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Managing Livestock Manure

If proper manure management practices are followed, animal wastes can be utilized as a valuable nutrient resource rather than treated as a waste. Manure is an excellent "organic" fertilizer containing nitrogen (N), phosphorus (P), potassium (K) and many other essential nutrients.

Manure can physically benefit the soil. It adds organic matter to the soil, which improves soil tilth and structure.

Because manure is "organic," there is a perception that manure cannot be harmful to soils or the environment. There is no question that adding modest amounts of manure to soil is very beneficial. However, too much of a good thing over time could lead to problems.

A proactive approach to manure management will ensure the sustainability of farms and the environment

Background

Livestock manure is receiving increasing public attention since the general public regards ground and surface water quality degradation from agricultural sources as an increasing environmental problem.

Excessive applications of manure, applied repeatedly over a period of years, will eventually result in nutrient overloading in soil. Nutrient overloading, poor handling or poor timing of manure applications could lead to contamination of ground and surface water with nutrients and possibly pathogenic microorganisms.

Odors from heavily manured fields reduce air quality. Manure also contains variable amounts of soluble salts and trace elements. A combination of these factors can lead to environmental problems when manure is mismanaged.

Beneficial management practices

To prevent problems from developing, intensive livestock operators must use best manure management practices (BMP). It is very important to remember that BMP's will vary from farm to farm, depending on a number of factors:

- climatic zone of the farm
- type and number of animals in confinement
- total amount of manure produced
- how the manure is handled, stored and applied
- amount of land available to apply manure
- soil types on the farm
- types of crops grown
- crop yield potential

BMP's need to be tailored to match the needs of each farm. Producers must take a proactive approach to manure management to ensure the sustainability of both the farm and the environment. Following a step-by-step approach is essential in planning best manure management practices for each farm.

Amount of manure produced

The place to start managing manure is to determine how much manure is produced by the livestock operation. The Alberta Agriculture book *Nutrient Management Planning Guide*, 2007, can provide general estimates of manure produced. However, the amounts produced vary considerably depending on methods of storage and handling.

The most accurate way to determine the amount of manure produced is to weigh every truckload of manure that leaves the operation. Alternately, and perhaps more practically, producers can use an average truck weight and then count the number of truckloads of manure removed.

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Manure storage

The next consideration is ensuring a suitable on-farm location to store manure. In the case of solid manure, storage is needed for up to six months while waiting for appropriate times to apply the manure onto fields.

The storage site must be on soil with very low permeability to prevent contaminants from seeping into the subsoil and eventually into the ground water. It is very important to ensure leachate from the manure piles cannot leave the storage area in surface runoff during periods of heavy rain or rapid snowmelt.

In the case of liquid manure storage, seepage from the containment area must be prevented. Line containment areas using flexible membranes or other approved types of impermeable material. In all cases, divert surface water runoff away from manure storage areas to prevent contamination of surface water.

Determine where and how much manure can be applied

The factors of "where to apply the manure" and "what rates to apply" require the greatest attention. These two factors go hand-in-hand and involve the following:

- identifying the fields where manure can be applied
- determining the acreage of each field
- soil testing each field

Soil sample each field to a depth of at least 2 feet (60 cm) and take depth samples at 0 to 6, 6 to 12 and 12 to 24 inches. Have samples analyzed at each depth for nitrate-nitrogen, phosphorus, potassium, sulphate-sulphur, pH and electrical conductivity.

Take 20 random sampling sites across each field to make up a composite soil sample for each depth. Ideally, each field should be analyzed each year, either in late fall or early spring.

This soil information is needed to identify which nutrients are deficient in each field. These deficiencies then determine how much of each nutrient must be added to the soil to ensure adequate levels for crop growth.

Ideally, soil sampling to a depth of 4 feet (1.2 metres) is recommended every few years to ensure that a nutrient leaching problem is not developing. If a leaching problem is recognized early, it can be dealt with before becoming a serious concern.

Representative manure samples should be taken each year and analyzed for **total** and **available nutrients**, specifically nitrogen, phosphorus and potassium. **Available nutrient** refers to an element that can be readily absorbed by growing plants. **Total** nutrient refers to an element in the soil or manure in both plant available and unavailable forms.

When determining manure application rates, available nutrients and the portion of the unavailable nutrients that will be released from manure in the year of application must be matched to crop nutrient requirements in each field.

Book values of typical nutrient levels can be obtained from the Natural Resource Conservation Board (see the *Agricultural Operations Practices Act – Manure Characteristics and Land Base Code*, September 2006 Edition). Remember that nutrient content of manure is highly variable, depending on source, feed and method of storage.

It is virtually impossible to apply manure to meet exact crop requirements for all nutrients. When manure is applied based on one nutrient, other nutrients either will be over or under applied.

To complicate the situation, nutrients such as nitrogen and phosphorus are contained in a number of different available and unavailable compounds in manure. The unavailable compounds break down and release nutrients at different rates over a period of years.

The problem is that the nutrient content of manure does not match the nutrient requirements of most crops. For example, if feedlot manure is applied to meet the nitrogen requirements of wheat or barley, phosphorus will be applied at approximately three to six times the rate of crop removal. Repeated applications over a period of years will result in a buildup of high soil phosphorus levels.

Most producers have applied manure based on nitrogen content, leading to a buildup of soil P. Some fields now exceed 400 lb/ac of available P in the top 6 inches of soil. This amount is equivalent to 1,770 lb/ac of 12-51-0 phosphate fertilizer.

To further complicate matters, the soil test does not measure the unavailable forms of P in the soil. Producers in this situation will have to take serious steps to draw down soil phosphorus levels and avoid manure or phosphate fertilizer application for a period of years.

Practices will have to change to draw down the soil P levels. For example, applying manure annually for five years of cereal silage to meet N requirements may have to be followed by four to six years of alfalfa to draw down the P soil levels. Another alternative is to apply manure to meet P crop requirements and supplement with nitrogen fertilizer. There is no single best answer.

Therefore, when developing a long-term manure management plan, producers have to decide whether to apply manure based on N or P content. In the long term, it is advisable to use phosphorus as the nutrient to match with crop removal rather than nitrogen.

For existing operations, this approach may mean expansion of the land base or working with adjacent farms to utilize all the manure produced by the intensive livestock operation. In addition, commercial nitrogen fertilizer may have to be added to make up the difference between what the crop requires and what is contained in the manure.

All the information gathered has to be put together to develop the manure management plans. Alberta Agriculture has developed a book called *Nutrient Management Planning Guide*, 2007, to assist producers with this exercise. Although the planning seems like a daunting exercise, it is essential in planning individual manure use programs and optimizing crop production.

In situations where intensive livestock producers do not have a large enough land base to utilize all manure produced, there is an opportunity to work with neighbors. Commercial fertilizer prices have dramatically increased over the past several years. One alternative is for neighbors near a feedlot or other type of intensive livestock operation to use manure to offset the dramatically rising cost of commercial fertilizers.

Determine when and how to best apply the manure

The decision as to when to apply manure is relatively easy. Obviously, manure cannot be spread during the growing season when annual crops are actively growing. Manure application onto perennial crops is not normally recommended due to a higher potential of runoff, the high losses of nitrogen into the atmosphere and the effect on air quality. The only exception is if liquid manure can be shanked directly into the soil.

Spreading manure onto frozen soils is not recommended due to the possibility of runoff problems from rapid snow melt, which can carry dissolved and solid manure particulate into surface waters, causing contamination.

When solid or liquid manure is applied, incorporate it into the soil the same day it is applied. Incorporation is critical to reduce nitrogen losses to the air and to prevent air quality concerns. The longer manure is left on the soil surface, the greater the nitrogen losses, which reduces the value of the manure as a nitrogen fertilizer (Table 1).

Also, the longer the manure is left on the soil surface, the greater the potential environmental concerns. Immediate incorporation of manure in soil prevents potential runoff. Apply manure in early spring or after harvest and before freeze-up in the fall.

Table 1. Approximate dry matter and fertilizer nutrient composition of various animal manures

Method of application	Type of waste	Nitrogen loss (%)*
Broadcast without cultivation	solid	21
	liquid	27
Broadcast with cultivation	solid	5
	liquid	5
Knifing	liquid	5
Irrigation	liquid	30

* Percent of total N in waste applied that was lost within four days after application

Source: *Sutton et al., Purdue Univ. 1D-101*.

The best management practice for liquid manure is to shank it directly into the soil. This practice has the advantages of minimizing nitrogen losses and avoiding air quality concerns. In very special cases, liquid manure could potentially be applied through an irrigation sprinkler system at very low application rates; however, extreme care is required to prevent surface water runoff and nitrogen losses to the air. Therefore, this approach is not normally a recommended practice.

Value of manure

It is difficult to put an exact value on manure because of the variability in nutrient content and because the nutrients are released over a period of years. Other benefits such as better soil tilth and reduced horsepower required to work the soil, are hard to quantify.

However, if the assumption is that commercial nitrogen (N), phosphate (P_2O_5) and potassium (K_2O) fertilizers have values of $0.65, 0.60 and 0.40 per pound, respectively, and feedlot manure has a total N, P_2O_5 and K_2O content of 21, 18 and 26 lb, respectively, in each ton of manure, then the approximate value of 1 ton of feedlot manure is about $35.00. If manure is applied at 30 tons per acre, the value of nutrients applied in the manure would be about $1050.00/ac, the total amounts of added N, P_2O_5 and K_2O would be 630, 540 and 780 lb/ac, respectively.

Keep in mind, however, that in the case of feedlot manure, only about a third of the N and about half of the P would become available in the year of application. A 30 ton/ac application rate should provide enough P_2O_5 and K_2O to meet the requirements of an irrigated crop for 8 to 10 years. The only nutrient that would be required would be nitrogen fertilizer, several years after the initial manure application.

Producers within 10 to 15 km of a confined livestock operation should consider using manure as a fertilizer source. The potential to purchase manure by paying for delivery and spreading it has a double benefit. The confinement operator can dispose of extra manure, and a nearby neighbor has the advantage of an excellent source of fertilizer for the cost of transportation.

In addition, manure applied to eroded fields will also improve the physical quality of the soil. When neighboring farmers can take advantage of win-win situations like this, the whole agricultural community benefits.

For more detailed information, consult the book *Nutrient Management Planning Guide*, 2007, available from Alberta Agriculture by calling 1-800-292-5697.

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