

# Calculating the Value of Manure as a Fertilizer Source

**M**anure has value on a field only if it offsets the need to purchase other nutrients or soil amendments. The worksheet on page 2 allows users to calculate the fertilizer value of the manure for a specific field. Assemble the information specified in the input form (Table 1) before completing the worksheet. An example worksheet (Table 2) is included in the following section.

Manure has characteristics that may reduce its value relative to that of commercial chemical fertilizers. Manure can be a less dependable nitrogen source and is perceived as a source of weed seeds. Because manure is

an unbalanced fertilizer source, meeting crop needs for one nutrient may result in application of too much or too little of other crop nutrients. Low nutrient concentration in manure increases handling and application costs. Manure has positive attributes as well. It is a slow-release fertilizer, and the organic material can improve soil quality.

The worksheet in this guide determines the value of manure only as a nutrient source, similar to commercial chemical fertilizers, regardless of its other attributes. Actual economic value of manure must be negotiated between the manure seller and the buyer.

**Table 1. Input form.**

<p><b>Step 1. Total nutrients in manure (pounds per ton or pounds per 1,000 gallons)</b></p> <p>1. Total nitrogen (TN or TKN) <input type="text"/></p> <p>2. Inorganic nitrogen (IN) <input type="text"/></p> <p>3. Organic nitrogen (ON) <input type="text"/> (ON = TN – IN)</p> <p>4. Phosphorus (P<sub>2</sub>O<sub>5</sub>) <input type="text"/> (P<sub>2</sub>O<sub>5</sub> = P × 2.29)</p> <p>5. Potassium (K<sub>2</sub>O) <input type="text"/> (K<sub>2</sub>O = K × 1.20)</p> <p>Users should get these numbers from a laboratory analysis of manure from their farm. Without a lab test, a table of typical nutrient values for manure can be used, but realize that the nutrient value of the manure could easily be half or double the tabular value. See MU Extension publication EQ215, <i>Laboratory Analysis of Manure</i>, for more information on manure testing. See MU Extension publication EQ201, <i>Reduce Environmental Problem With Proper Land Application of Animal Manure</i>, for average nutrient values of several types of livestock manure.</p>	<p><b>Step 2. Crop nutrient need (pounds per acre)</b></p> <p>1. Nitrogen (N) <input type="text"/></p> <p>2. Phosphorus (P<sub>2</sub>O<sub>5</sub>) <input type="text"/> (P<sub>2</sub>O<sub>5</sub> = P × 2.29)</p> <p>3. Potassium (K<sub>2</sub>O) <input type="text"/> (K<sub>2</sub>O = K × 1.20)</p> <p>The need for phosphorus and potassium should be based on soil testing results, and nitrogen need depends on the crop grown and yield goal. For more information, see MU Extension publications G9217, <i>Soil Sampling Hayfields and Row Crops</i>, and G9112, <i>Interpreting Missouri Soil Test Reports</i>.</p> <p><b>Step 3. Fertilizer costs (dollars per pound)</b></p> <p>1. Fertilizer N <input type="text"/></p> <p>2. Fertilizer P<sub>2</sub>O<sub>5</sub> <input type="text"/></p> <p>3. Fertilizer K<sub>2</sub>O <input type="text"/></p> <p><b>Step 4. Other information</b></p> <p>1. Spreader capacity (tons or 1,000 gallons) <input type="text"/></p>
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**Table 2. Worksheet to calculate fertilizer value per load of manure.**

	Nitrogen			P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
	Inorganic N <sup>1</sup>	Organic N	Total N		
1. Manure nutrient content (pounds per ton or per 1,000 gallons) from input form, step 1					
2. Nutrient availability <sup>2</sup>				1.0	1.0
3. Available nutrients <sup>3</sup> in manure (pounds per ton or per 1,000 gallons) <i>Multiply line 1 by line 2.</i>					
4. Crop need (pounds per acre) from input form, step 2					
5. Quantity of manure needed (tons per acre or 1,000 gallons per acre) <i>Divide line 4 by line 3.</i>					
6. Quantity of manure to apply <sup>4</sup> (tons per acre or 1,000 gallons per acre) <i>Select one value from line 5.</i>					
7. Available nutrients that will be applied (pounds per acre) <i>Multiply line 6 by line 3.</i>					
8. Nutrients with value (pounds per acre) <i>Select the value of line 4 or line 7, whichever is lower.</i>					
9. Fertilizer cost (dollars per pound) from input form, step 3			\$	\$	\$
10. Manure value by nutrient (dollars per acre) <i>Multiply line 8 by line 9.</i>			\$	\$	\$
11. Manure value per acre (dollars per acre) <i>Sum the values in line 10.</i>	\$				
12. Manure value per unit of manure (dollars per ton or per 1,000 gallons) <i>Divide line 11 by line 6.</i>	\$				

<sup>1</sup>Inorganic N is also called ammonia N.

<sup>2</sup>Inorganic N availability can range from 0.20 for surface-applied manure to 1.0 for incorporated manure. Organic N availability ranges from 0.25 to 0.6 in the year of application, depending on manure type. Missouri Department of Natural Resources (MDNR) regulations may stipulate that certain availability coefficients be used for MDNR-permitted waste facilities.

<sup>3</sup>Add available inorganic N and organic N in line 3 to determine available total N in line 3.

<sup>4</sup>Select from line 5 the quantity of manure to be applied per acre based on whether you want to meet the N, P or K needs of the crop. If you want to meet or exceed all crop nutrient needs, select the highest value in line 5.

## Example

This example is based on a surface application of poultry litter on dryland corn. See example worksheet (Table 3).

## Example inputs

### Step 1. Total nutrients in manure (pounds per ton or pounds per 1,000 gallons)

1. Total nitrogen (TN or TKN):	<u>54 lb/ton</u>
2. Inorganic nitrogen (IN):	<u>10 lb/ton</u>
3. Organic nitrogen (ON):	<u>44 lb/ton</u>
(ON = TN – IN)	
4. Phosphorous (P <sub>2</sub> O <sub>5</sub> ):	<u>50 lb/ton</u>
(P <sub>2</sub> O <sub>5</sub> = P × 2.29)	
5. Potassium (K <sub>2</sub> O):	<u>39 lb/ton</u>
(K <sub>2</sub> O = K × 1.20)	

### Step 2. Crop nutrient need (pounds per acre)

1. Nitrogen (N):	<u>165 lb/acre</u>
2. Phosphorous (P <sub>2</sub> O <sub>5</sub> ):	<u>98 lb/acre</u>
(P <sub>2</sub> O <sub>5</sub> = P × 2.29)	
3. Potassium (K <sub>2</sub> O):	<u>107 lb/acre</u>
(K <sub>2</sub> O = K × 1.20)	

### Step 3. Fertilizer costs (dollars per pound)

1. Fertilizer N:	<u>\$0.33/lb</u>
2. Fertilizer P <sub>2</sub> O <sub>5</sub> :	<u>\$0.35/lb</u>
3. Fertilizer K <sub>2</sub> O:	<u>\$0.34/lb</u>

### Step 4. Other information

1. Spreader capacity (tons or 1,000 gallons)	<u>5 tons</u>
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**Table 3. Example worksheet for dryland corn and soybean fertilizer needs.**

	Nitrogen			P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
	Inorganic N <sup>1</sup>	Organic N	Total N		
1. Manure nutrient content (pounds per ton or per 1,000 gallons) from input form, step 1	10	44	54	50	39
2. Nutrient availability <sup>2</sup>	0.6	0.6		1.0	1.0
3. Available nutrients <sup>3</sup> in manure (pounds per ton or per 1,000 gallons) <i>Multiply line 1 by line 2.</i>	6	26.4	32.4	50	39
4. Crop need (pounds per acre) from input form, step 2			165	98	107
5. Quantity of manure needed (tons per acre or 1,000 gallons per acre) <i>Divide line 4 by line 3.</i>			5.1	2.0	2.7
6. Quantity of manure to apply <sup>4</sup> (tons per acre or 1,000 gallons per acre) <i>Select one value from line 5.</i>			2.7	2.7	2.7
7. Available nutrients that will be applied (pounds per acre) <i>Multiply line 6 by line 3.</i>			87	135	105
8. Nutrients with value (pounds per acre) <i>Select the value of line 4 or line 7, whichever is lower.</i>			87	98	105
9. Fertilizer cost (dollars per pound) from input form, step 3			\$0.33	\$0.35	\$0.34
10. Manure value by nutrient (dollars per acre) <i>Multiply line 8 by line 9.</i>			\$39.37	\$47.02	\$42.12
11. Manure value per acre (dollars per acre) <i>Sum the values in line 10.</i>	\$39.37 + \$47.02 + \$42.12 = \$129.51				
12. Manure value per unit of manure (dollars per ton or per 1,000 gallons)	\$129.51 ÷ 2.7 = \$47.97				

<sup>1</sup>Inorganic N is also called ammonia N.

<sup>2</sup>Inorganic N availability can range from 0.20 for surface-applied manure to 1.0 for incorporated manure. Organic N availability ranges from 0.25 to 0.6 in the year of application, depending on manure type. Missouri Department of Natural Resources (MDNR) regulations may stipulate that certain availability coefficients be used for MDNR-permitted waste facilities.

<sup>3</sup>Add available inorganic N and organic N in line 3 to determine available total N in line 3.

<sup>4</sup>Select from line 5 the quantity of manure to be applied per acre based on whether you want to meet the N, P or K needs of the crop. If you want to meet or exceed all crop nutrient needs, select the highest value in line 5.

## Comments

Poultry litter was surface applied to ground that is to be planted in corn. enough poultry litter was applied to meet the  $K_2O$  requirements of the corn and subsequent soybean crop. This manure would have a value of \$129.51 per acre if applied at 2.7 tons per acre. The value per ton would be \$47.97 ( $\$129.51 \text{ per acre} \div 2.7 \text{ tons per acre}$ ).

In this example, manure is applied to meet  $K_2O$  requirements of the crop. Consequently, N is underapplied and additional fertilizer N will be needed. The crop requires 165 pounds of N per acre; we will apply 87 pounds N per acre. The crop will need 78 pounds additional fertilizer N per acre ( $165 - 87 = 78$ ).

In this example, applying manure to meet the  $K_2O$  requirements of the crop results in applying substantially more  $P_2O_5$  than is needed as indicated by soil test. Excess  $P_2O_5$  in the manure does not contribute to the value of the manure because the nutrients are not required for crop growth.

## Additional information

Farmers can estimate the value of their manure by using the Manure Value Estimator spreadsheet tool (<https://extensiondata.missouri.edu/Pro/Swine/Docs/ManureValueEstimator.xlsx>).