Calculating the Value of Manure for Crop Production

Charles S. Wortmann, Extension Soil Specialist — Nutrient Management
Charles A. Shapiro, Extension Soil Specialist — Crop Nutrition

This NebGuide provides criteria and guidelines to determine the market value of manure for crop production.

Manure has value for crop production when it provides nutrients or soil amendments needed for optimum crop yields. Manure does not supply nutrients in balance with crop needs, but has the advantage of slowly releasing nutrients which reduces the risk of nitrate leaching. Manure nutrient content varies widely due to weather conditions, the livestock facility, manure storage systems, the age of manure, and feed composition. Low nutrient concentration due to weathering and dilution with water or soil decreases the value of manure. The organic material in manure also can improve soil productivity by increasing the water infiltration rate and water-holding capacity. On some soils, this gain in productivity may be more than its nutrient value.

The worksheet on page 3 is used for calculating the fertilizer value of a manure source for a specific field. It includes the value of needed nutrients for a four-year period and offers the option of including the value of manure nutrients used after that. The value of other benefits of using manure, such as an expected yield increase, can be estimated. An example worksheet is included on page 4. To complete the worksheet you will need one or more recent analyses of the manure to be valued, a recent soil test for the application area, recommendations for nutrients needed for the next and following crops, and current fertilizer prices.

Determining Nutrient Value of Manure

Manure or compost should be applied at or below the rate that meets the nitrogen (N) need of the next or current crop. Applying manure to meet the crop’s nitrogen needs usually results in applying substantially more phosphate ($P_2O_5$), potash ($K_2O$), sulfur (S), and zinc (Zn) than is needed by the crop. University of Nebraska–Lincoln recommendations for $P_2O_5$, $K_2O$, and Zn are based on meeting crop needs while slowly building soil nutrient levels$^{3,4}$. This is generally the most profitable option for nutrient management. For corn, sorghum, soybean, and sugar beet, research results show no economic benefit to nutrient applications that raise soil test levels higher than 20 ppm phosphorus (P) (Bray-1 P test), 125 ppm potassium (K), and 0.8 ppm zinc. Yields of alfalfa, wheat, and six other crops respond to higher soil phosphorus levels$^2$.

Applying large quantities of nutrients at one time, in excess of recommendations, may be profitable when interest rates are low and nutrients are inexpensive, as may be the case with manure nutrients. A producer receives value from these excess nutrients only if subsequent crops remove the nutrients before more nutrients are applied. This approach is acceptable for relatively immobile soil nutrients like phosphorus, potassium, and zinc, applied where or in a way such that phosphorus is not likely to be transported to surface water, and if total available nitrogen does not exceed crop utilization in year one. Nitrogen released in subsequent years from the organic-N in manure can be credited toward future crop needs.

The organic matter in manure may improve soil productivity and crop yields. For example, manure demonstration plots in Nebraska from 1996 to 2001 produced an average of 7 bu/acre more corn (14 site years) and 2 bu/acre more soybean (6 site years) where manure or manure plus fertilizer was applied compared to fertilizer alone. Soybean in one other site year lost 4.5 bu/acre due to compaction during manure application and incorporation. Line 12 in the worksheet provides a place to include the value of a yield increase. This value is typically between $0 and $60 per acre. Expect less yield increase on fine and high organic matter soil, or if the land has a recent history of manure. Expect greater increase on sandy, eroded, or disturbed soil with no recent manure history.

Manure Testing

Manure varies greatly in nutrient content so recent samples of the manure or effluent to be applied should be analyzed by

---

1. This worksheet is based on a publication from the University of Missouri, Calculating the Value of Manure as a Fertilizer Source (G9330).
2. Nutrient Management for Agronomic Crops in Nebraska, University of Nebraska–Lincoln Extension EC155
3. Fertilizer Suggestions for Corn, EC117 (August 2009)
4. Fertilizer Suggestions for Soybeans, G859 (Revised February 2006)
a laboratory to determine nutrient content. Without a lab test, a “book” value of typical nutrients in manure could be used, but this is not recommended since the actual concentration of one or more nutrients in any manure is often several times more or less than the “book” value.

### Availability of Manure Nitrogen

Manure nitrogen is mostly in two forms: ammonium nitrogen and organic nitrogen. All ammonium nitrogen is available the first year if it is not lost. Ammonium nitrogen is quickly lost from manure spread in a thin layer and left on the surface of either a feedlot or a field. Cooler temperatures at time of spreading will slow ammonia loss. Ammonium nitrogen is retained once it is incorporated into the soil (Table II) by injection, tillage, or by rainfall or irrigation of one-half inch or more.

Organic nitrogen is slowly released during warm weather by microbial action. From 25 to 50 percent of the organic nitrogen in manure becomes available to crops in the first year (Table II). About 15 percent of the original organic nitrogen in manure or compost is released in year two, 7 percent in year three, and 4 percent in year four. Much of the organic nitrogen in manure is not recovered by crops in the following years.

### Table I. Fraction of ammonium nitrogen available this year.

<table>
<thead>
<tr>
<th>Sidedress Application</th>
<th>Temperature at Time of Spreading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorporated</td>
<td>Solid Liquid &gt; 50°F Liquid ≤50°F</td>
</tr>
<tr>
<td>Sprinkler irrigation</td>
<td>Not incorporated</td>
</tr>
<tr>
<td>Preplant Application and Not Incorporated</td>
<td>Immediately</td>
</tr>
<tr>
<td>Surface - spring or fall</td>
<td>One day later</td>
</tr>
<tr>
<td>Preplant Application and Incorporated</td>
<td>Two days later</td>
</tr>
<tr>
<td></td>
<td>Three days later</td>
</tr>
<tr>
<td></td>
<td>Seven+ days later</td>
</tr>
</tbody>
</table>

### Table II. Fraction of organic nitrogen available this year.

<table>
<thead>
<tr>
<th>Beef/Dairy</th>
<th>Solid</th>
<th>Liquid &gt; 50°F</th>
<th>Liquid ≤50°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid (e.g. feedlot)</td>
<td>0.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stored liquid</td>
<td>0.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compost</td>
<td>0.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stored liquid</td>
<td>0.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poultry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deep pit</td>
<td>0.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid with litter</td>
<td>0.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid without litter</td>
<td>0.35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

6 Sampling Manures for Nutrient Analysis, G1450
6 Manure Testing: What to Request?, G1780
6 Determining Crop Available Nutrients from Manure, G1335
Worksheet to calculate the value of manure. (Instructions for most lines are on page 2.)

Click here for the interactive version of this worksheet. When you input your numbers, the calculations will automatically be figured.

| Manure Source: __________________________ | Nitrogen | | | | |
| Field: __________________________ | Ammonium N | Organic N | Total N | P₂O₅ | K₂O | Sulfur | Zinc |
| Date: __________________________ | 1.0 | 1.0 | 1.0 | 1.0 |

1. Manure nutrient content from manure test report (lbs/ton, lbs/1,000 gal, or lbs/acre-inch).
3. Available nutrients (lbs/ton, lbs/1,000 gal, or lbs/acre-inch). Multiply line 1 x line 2.
4. Nutrient recommendations for the next crop (lbs/acre/year).
5. Manure application rate. To meet crop nitrogen need, divide total nitrogen in line 4 by line 3 (round to whole units) (tons/ac, 1000 gal/ac, or acre-inches).
6. Total nutrients available (lbs/ac). Multiply each value in line 3 x line 5 (application rate).
7. Nutrient need for four years (except N) (lbs/ac). Multiply line number 4 x 4.
8. Additional nutrients of value (lbs/ac).
9. Total nutrients of value (lbs/ac).
10. Fertilizer nutrient costs ($/lb).
12. Estimated value of yield increase ($/ac).
13. Total value of applied manure ($/ac). Sum all values in line 11 and line 12.
14. Manure value per unit ($/ton, $/1,000 gal, $/acre-inch, $/load). Divide line 13 by line 5, or by loads per acre.
15. Manure costs: hauling, spreading, incorporation ($/ac).

**Line 12:** The value of increased yields from manure typically ranges from $0 to $30 per acre. The table below can be used to calculate a value. The example yield increase is based on 70 percent of the average yields described on page 1 over a period of two years.

<table>
<thead>
<tr>
<th>Value of Yield Increase</th>
<th>Year #1</th>
<th>Year #2</th>
<th>Total Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of Yield Increase</td>
<td>Crop</td>
<td>Yield Increase</td>
<td>Value/unit</td>
</tr>
<tr>
<td>Example</td>
<td>corn</td>
<td>5 bu/ac</td>
<td>$5.00/bu</td>
</tr>
</tbody>
</table>

**Line 15:** The costs of manure-handling equipment, and the loading and spreading of manure, should be charged against the livestock operation. Only the cost of hauling it from the feedlot to the entrance of the application site, and an optional incorporation to retain the ammonium nitrogen, should be charged against manure value. The worksheet example on the last page shows one example of this.

**Line 17:** If the difference is negative, enter zero. For this, line 4 must NOT be a multi-year average of recommendations.
Sample worksheet to calculate the value of manure. (Instructions for most lines are on page 2.)

<table>
<thead>
<tr>
<th>Manure Source: Upper Lots</th>
<th>Field: Dad’s 80, S-20 Ac</th>
<th>Date: Nov. 5, ’12</th>
</tr>
</thead>
</table>

**Nutrient Plan**
1. Manure nutrient content from manure test report (lbs/ton, lbs/1,000 gal, or lbs/acre-inch).
3. Available nutrients (lbs/ton, lbs/1,000 gal, or lbs/acre-inch). Multiply line 1 x line 2.
4. Nutrient recommendations for the next crop (lbs/acre/year).
5. Manure application rate. To meet crop nitrogen need, divide total nitrogen in line 4 by line 3 (round to whole units) (tons/ac, 1000 gal/ac, or acre-inches).

**Nutrients of Value**
6. Total nutrients available (lbs/ac). Multiply each value in line 3 x line 5 (application rate).
7. Nutrient need for four years (except N) (lbs/ac). Multiply line number 4 x 4.
8. Additional nutrients of value (lbs/ac).
9. Total nutrients of value (lbs/ac).
10. Fertilizer nutrient costs ($/lb).
12. Estimated value of yield increase ($/ac). $43.00
13. Total value of applied manure ($/ac). Sum all values in line 11 and line 12. $314.80/acre
14. Manure value per unit ($/ton, $/1,000 gal, $/acre-inch, $/load). Divide line 13 by line 5, or by loads per acre.
15. Manure costs: hauling, spreading, incorporation ($/ac).
17. Nutrients still needed for this year’s crop (lbs/ac). Line 4 minus line 6. 0

*Zinc is half the corn recommendation due to averaging 5 lbs/acre with zero for soybean. Use 5 lbs/acre for line 4 when calculating zinc in line 17.

**Break-even price of hauling manure two miles from the feedlot to the field entrance is based on spreading 18 tons/acre with a 10-ton spreader, using a 70 hp tractor at 10 mph road speed. Based on the most common hourly loading/hauling/spreading rates ($100/hr) reported in the Nebraska 2012 Farm Custom Rates (EC823) publication and the Missouri Distribution Cost Analyzer (http://agebb.missouri.edu/commag/crops/massey/downloads/Manure%20Distribution%20Cost%20Analyzer.xls) for time to travel to the field (0.7 hr/mi, 100 * 0.7 = $70/acre) and incorporation ($10/acre) for a total of $80/acre.

Acknowledgment
The authors would like to acknowledge Richard DeLoughery, former extension water quality educator, for contributions to a previous version of this publication.

UNL Extension publications are available online at http://extension.unl.edu/publications.