STRATEGIES TO REDUCE EXCESS SOIL TEST PHOSPHORUS BUILDUP ON LIVESTOCK FARMS

Strategy: Export Dairy Pen-Pack Manure

CASE STUDY: DAIRY OPERATION

The purpose of this case study is to demonstrate the economic and environmental value of exporting manure from farms where farm phosphorus imports exceed exports and soil test phosphorus is very high.

Farm Description:

This dairy farm in Central Minnesota has 180 head of Holstein cows with a DHIA Rolling Herd Average of 21,000 pounds milking 2X per day, and with an average of 336 animal units (A.U.) on site. The milking cows are in a freestall barn utilizing separated solids for bedding. The dry cows and replacement heifers are on conventional bedding packs. This dairy farm has 269 dry-land harvested and 256 tilled acres with Loam type soils. With the exception of purchasing some grass hay and bedding, they raise all of their own feed and bedding. Depending on the year, the farm sells some corn grain.

Photo: Conventional Bedding Pack

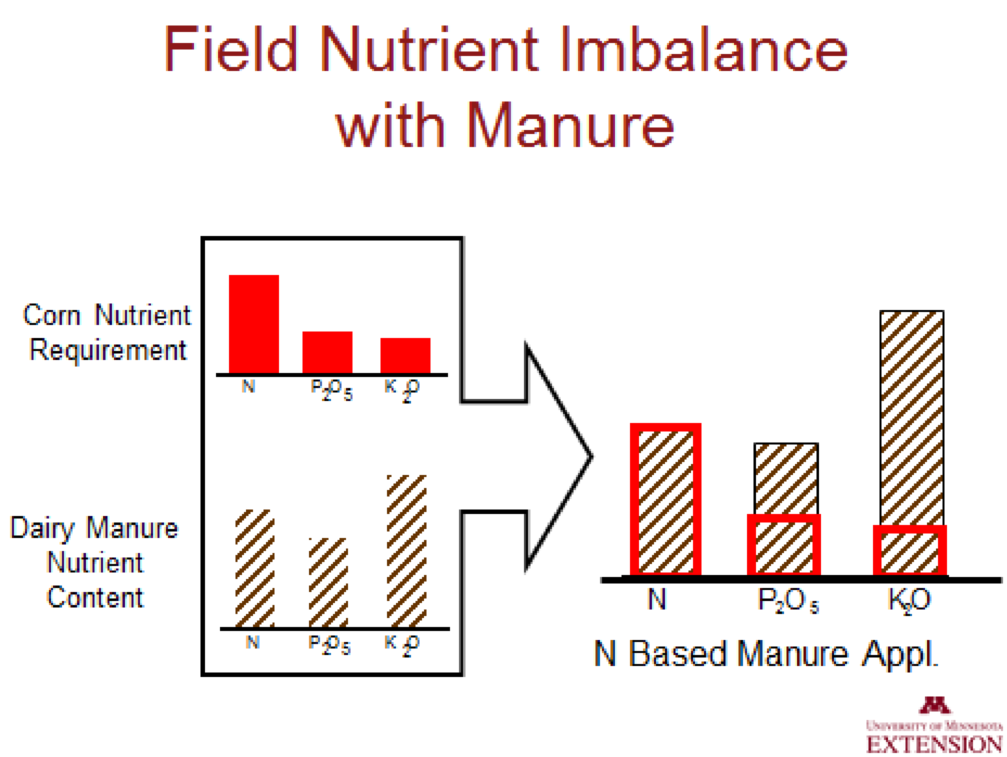
Phosphorus Import-Export Analysis:

Feed supplements and hay for dry cows and are purchased. Total phosphorus (P) in the lactation ration ranges from .40 to .44%. The only commercial fertilizer imported is some pelletized lime used to broadcast alfalfa seed. No commercial P fertilizer is imported. Most of this farm's Loam type soil is very high, exceeding 40-ppm Bray 1-P. The harvested and tilled acre to animal unit ratio is 0.8. Exporting some of their pen-pack manure has reduced this farm's excess P to 8 lb. /acre and 6.4 lb. /animal unit. The 8 lb./acre excess P is equivalent to 18 lbs./acre of excess P2O5 fertilizer per year. The following table presents the P import/export information.

Phosphorus Balance						
	Phosphorus (lb.)			Ratios		
P Source	Imports	Exports	Excess			
Animals	22	707		**Harvested Acres**	**Animal Units**	**Ratio**
Forages	2475	0		269	336	0.8
Grains	0	891				
Protein/Minerals	6204	0		**Excess P (lb.)**	**Harvested Acres**	**Ratio**
Bedding	141	0		2164	269	8.0
Fertilizer	0	0				
Milk	0	3462		**Excess P (lb.)**	**Animal Units**	**Ratio**
Manure	0	1618		2164	336	6.4
Total	8842	6678	2164			

Dilemma of long-term application of manure based on nitrogen needs:

Manure is an excellent soil amendment for N, P, K, sulfur, trace minerals, and organic matter. However, the N: P ratio in most manure does not match the relative N: P ratio needs of common agriculture crops. Applying manure continuously to corn fields based on nitrogen need usually causes an increase in soil P over a period of years. The following diagram illustrates this long-term phenomenon. With a typical dairy farm's crop rotation of corn and alfalfa, the alfalfa will utilize much of the potassium, but alfalfa has about the same P needs as corn.



Strategy: Export dairy pen-pack manure

This farm exported 342 tons/year of bedding pack manure, which amounts to about one-third of the manure from the dry cows and heifers. If this dairy farm were to not export this manure, 1618 lbs. of P would not be leaving the farm, which would increase the P excess to 3782 lbs. per year (1618+2164). This in turn would affect the excess P/acre as shown on the following table. This increases the excess P/Harvested Acres by 6.1 lb. /acre and the P/A.U. by 4.9 lb. /acre:

Effect of Manure Export on Excess P per Acre and per Animal			
	Ratio with Manure Export	Ratio with No Manure Export	Difference
Excess P (lb.)/ Harvested Acres	2164/269 = 8.0	3782/269 = 14.1	6.1
Excess P (lb.)/ Animal Units	2164/336 = 6.4	3782/336 = 11.3	4.9

Economic Considerations:

Manure can provide valuable nutrition to our soils in nitrogen (N), P, potassium (K), sulfur, trace minerals, and organic matter. Analysis of manure varies by animal species, type of production (growing vs lactation), type of bedding used, and manure storage system. Sampling the manure and submitting it to a certified laboratory for testing is necessary to determine the nutrient analysis. By using worksheets available on the University of Minnesota Extension website[1] along with a manure analysis of 14% N, 11% P, and 7% K, the NPK value of manure can be determined compared to commercial fertilizer. Manure is usually more expensive to apply than commercial fertilizer and the aforementioned worksheet accounts for this. All too often, the livestock farmer selling manure does not receive a price reflecting manure's fertilizer replacement value. Dairy pen-pack manure incorporated within 12 hours after application gives us 55% nitrogen availability the first year. When using the University of Minnesota Manure Value Calculator, the bedding pack exported from this farm has a total value of $4873 but this reduces to $2479 after subtracting $7/ton application cost or a net value of $7.25/ton[2]. This is assuming that the receiving field needs all of the nutrients in the manure.

Photo: Solid Manure Spreader

Conclusions:

1. Manure can provide significant nutrient contributions for crop production.
2. The relative level of nutrients in manure does not match the relative needs of crops.
3. Exporting manure is one way of quickly reducing buildup of excess soil test P on a livestock farm.
4. There is economic value to manure exported from a farm.

References:

1. Spreadsheets for calculating the economic value of manure. http://wlazarus.cfans.umn.edu/william-f-lazarus-animal-wastemanure-economics/
2. Commercial fertilizer values used in economic comparison: Urea (46-0-0) $/490/ton, DAP (18-46) $595/ton, and Potash (0-0-60) $525/ton.