

LPES Small Farms Fact Sheets*



Photos courtesy of USDA NRCS.

Manure on Your Farm: Asset or Liability?

By Craig Cogger, Washington State
University

Summary

If farm animals spend any part of the year in pens, barns, stalls, loafing areas, or feeding areas, you will need to deal with manure from those areas. What do you think about that manure? Do you view it as an asset? Or, do you see that pile as being a liability? This fact sheet compares the value of different types of manure as sources of nutrients and organic matter. It describes how to make manure on your farm an asset rather than a liability.

MWPS



*Now available online at www.lpes.org.



Manure Contains Nutrients

Manure contains valuable plant nutrients, like nitrogen (N), phosphorus (P), potassium (K), and sulfur (S). Manure nutrients come from the feed that the animals have eaten. In fact, most of the nutrients that animals eat end up in their manure. For example, more than 75% of the nitrogen and more than 65% of the phosphorus that a steer eats will be passed into the manure.

Most of the nutrients that animals eat end up in their manure.

The amount of nutrients in manure depends on the type of manure and how it is handled. Poultry manure contains the greatest amount of nutrients, while horse manure has much less nutrients (Table 1). Manure that contains lots of bedding will have fewer nutrients per pound than pure manure.

Poultry manure contains the greatest amount of nutrients.

Table 1. Typical nutrient content, moisture content, and weight of manure.

Type of Animal Manure	N	P ²	K	Moisture, percent	Weight, lb/cu yard
	lb per ton as is ^{1,2}				
Chicken with litter	73	28	55	30	900
Laying hen	37	25	39	60	1,400
Sheep	18	4.0	29	72	1,400
Rabbit	15	4.2	12	75	1,400
Beef	12	2.6	14	77	1,400
Dry stack dairy	9	1.8	16	65	1,400
Separated dairy solids ³	5	0.9	2.4	81	1,100
Horse	9	2.6	13	63	1,400

¹ Manure analyses are usually reported in terms of P and K, while fertilizer labels use phosphate (P₂O₅) and potash (K₂O). To convert from P to P₂O₅, multiply P by 2.3. To convert from K to K₂O, multiply K by 1.2.

² These values assume that manure has been protected from rain.

³ Separated dairy solids are produced when dairy manure is pumped over a screen, separating the solids from the rest of the manure.



Forms of Manure Nutrients

The nutrients in manure are a mixture of inorganic and organic forms. Many of the inorganic nutrients in manure are the same as those in a commercial fertilizer. These nutrients include ammonium nitrogen, soluble phosphate, and potassium salts. They dissolve in water, and plants can use them right away.

The organic forms of nutrients come from the remains of plant tissue, cells, and bacteria that are in the manure. They are called slow-release nutrients because plants cannot use them immediately. These slow-release nutrients become available to plants as the manure decays in the soil and releases the nutrients.

Liquid manure and solid poultry manure contain large amounts of inorganic nutrients, especially nitrogen, that dissolve easily. Most of the nitrogen in other solid manures is organic and is slowly released.

Nitrogen in manure and soil

Tiny organisms in the soil (Figure 1) break down the organic matter in the manure. This releases nitrogen and other nutrients into inorganic forms that quickly dissolve. The type of manure and the environment determines how quickly the nitrogen is released (Figure 2).

Fresh manure breaks down faster than composted manure. Poultry manure breaks down faster than manure from horses, cattle, goats, and other animals. In general, the more nitrogen that manure contains the quicker the nitrogen is released.



Figure 1. Tiny soil organisms that help break down organic matter.

Photo courtesy of Mary Fauci, Washington State University.

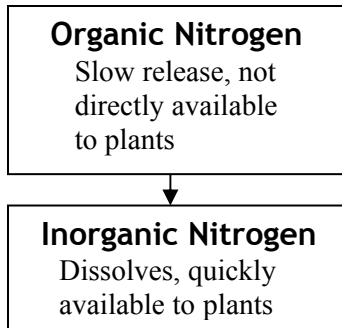


Figure 2. Organic N from manure is slowly released as inorganic N in soil.

Fresh manure breaks down faster than composted manure.

Soil organisms are most active when the soil is warm and moist. They are least active when the soil is cold or dry. Thus, nitrogen is released quickly from manure during the spring or summer and slowly during the winter.

Not all manure provides nutrients to plants. As it breaks down, manure containing lots of bedding takes nitrogen from the soil. This reduces the amount of nitrogen available to plants.

What is Manure Worth?

A ton of typical chicken litter (about 2 yds) contains

about 70 pounds of nitrogen. If half of the nitrogen becomes available to plants during the growing season, 4 tons of chicken litter will supply about 140 pounds of nitrogen. This is enough nitrogen to grow an acre of sweet corn. The same amount of commercial fertilizer, such as urea, would cost about \$45 per acre. The chicken litter also supplies phosphorus and potassium. If needed for the plants, these nutrients would cost up to \$40 per acre as commercial fertilizer. In the second year after being applied, the litter also will slowly release smaller amounts of nutrients.

Most other types of manure contain fewer nutrients. Their nutrient value per ton of manure will be much less.

If we only think about nutrients, we do not recognize the full value of the manure. The organic matter in manure is also valuable because it makes soil easier to manage, less likely to erode, and more likely to absorb water. These are important benefits that inorganic fertilizer does not provide, but it is harder to put a dollar value on them.



The organic matter in manure is valuable for making soil more productive and easier to manage.

How Much Manure Should I Apply?

Applying too much manure leads to the same problems as applying too much fertilizer. Overfertilization may reduce crop yields and can lead to nitrogen filtering into groundwater like wells and aquifers. In dry regions, salt may accumulate in the soil.

Applying too much manure may reduce crop yields and can lead to nitrogen filtering into wells and aquifers.

To estimate manure application rates, follow these steps.

- Decide how much nitrogen your crop needs. You can get this information from fertilizer guides or production guides for the crop you are growing. These are often available through your local Extension office.
- Then use Table 2 to estimate how much manure to apply, based on the amount of nitrogen you need.

Table 2. Approximate amount of manure needed to supply 50, 100, or 150 lbs of N/acre to a crop.

Manure	Tons of manure/acre to supply N		
	50 lb N	100 lb N	150 lb N
Chicken litter	1.5	3	4.5
Laying hens	3	6	9
Rabbit	10	20	30
Beef	25	50	75
Horse (no sawdust bedding) ¹	60	120	180
Separated dairy solids	100	200	300

¹ Horse manure with sawdust bedding often reduces the amount of N that plants can use. For more information, see the LPES Small Farms fact sheet titled "Good Stewardship Practices for Horse Owners."



It is not practical to apply more than 60 tons of manure per acre to any field larger than a garden. If you are applying manure to pastures or hayfields, the rates should be much lower to avoid smothering the crop and slowing its growth.

If you use low-nutrient manures such as horse manure, you will not be able to apply enough manure to meet crop nutrient needs, and you will need to supplement with other nutrients. Horse manure is best used as a source of organic matter rather than nutrients.

The numbers in Table 2 are averages. Manure nutrient values can vary widely from farm to farm. If you want more information about testing and estimating the nutrient value of manure from your farm, read “Fertilizing with Manure,” available from Washington State University Extension.

How Do I Apply Manure?

For any field larger than a garden, a manure spreader is a great timesaver. Manure spreaders vary in size, depending on the amount of land you need to spread and the size of your tractor.

By calibrating your manure spreader, you can get a good

idea of how much manure you are applying. The principle of calibrating a manure spreader is the same as calibrating a fertilizer spreader, a planter, or a sprayer. The simplest method is to spread tarps on the ground and weigh the amount of manure that falls on each tarp as the spreader passes over it. If you have access to truck scales, you can weigh a full spreader, apply a load to your field, weigh the spreader again, and measure how much land you covered (Figure 3). You can also estimate volume spread by calculating the volume of your spreader. For details and simple worksheets on calibration, see “Fertilizing with Manure,” available from Washington State University Extension.



Figure 3. Calibrate your manure spreader so you have a good idea of how much manure you are applying.



When Can I Apply Manure?

To get the most value from manure, apply it close to planting time. Applying manure at this time makes it less likely that you will lose nutrients through leaching, or washing away of nutrients, and runoff. If you lose nutrients, the manure loses value, and you may harm nearby groundwater like wells and surface water like streams and ponds. This issue is especially a problem for nutrient-rich manures such as poultry litter.

To get the most value from manure, apply it close to planting time.

If you have manure that has few available nutrients, you can apply it in the fall before planting, as long as the manure is not likely to wash into nearby streams and ponds. To keep the manure in place and reduce runoff during the winter, plant cover crops like rye and oats whenever you apply manure in the fall (Figure 4).

A fall-planted cover crop such as rye protects the soil and prevents manure runoff during the winter.



Figure 4. A rye cover crop protects a field fertilized with manure.

Is Manure Safe to Use on All Crops?

Fresh manure sometimes contains pathogens (such as bacteria and viruses) that can cause diseases in humans. Salmonella and certain strains of E. coli are among the most serious pathogens found in animal manure.



Pathogens can be a risk when fresh manure is applied to crops (1) that grow in or close to the soil and (2) that are eaten raw. This includes crops such as carrots, lettuce and other greens, and strawberries.

With the passage of time, pathogens will naturally die. If we use manure on plants such as carrots, we need to put time on our side. We can put time on our side by

- Aging or thoroughly composting the manure before we use it.
- Waiting at least four months from the time we apply manure until the time we harvest the crop.

What if I Cannot Use All of the Manure on My Own Land?

If you have more manure than you can use without risking runoff or leaching, you will need to develop ways to sell the manure or give it away. Nutrient-rich manure such as poultry manure is in demand by farmers. It sells for \$30 a yard in some parts of the country. Other manures are

too bulky for farmers to buy, but gardeners often seek them to enrich their soil (Figure 5). Many gardeners are eager to buy or take manure from local farms.



Figure 5. Many home gardeners like to use cow manure to enrich their soil.

Photo courtesy of USDA.

Farmers and gardeners may be willing to take or even buy manure from local farms.

Appearance sells. A relatively dry, easy-handling product (Figure 6) will bring more repeat calls than material from a wet, smelly, or weedy pile. When you advertise manure to gardeners, let them know what it is good for. For example, advertise poultry manure as



a fertilizer and horse manure as a mulch or soil amendment.



Figure 6. Well-composted manure is dark and crumbly.

Advertise poultry manure as a fertilizer, and horse manure as a mulch or soil amendment.

Composting manure produces a more attractive product, reduces the volume of manure, and kills pathogens. Some composting methods do not need much equipment.

Composting requires lots of planning upfront and good management to produce a quality product. Before you start composting manure, learn as much as you can. The “On-Farm Composting Handbook,” a publication available through Cornell University, is a detailed

and useful source of information. Visit local composters, too, to look at their systems and learn about which methods could work best for you.

Points to Remember

- Manure contains nutrients and organic matter that benefit plants and enrich the soil.
- The amount of nutrients in manure depends on the type of manure and how it is handled.
- To estimate the nutrient value of manure on your farm, use Tables 1 and 2 in this fact sheet, or have the manure analyzed at a laboratory.
- Applying too much manure can harm crops and the environment.
- Calibrate your manure spreader so that you have a good idea of how much manure you are applying.
- Fresh manure may contain pathogens. Use well-aged or thoroughly composted manure on high-risk crops such as root crops and greens.
- Sell or give away manure that you cannot use.



Author

Craig Cogger, Soil Scientist, Washington State University, can be reached at 253-445-4512 or cogger@wsu.edu.

For More Information

Educational Resources

Fertilizing with Manure. PNW 533. WSU Extension Bulletin Office, Washington State University, Box 645912, Pullman, WA, 99164-5912, 1-800-723-1763 or <http://cru.cahe.wsu.edu/CEPublications/pnw0533/pnw533.pdf>.

Managing Cover Crops Properly. Sustainable Agriculture Network. 1-802-656-0484 or www.sare.org/publications/covercrops/covercrops.pdf.

On-Farm Composting Handbook. NRAES-54, Northeast Regional Agricultural Engineering Service, www.nraes.org or 1-800-562-3618 (MWPS).

Environmental Stewardship for Horse Owners. LPES Small Farms Fact Sheet series. MWPS. Iowa State University, 1-800-562-3618 or www.mwps.org.

USDA-CSREES Small Farm hotline—1-800-583-3071

Acknowledgments

The author wishes to thank Marion Simon of Kentucky State University and Wayne Madson of Washington State University Extension, Colville, for their constructive reviews of this fact sheet.

The author also wishes to thank Diane Huntrods, the LPES Project Manager, for editing this fact sheet and coordinating its completion.



Financial Support

The LPES Small Farms Fact Sheets were developed with support from the USDA-CSREES, U.S. EPA's National Agriculture Assistance Center, and University of Nebraska Cooperative Extension at Lincoln, under Cooperative Agreement Number 2003-39490-14107.

*Copyright © 2005 by MidWest Plan Service.
Iowa State University, Ames, Iowa 50011-3080.*

Copyright

For copyright permission, contact MidWest Plan Service (MWPS) at 515-294-4337. Organizations may reproduce this fact sheet for non-commercial use, provided they acknowledge MWPS as the copyright owner and include the following credit statement:

Reprinted from the LPES Small Farms Fact Sheets, authored by Craig Cogger, Washington State University, courtesy of MWPS, Iowa State University, Ames, Iowa 50011-3080
Copyright © 2005.