weight gain, and fetal development. Given allocation of manure to crops, and estimated nutrient uptake by those crops, we calculated acreage required to land-apply manure for changing dietary phosphorus using the CropNP spreadsheet developed here at Virginia Tech.

Evaluating a dairy farm milking 100 cows with different cropping strategies demonstrates the tremendous impact P intake has on acreage required for disposal of manure on a phosphorus

basis (Table 2). Acreage required to dispose of manure generated by the herd increases by about 60% as phosphorus intake increases from .4% to .55%.

Alternatively, given a fixed land base and different cropping strategies, we calculated the maximum number of milking cows supported by that land base. As phosphorus intake by the herd increases from .4 to .55%, herd size that can be accommodated with phosphorus-based manure application decreases by 35%.

**Table 2. Impact of P intake on manure disposal under P-based nutrient management**

	<b>Dietary P concentration</b>			
	<b>.4</b>	<b>.45</b>	<b>.5</b>	<b>.55</b>
	<u>Acres required to land apply manure<sup>1</sup></u>			
100 cows, 60 lbs milk	91	108	126	143
100 cows, 80 lbs milk	93	112	132	151
	<u>Maximum herd size on 100 acres<sup>2</sup></u>			
50% corn 50% alfalfa	93	78	68	60
50% corn, 25% small grains, 25% alfalfa	73	62	54	47

<sup>1</sup>Assumes cropping program of 50% corn, 50% alfalfa.

<sup>2</sup>Assumes milk yield of 60 lb/d

### ***Survey results for nitrogen***

Nitrogen nutrition is more complex than phosphorus nutrition, but nitrogen excretion is tightly linked to nitrogen intake. Our survey also supplies some evidence that Virginia farms are overfeeding nitrogen, and so needlessly increasing nitrogen excretion. We measured nitrogen intake and compared it to calculated nitrogen needs to estimate overfeeding and to predict nitrogen excretion.

Average dietary nitrogen content in the surveyed herds was 2.52% (Table 3), about twenty percent in excess of current published requirements (nitrogen requirements calculated using NRC equations averaged 2.1%, Table 3). The range in dietary nitrogen content was from 2.04% (4% below requirements) to 2.92% (45% above requirements). Twenty-nine of 33 herds were overfeeding nitrogen relative to NRC requirements. Purchased feed was the source of 65% of the nitrogen fed on that average farm, with a range of 39% to 89%. Predicted nitrogen excretion as a fraction of intake ranged from 58% to 83% with a mean of 72% (Table 3).

**Table 3. Dietary nitrogen intake and requirements for thirty-three dairy farms in Franklin, Rockingham and Augusta counties**

	<b>Dietary N, % of DM</b>	<b>Dietary N req't, % DM</b>	<b>% excess relative to NRC</b>	<b>Purchased N, % of intake</b>	<b>N excretion, % of intake</b>
Mean	2.52%	2.10%	23.80%	64.7%	72.2%
Minimum	1.84%	1.70%	-3.74%	39.2%	58.3%
Maximum	3.26%	2.88%	84.62%	88.5%	82.6%

Does this mean that most of these herds are overfeeding nitrogen? Not necessarily. Calculating requirements of lactating cows for dietary nitrogen is much less straightforward than calculating phosphorus requirements because of the complexity of rumen fermentation. There is likely an opportunity to reduce nitrogen excretion in the herds grossly overfeeding relative to current NRC requirements. We **cannot** conclude, however, that all herds feeding more nitrogen than the current NRC publication recommends are actually overfeeding relative to the cow's needs. Factors such as dietary carbohydrate content and digestibility, protein degradability, and variability in protein content of milk all affect the actual nitrogen requirement. None of these factors was measured in this survey.

Reducing the nutrient content of manure through nutrition is a powerful, cost effective approach to reducing potential nitrogen and phosphorus losses from dairy farms. Feeding phosphorus in excess of the cow's true requirements increases phosphorus excretion directly, increasing the amount of phosphorus applied to land. This survey makes clear that phosphorus intakes in the field are significantly in excess of current requirements, giving farmers a tremendous opportunity to benefit both economically and environmentally by feeding phosphorus according to their herd's true needs. Similar opportunity may exist in many herds to reduce nitrogen losses and reduce the feed bill by refining diets to more precisely meet herd nitrogen needs.