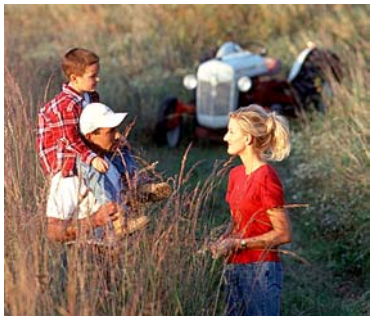
Livestock and Poultry Environmental Stewardship <LPES> Curriculum

LPES Small Farms Fact Sheets*



Photos courtesy of USDA NRCS.

Nutrient Management– *SIMPLIFIED!*

By Randall James, Ohio State University Extension

Summary

This fact sheet outlines a method that uses manure to fertilize crops. The fact sheet is aimed at those small-scale livestock farmers who raise more than one type of animal and haul their manure on a daily or weekly basis because long-term storage is not available. This manure management system is based on the "book values" of manure rather than on manure tests. Manure testing is not necessary, and manure spreader calibration is not needed. However, soil testing is suggested.

MWPS USDA EPA

*Now available online at <www.lpes.org>.

Introduction

In much of the United States, small-scale livestock farms with a limited number of acres and a mix of livestock species are typical. If these farmers are concerned about the possible environmental impact of their farms on soil and water quality, where can they get information? Much of the information about using the nutrients in manure to fertilize crops is meant for large, single-species farms. It is not meant for small, multi-species farms. For instance, the example farms in this information often have over 200 cows, 1,000 pigs, or hundreds of thousands of chickens. They do not apply to small farms with a mix of animals and a changing mix of manure.

Use book values if you haul manure on a daily or weekly basis.

In addition, most sources suggest that livestock manure be tested by a laboratory. This suggestion is based on the assumption that producers have manure storage facilities and a consistent manure mix. On many or most small livestock farms, the manure spreader is the storage facility, and the main manure-handling method is to haul manure every day or week. Laboratory testing of the manure does not make sense in a daily or weekly haul system, because it is nearly impossible to collect a good sample of the manure. Depending on who is cleaning the barn, the chicken manure may be under the cow manure and on top of the horse manure one day and in a completely different part of the spreader the next day. The heifer pen may only be cleaned once a week.

However, if the manure on a particular farm is very well mixed and the number of animals does not change a lot, then a manure test might help refine the manure management process.

This fact sheet looks at a basic manure nutrient management system that small farmers with a mix of livestock can use. The system is designed for farms using daily or weekly haul and no storage facility except the manure spreader. The manure nutrients available to fertilize crops are based on general "book values" rather than on manure tests. Manure application rates are given in months/field, rather than in gallons or tons/acre. As a result, the manure spreader does not need to be calibrated, and the manure does not need to be weighed. Likewise, manure testing is not necessary, but soil testing is suggested.

On the following pages, this fact sheet will describe the four main steps that small-scale farmers can use to decrease their farm's effect on soil and water quality.

Step 1. Total farm manure nutrients

To get book values for the nutrients found in the manure of farm animals, contact the local office of the USDA Natural Resource Conservation Service (NRCS) or the Conservation District office. They can provide the average pounds of nutrients found in the manure of farm animals in each state or region of the United States. Book values are given in many different units, such as pounds/-ton, pounds/day and percentage. Work with the conservation expert to convert the numbers to pounds/animal/-month. For example, in the Midwest, a 1,400-pound dairy cow would produce about 18 pounds of nitrogen (N), 10 pounds of phosphorus (P_2O_5), and 14 pounds of potash (K_2O) each month (Table 1).

The P_2O_5 and K_2O are fairly stable in the soil and can be used by plants as fertilizer. So for each pound of manure P_2O_5 or K_2O that is spread on a field, producers can reduce the amount of commercial fertilizer, P_2O_5, and K_2O applied by one pound. Nitrogen (N) is a different story. It changes all of the time. It can be tied up in organic matter. It can seep out of the soil or turn into a gas and float away. In each case, it is not available to plants.

Table 1. Examples of available manure nutrients in pounds per animal per month.

Animals	N[1]	P_2O_5	K_2O
	Pounds/month		
1,400-pound dairy cow	6	10	14
1,000-pound horse	3	3	6
500-pound dairy heifer	2	3	1

[1]Adjusted for N losses – 1/3 of total N.

Assume that plants can only use about one-third of the book value nitrogen in the manure. So each month, the Midwest dairy cow mentioned on the preceding page would produce around 6 pounds of available N, 10 pounds of P_2O_5, and 14 pounds of K_2O that could be used to fertilize crops.

Note: If your animals have free access to pasture but are fed in the barn, about one-half of the manure will end up in the barn, where it can be collected and spread on crops.

Test the soil in all of your crop fields.

To get the total amount of each nutrient produced per month, add the book values for the manure nutrients that each farm animal produces in a month.

Step 2. Test the soil.

Test the soil in the fields where the manure will be spread (Figure 1). The test will tell you the amount of fertilizer or manure nutrients each crop will need. Contact your County Extension Office for information on soil testing. Table 2 gives a few examples of the type of crop nutrient needs that soil test results might show. However, these are only examples. You need to test your fields to find out what each field actually needs. **To get the total amount of nutrients needed for the whole field, multiply the amount of each nutrient required (according to the soil test) by the number of acres in the field.**

Table 2. Examples of crop nutrient needs.

Crop	N	P_2O_5	K_2O
	Pounds/acre		
Corn for grain	140	45	90
Alfalfa hay	0	65	300
Winter wheat	40	55	80

Figure 1. Taking a soil sample for testing.

Photo courtesy of USDA NRCS.

Step 3. Replace some commercial fertilizer with manure nutrients.

Usually, manure should be applied to meet the P_2O_5 needs of the crop. If you apply manure to meet the N or K_2O needs of crops, you will almost always apply too much P_2O_5. Over application wastes money and nutrients and can pollute the environment.

To figure out the number of months of manure to apply to a field, divide the total P_2O_5 needed for the field (Step 2 on page 4) by the total pounds of manure P_2O_5 produced in a month (Step 1 on page 3). The result is a months/field manure application rate. Apply all of the manure from the barn to each crop field for one or more months, based on the months/-field rate, until all of the manure is used.

Apply manure at months/field rates.

Step 4. Determine how much commercial fertilizer is needed.

Because manure nutrients usually do not exactly match crop needs, some additional commercial fertilizer will like-

ly be needed for the crop. To figure the additional fertilizer needed, multiply the months that manure will be applied to the field times the manure nutrients produced per month. Then subtract the amount of each nutrient applied from the total crop nutrient needs of the field.

Whole Farm Example

Using Tables 1 and 2, let's look at a whole farm example. This example farm has 19 dairy cows, 8 dairy heifers averaging 500 pounds, and 3 light horses (1,000 pounds each) in one barn. We will figure the amount of manure that could be applied to a 10-acre corn field.

Step 1. Manure produced per month

19 dairy cows
x 6 pounds of N/month = 114 pounds of available N
x 10 pounds of P_2O_5/month = 190 pounds of P_2O_5
x 14 pounds of K_2O/month = 266 pounds of K_2O/month

8 dairy heifers
x 2 pounds of N/month = 16 pounds of available N
x 3 pounds of P_2O_5/month = 24 pounds of P_2O_5
x 1 pound of K_2O/month = 8 pounds of K_2O/month

3 light horses
x 3 pounds of N/month = 9 pounds of available N
x 3 pounds of P_2O_5/month = 9 pounds of P_2O_5
x 6 pounds of K_2O/month = 18 pounds of K_2O/month

Total Available Manure N = 114 + 16 + 9 = 139 pounds of N/month

Total Available Manure P_2O_5 = 190 + 24 + 9 = 223 pounds of P_2O_5/month

Total Available Manure K_2O = 266 + 8 + 18 = 292 pounds of K_2O/month

Step 2. Field crop nutrient requirements

(Note that the nutrient needs for 10 acres of corn should be figured by multiplying the number of acres in the field times the soil test suggestion. However, for this example, we will use the nutrient needs from the example in Table 2.)

10 acres x 140 pounds of N/acre = 1,400 pounds of N/field

10 acres x 45 pounds of P_2O_5/acre = 450 pounds of P_2O_5/field

10 acres = 90 pounds of K_2O/acre = 900 pounds of K_2O/field

Step 3. Months of manure to apply to the field

Field P_2O_5 need ÷ Manure P_2O_5 produced per month
= 450 pounds of P_2O_5/field ÷ 223 pounds of P_2O_5 produced/month = 2 months

Step 4. Supplemental commercial fertilizer needed

The manure nutrients will supply all of the approximately 450 pounds of P_2O_5 needed for the field.

The amount of available N applied will be 2 months x 139 pounds of N/month = 278 pounds of available N.

The amount of K_2O applied will be 2 months x 292 pounds of K_2O/month = 584 pounds of K_2O.

The N fertilizer required will be the difference between what was needed (Step 2 on page 6) and what is applied (Step 3 on this page). 1,400 - 278 = 1,122 pounds of available N divided by the number of acres = 1,122 ÷ 10 acres = 112 pounds of N/acre.

The additional K_2O fertilizer required is calculated the same way: 900 – 584 = 316 pounds of K_2O and 316 ÷ 10 acres = 32 pounds/acre.

Best Management Practices for Manure Application

- Apply the manure to fields that have the highest need according to the soil test.
- When spreading manure in the winter, apply it to fields with the most cover (residue or growing crop).
- Avoid spreading manure on steep slopes.
- Spread manure as far as possible from easily affected areas such as wells, springs, streams, lakes, and ponds.
- Spread the manure as evenly as possible across the field.

Points to Remember

- Get local "book values" for the monthly manure fertilizer nutrients produced on your farm.
- Test the soil in each field to find the nutrient needs of the crop in that field.
- Apply manure using a months per field rate of application.
- If needed, apply commercial fertilizer to meet crop nutrient needs.

References

MWPS-18-S1, Manure Characteristics, MidWest Plan Service, 2004.

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For More Information

Educational Resources
http://www.lpes.org/–To view the Livestock and Poultry Environmental Stewardship (LPES) curriculum resources

http://www.reeusda.gov/1700/statepartners/usa.htm/–To obtain state Cooperative Extension contacts

Environmental Regulations Resources
http://www.epa.gov/npdes/afo/statecontacts/–To obtain state environmental agency contact

Small Farm Resources
1-800-583-3071–USDA-CSREES Small Farm hotline

State-Specific Resources
The local contact for your land-grant university Cooperative Extension program is listed in the phone book under "Cooperative Extension" or "*(county name)* County Cooperative Extension.

Acknowledgments
The author wishes to thank Doug Beagle, Penn State University, and Carol Galloway, U.S. EPA National Agricultural Compliance Center for their review 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.