

NUTRIENT MANAGEMENT
FOR DAIRY PRODUCTION

Dairy manure as a fertilizer source

J. Hart, M. Gangwer, M. Graham, and E.S. Marx

Most dairies need no commercial fertilizer if they use manure properly. In most cases, manure can supply all the nitrogen, phosphorus, potassium, and several other nutrients needed for forage production.

More than half the nutrients in dairy rations are excreted in manure. The key to managing manure is to treat it as a resource by recycling these nutrients to produce forage. For example, one lactating dairy cow's manure can supply enough nitrogen for 1.5 acres of silage corn.

This publication examines several aspects of the nutrient content and value of dairy manure:

- Nutrient flow through a dairy
- Distribution of nutrients in manure
- Dairy manure nutrient content
- Value of manure

John Hart, Extension soil scientist, Oregon State University; Mike Gangwer, Extension agent, Marion County, Oregon State University; Monte E. Graham, soil conservationist, USDA Natural Resource Conservation Service; and E.S. Marx, former research assistant in soil science, Oregon State University.

Nutrient flow through a dairy

Nutrients enter your farm in feed and fertilizer. Cows remove nutrients from feed for metabolism and milk production.

Some nutrients leave the farm in milk, but most are excreted in manure and remain on the farm. Manure applications return nutrients to the soil, where they can be reused to produce more feed.



Figure 1 illustrates nutrient flow through a dairy. Figure 2 shows a cow's daily feed intake and where the nutrients end up. **Note that more than half the nutrients in feed are excreted in manure.**

Each year, a 1,400-pound lactating cow producing 70 pounds of milk per day excretes the following nutrients in manure:

- 300 pounds of nitrogen
- 45 pounds of phosphorus
- 165 pounds of potassium

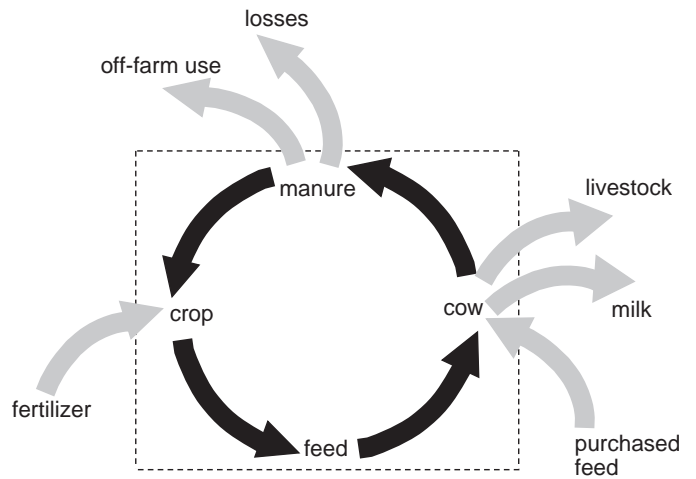


Figure 1.—Nutrient flow through a dairy.

Contrast these amounts to the smaller quantities of nutrients that leave the farm each year in milk:

- 100 pounds of nitrogen
- 20 pounds of phosphorus
- 30 pounds of potassium

Only 15 to 25 percent of the nutrients in feed end up in milk. The majority remain in manure, a valuable fertilizer resource for forage production. Figure 3 illustrates the proportions of nitrogen, phosphorus, and potassium excreted in manure and leaving the farm in milk.

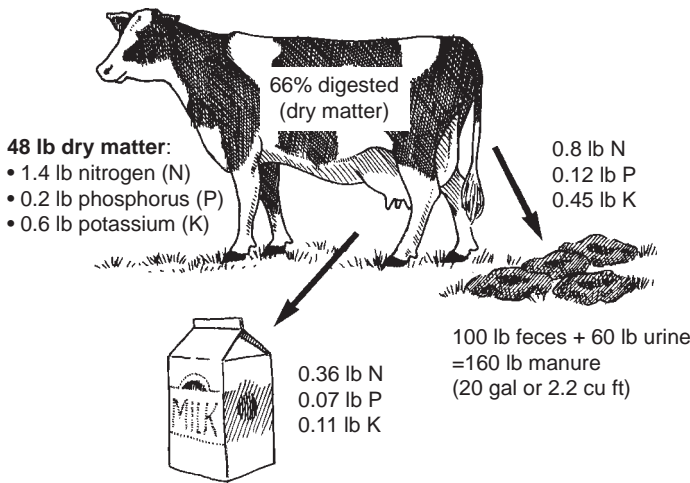


Figure 2.—Daily nutrient flow for a lactating cow.

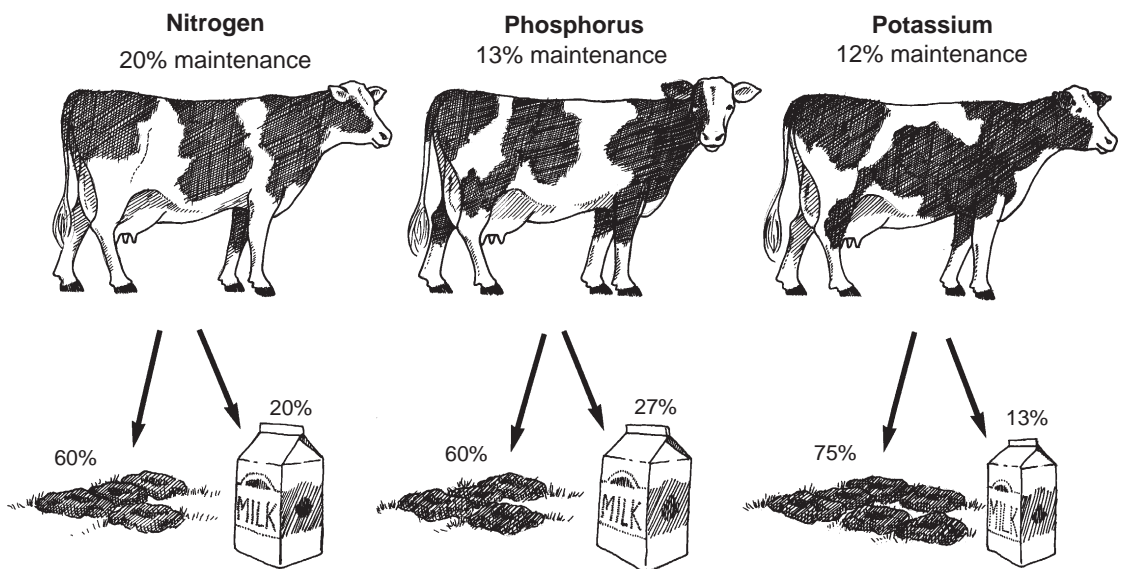


Figure 3.—Fate of nutrients in feed.

Distribution of nutrients

Not all nutrients are divided evenly between the feces and urine. Most of the phosphorus is found in the feces, while most of the potassium is excreted in the urine. Nitrogen is evenly divided between feces and urine. Figure 4 shows how the nutrient output is divided.

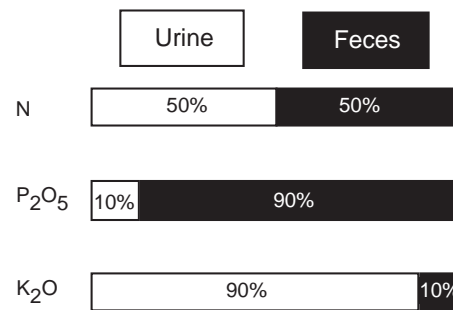


Figure 4.—Distribution of nutrients in manure.

Source: *Field Application of Manure, A Supplement to Manure Management for Environmental Protection*, Robert E. Graves, ed. (Pennsylvania Department of Environmental Resources, Harrisburg, 1986).

Dairy manure nutrient content

The approximate nutrient composition of manure in four common handling systems is shown in Table 1. Use Table 1 to estimate nutrient amounts remaining for crop use.

For example, 1 acre-inch of typical storage pond effluent provides more than twice the nitrogen needed for one cutting of grass forage or more than half the nitrogen needed for a corn silage crop.

Nutrient amounts are expressed in the same way as a fertilizer analysis:

- Total nitrogen (N)
- Phosphorus (P) as P₂O₅
- Potassium (K) as K₂O

The second column in Table 1 indicates the amount of ammonium N (NH₄-N). Ammonium N is readily available to plants. Most of the nitrogen found in storage ponds is in the form of ammonium nitrogen, and therefore is available to crops.

In contrast, nitrogen in other forms is only slowly available to plants. This is why only half the nitrogen from separated solids is available to plants during the growing season.

Potassium from any of the sources is readily available to plants. Most of the phosphorus is available the season manure is applied.

Table 1.—Nutrient composition of dairy manure.

Manure Type	Total N Nitrogen	Ammonium Nitrogen	Total P ₂ O ₅ Phosphorus	Total K ₂ O Potassium
Dry stack (lb/ton wet manure)	10	3	10	15
Separated solids (lb/ton wet solids)	5	NA ¹	2	2
Reception tank (lb/1,000 gallons)	20	8	7	18
Storage pond (lb/acre-inch)	135	109	30	135

¹Little if any ammonium nitrogen is found in separated solids.

Sources of data: storage pond and separated solids—Willamette Valley, Oregon; dry stacks—Yakima area, Washington; reception tank—Whatcom County, Washington.

Sample and analyze manure from your dairy. Nutrient content varies widely from farm to farm. For example, Table 2 shows the low, average, and high nitrogen content of solids from 51 Willamette Valley separators. Nitrogen content varies almost sixfold from the low to high analysis.

Value of manure

Nitrogen generally is the limiting nutrient to plant growth and the most expensive to purchase. Nitrogen in commercial fertilizer costs approximately 30 cents per pound and \$5 per acre to apply. Phosphorus costs 20 cents per pound, and potassium costs 15 cents per pound.

Figure 5 shows the annual fertilizer value of manure from 100 dairy cows. This illustration does not take into account loss during storage or handling or incomplete availability of nutrients.

If losses and incomplete availability are taken into account, **the annual value of nutrients in manure from 100 lactating cows exceeds \$10,000.**

Proper management of manure can increase farm profits and reduce risk of environmental damage.

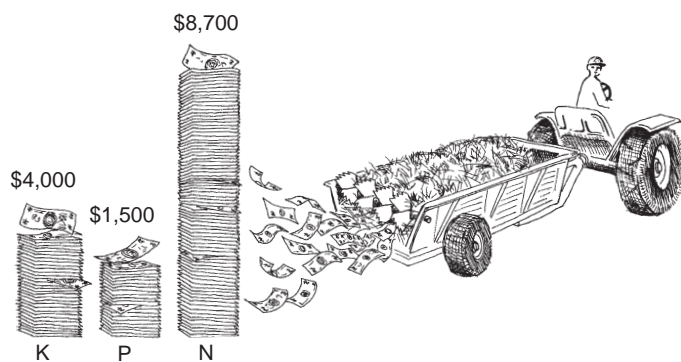


Figure 5.—Annual value of manure from 100 cows.

Table 2.—Nutrient contents from solids.

	Low	Average	High
Nitrogen (N)	0.29%	1.22%	1.88%
Phosphorus (P)	0.09%	0.21%	0.83%
Potassium (K)	0.09%	0.46%	1.34%

Based on samples from 51 Willamette Valley separators.

Source: *Analysis of Separated Manure Solids from Selected Manure Separators in Willamette Valley, Oregon Dairy Facilities*, SR 945, by Mike Gangwer and Monte Graham (Oregon State University, Corvallis, 1995).

For more information

The following publications can be ordered from:
 Mike Gangwer
 Marion County Office
 OSU Extension Service
 3180 Center St. NE, Room 160
 Salem, OR 97301

Analysis of Separated Manure Solids from Selected Manure Separators in Willamette Valley, Oregon Dairy Facilities, SR 945, by Mike Gangwer and Monte Graham (Oregon State University, Corvallis, 1995). No charge.

Wastewater Volume and Nitrogen Concentrations in Willamette Valley, Oregon Dairy Ponds, SR 939, by Mike Gangwer and Monte Graham (Oregon State University, Corvallis, 1994). No charge.

This publication was produced and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Extension work is a cooperative program of Oregon State University, the U.S. Department of Agriculture, and Oregon counties.



Oregon State University Extension Service offers educational programs, activities, and materials—without regard to race, color, religion, sex, sexual orientation, national origin, age, marital status, disability, and disabled veteran or Vietnam-era veteran status—as required by Title VI of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, and Section 504 of the Rehabilitation Act of 1973. Oregon State University Extension Service is an Equal Opportunity Employer.