

Determining Manure Value

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Background

Manure handling and storage is a necessity and a given in a modern livestock operation. Manure storage is designed to collect and store the manure so as to not interfere with efficient livestock production and to comply with manure storage and handling regulations that are placed upon the operation. Though there is some interest in alternative uses for manure such as energy production, currently almost all manure is used to supply nutrients for crop production. Over time this needed removal from storage has moved from a waste disposal context to a fertilizer replacement focus.

Increased Interest in Manure for Fertilizer

The increasing price of commercial fertilizer has heightened interest in the use of livestock manure for supplying crop nutrients and has significantly increased the value of manure as a nutrient source. Also, some research and much anecdotal evidence suggests that manure results in superior yields when compared to commercial fertilizer providing similar nutrient levels, especially on fields that do not have a manure application history.

Increased Interest in Determining Manure Value

More producers have been considering the contribution of manure value to cash flow in livestock operation budgets, and seeking an appropriate market value in exchange situations between livestock producers and crop producers. More crop producers also appear to be seeking livestock manure as a major nutrient source, either by purchasing from a livestock producer or by adding livestock (particularly swine finishing) to their operations. Often contract swine finishing opportunities emphasize the value of manure as a feature.

Basic Methodology

The key to determining manure value is to adhere to sound economic principles. A crop producer who adheres to the cost minimization principle would be likely to base the value of manure nutrients (N, P₂O₅, K₂O, and micronutrients) on the cost of the fertilizer nutrients that would have otherwise been purchased in a commercial fertilizer based program. In addition, adjustments can be made for factors that will result in economic impact as a result of the manure application. These factors are yield impacts (usually positive), tillage replacement impacts (usually positive), and weed control costs (usually negative). Yield impact is thought to be the most significant of these factors. After a gross value is determined on a per acres basis a net value is determined by subtracting the per acre application cost. After a per acre financial impact is calculated, additional analysis can be done per barn, per field, per animal or animal space, etc.

Manure Value Determinations Can Be Complex Due to Many Variables

Determining the economic value of the nutrients in livestock manure can be complex. Nutrients in commercial fertilizer are acquired by paying for the nutrients and a small application charge. With manure you, in effect, "acquire" nutrients by paying for the cost of application, even if you already have ownership of the manure in a storage structure. Additionally, commercial fertilizer supplies the amount and ratio of nutrients you need or ordered. With manure, you get the amount and ratio of nutrients that the manure contains even if different from the ratio you need, which complicates the determination of a value. Even when a rate that supplies the correct amount of nitrogen is applied, the amount of phosphorous and potash applied may not match what you would have purchased commercially, and amounts applied above crop need probably have no value. From a nutrient replacement context, only nutrients that are replacing something you would buy with commercial otherwise have value. In the past, manure application costs often exceeded the value of the nutrients applied. Now, in many situations, the nutrient value in the manure exceeds the cost of application. A formula that estimates manure value can be described by:

Net Economic Impact of Manure =

Value of Year 1 Fertilizer & Application Costs Replaced (N, P₂O₅, K₂O, and micronutrients)

+ Residual Value (Mostly Year 2 if any, of nutrients that would have been purchased)

+/- Non- NPK Yield Response (and possibly tillage impacts and weed control impacts)

- Manure Application Costs

The most significant factors are *Value of Year 1 Fertilizer & Application Costs Replaced*, *Non- NPK Yield Response*, and *Manure Application Costs*. However, as indicated in the above formula, some producers might want to also consider factors like tillage cost reduced by manure application or need for greater weed control after manure application. Micro nutrient contributions should only be considered if micronutrients were going to be purchased but are supplied by the manure instead. As mentioned above, manure value can be calculated on a per acre applied basis, per unit of weight or volume, per storage unit, or per operation. The value will vary widely, influenced by factors such as the amount of N, P₂O₅, and K₂O required per acre by the crop, manure nutrient concentration in the manure, application rate, potential yield response attributed to manure beyond N-P-K application, and application cost per ton or gallon. The same manure in terms of nutrient concentration can have widely differing value depending on crop need and accuracy of application.

Efficient Manure Nutrient Utilization is Key

Ultimately, maximum economic benefit from a given manure is derived from maximizing nutrient utilization efficiency, that is, not wasting available nutrients, as long as gains in percent of nutrients used are not eroded by increased application costs to get that

accomplished. Between manures, nutrient concentration is a major factor as it influences the cost to supply the needed nutrients. Nutrient ratio in a manure can also be a contributor to efficiency.

Some attempts to determine manure value start by giving a value to all available nutrients in the manure but never consider that many of these nutrients are not needed by the crop and are not replacing something that would be purchased. This approach will over value manure.

Challenges/Observations

From an economic view, manure value is based on giving value to nutrients your crop needs and that you would purchase if in a commercial fertilizer program. Adjustments for yield and logistics can also be considered before subtracting application cost to reach a net value. However, an agronomic issue that will influence value calculations is whether crop removal or recommended rates are used to make this crop need determination. Many land grant soil scientists and agronomists suggest using soil test based recommended rates over crop removal. This is particularly true for phosphate and potash. If fertility levels in the soil test medium to high, most manure will have some levels beyond what is deemed as needed and thus will not have value.

A second, and related issue has to do with second (and later) year credits. Some approaches value all nutrients, suggesting a 4-5 year crop removal time frame. Again, if P_2O_5 and K_2O were to be purchased in year 2, and are not because manure applied for year 1 had sufficient extra nutrients for year 2, some rationalize that this value can be added to the year one application. However, it is more accurate to take a soil test in following years (2-5) and apply based on the soil test result. The soil is not necessarily a bank of available nutrients from which you can add or subtract on a one to one basis. Even though those extra nutrients are present, various soil properties will determine the amount of P_2O_5 and K_2O that is available in those years. If that subsequent soil test shows a significant increase in soil test levels, to the extent that subsequent fertilizer rates can be reduced, the manure application will actually have a value. However, it is very difficult to make that prediction with any accuracy at the time of the application..

Producers are strongly urged to make calculations based on their own situations. However, some "thumb rules" for liquid swine manure can provide guidelines if one is assured that application rate will be based on the recommended nitrogen rate and that application costs are approximately \$0.01 per gallon. For "weak" manure (about 25 pounds N/1000 gal.) and a nitrogen-only crop need the manure value is often about 50-60% of application cost. For "hot" finishing barn manure (50-60 pounds N/1000 gallons) and a nitrogen-only crop need (fields that have high soil test levels of P_2O_5 and K_2O) the manure value is reduced by about \$25 per acre and may still modestly exceed manure application cost. For "hot" finishing barn manure and fields that need both nitrogen and moderate P_2O_5 and K_2O levels the total value can be significantly above the cost of application. The nitrogen rates in the above examples would be typical for a corn crop.

Solid manure is influenced by the same issues of nutrient concentration, crop need, etc. However, the less dense nutrient concentration of most cattle manures makes it more challenging to accumulate gross value that will exceed application cost. An exception is most poultry manure which has high nutrient density and can be very cost effective when applied at agronomic rates.

Manure Application Costs

When liquid manure is applied by a commercial applicator the application cost is usually already in a cost per gallon format, or a form where that conversion can be made (like total gallons pumped and total pumping costs, possibly determined by a per hour charge). This conversion to a ton cost is usually more difficult for solid manure where billing may be on a per load or per hour basis and only total loads might be reported. In that case an estimate of load weight, or if possible, some sample weighing of loads must be used to estimate tons hauled. When the operator owns their own equipment, with either liquid or solid, programs do exist to help estimate application costs, again based on machinery ownership costs, labor, fuel, etc.

Phytase in Swine Diets

The use of phytase in swine diets and its impact on manure value is also a current hot discussion item. Many seem to be concerned about the reduced phosphorous levels in the manure. However, typical nitrogen based application rates of about 3500 gallons of manure per acre (swine finishing manure) will still supply phosphorous additions of 55-70 pounds per acre, even if the P_2O_5 level in the manure is only 20 pounds per 1000 gallons. University of Minnesota recommended P_2O_5 application rates for corn do not suggest more than those amounts unless soil test levels are in the low or very low range. Thus, many fields, especially those that have received manure in the past, should not be negatively affected by this practice and the feed cost savings will not be lost in reduced fertilizer replacement value. However, in the past several years some manure tests are reporting even lower levels of P_2O_5 , as low as 7-10 pounds per 1000 gallons.

Manure Value Calculation Tools

A spreadsheet that considers first year fertilizer replacement value, possible residual value, and yield impacts, along with application cost, will calculate net manure value for interested producers, consultants, etc. based on their situations. It is available at <http://swroc.coafes.umn.edu/Bob/docs/manurwkst.htm>.

This template is supported with a significant directions section and with comment boxes.

In addition, for those seeking a more systematic analysis, manurcst.xls is available. This approach calculates fertilizer replacement value in a manner similar to manurwkst.xls but also calculates application costs based on machinery ownership costs, labor, fuel, etc. It is more complex to use and available from the authors.

Related References

The topic of soil phosphorus chemistry is complex and attitudes toward crop yield response is varied . Two references are listed. A paragraph from the first is shown that briefly gives an overview.

- 1) <http://www.soil.ncsu.edu/publications/Soilfacts/AG-439-16/#Phosphorus>

Zublena, J. P, Nutrient Removal by Crops in North Carolina, Extension Soil Science Specialist, North Carolina Cooperative Extension Service, Publication AG-439-16 March 1991 (TMD)

“Much of the phosphorus added to soil is "fixed" by chemical reactions with iron, aluminum, and calcium and becomes unavailable for uptake by crops. The quantity of phosphorus available to plants is much smaller than the total quantity of phosphorus in the soil. This amount can be determined only through soil tests. The quantity of available phosphorus in soils is the fraction that is affected by plant removal.”

- 2) <http://www.extension.umn.edu/cropenews/2004/04MNCN34.htm>

Rehm, George, Fertilizing when Soil Test Phosphorus Values are in the Medium Range, Extension Soil Scientist, Department of Soil, Water, and Climate, University of Minnesota, Minnesota Crop eNews, October 4, 2004.

Results show, with commercial phosphate fertilization, that with soils starting in the medium testing range for phosphorous there was no yield difference in corn or soybeans resulting from application at crop removal rates versus U of M recommended rates. Crop removal rates did result in increased soil test phosphorus levels.