What to Do with Excess Manure?

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Introduction

Manure and other agricultural by-products are valuable sources of nutrients and organic matter which are essential for healthy and productive soils. However, overapplying manure or other nutrient sources to cropland can be detrimental to the environment and public health as the nutrients can run off into surface water or leach into groundwater. This could lead to algae blooms in surface waters or pathogens and nitrates contaminating drinking water.

Role of the AEM Code

The Code of Practice for Agricultural Environmental Management (AEM Code) is the primary piece of legislation that governs manure application and storage requirements in BC. This factsheet focuses on the factors that affect land base requirements for your farm and how to manage excess manure nutrients.

The AEM Code regulates the storage and application of manure and other agricultural by-products on farms. All agricultural operations, from hobby farms to large commercial operations, need to follow the requirements of the AEM Code.

The same farming activities (ex. storage) will have different requirements or restrictions depending on the location of your farm. The regions with more constraints are known as "High-risk areas" and require greater care to ensure nutrients are not unintentionally released into the environment.

Learn more about high-risk areas here.

How Much Land Do I Need

While British Columbia has a significant land base, much of the manure is produced in localized areas of the province. Transporting liquid manure outside of the local area can be cost-prohibitive. The amount of land required by farms to safely apply manure is determined by several factors, with the number of animals on the farm operation being one of the most critical considerations.

Additional influencing factors for a farm include manure nutrient content, crop nutrient requirements, soil nutrient levels, and setbacks from watercourses.

Factors Affecting Manure Production

Herd/Flock Size

The amount of manure produced by an operation is directly related to herd or flock size. Construction and use of manure storage and application equipment should be based on predicted or current animal numbers. Proper storage and application of manure is essential for environmental sustainability, ensuring regulatory compliance, and making efficient use of a valuable resource for optimal crop production.

Over a 3-month period, a significant amount of manure can be produced, and manure storage structures can fill up more quickly when precipitation is taken into account. For every animal added to the herd/flock, manure storage will need to expand by the amounts shown in Table 1.

Table 1. Manure produced by various livestock over a 3-month period.

Livestock Type	3-month Manure Production, L (US Gal)
Milking Cow	6,750 (1,783)
Dry Cow	6,750 (1,783)
Heifer (15-26 months)	3,150 (832)
Beef - Finishing	2,547 (673)
Cow Calf Pair	3,060 (808)
Nursing Sow and Litter	2,115 (559)
Hog - Finishing	1,080 (285)
100 Layers	1,170 (309)

Covered vs Uncovered Storage

For farms with uncovered liquid manure storage in high-precipitation areas, precipitation over the fall and winter months can significantly reduce storage capacity and force farmers to search for alternative storage.

For example, if a 300-cow dairy in the Fraser Valley has a 15.2 m (50 ft) by 61 m (200 ft) x 3m (10 ft) uncovered manure storage, and the farm receives a typical 500 mm (20.7 in) of precipitation from November to January, storage capacity will be reduced by approximately 20 days.

While not always possible, covering existing storages or building new covered storages will reduce the overall volume of slurry needing to be managed.

Roof and Yard Runoff

Roof and yard runoff refers to the rainwater and snowmelt that flows from the roof of agricultural buildings or across animal yards. Runoff that has come into contact with contaminants, such as manure, can negatively impact water quality if it enters a watercourse.

Under the AEM Code, roof and yard runoff should be directed away from contamination sources. This may be achieved using gutters, downspouts, and proper drainage system to move the runoff away from areas with manure and other contaminants.

For runoff that has come into contact with manure or other contaminants, the AEM Code requires that it be contained and directed into manure storage. Minimizing contaminated runoff is important because every 10mm (0.4 in) of precipitation over 15 m^2 (~160 ft^2) of roof or yard area results in an additional 150 L (40 US Gal) that must be collected and stored. While not a large amount to manage for a single precipitation event, frequent and substantial precipitation events during the fall, winter, and spring months will reduce the amount of available storage space.

Factors Affecting Manure Storage

Application Windows
For farms in high-precipitation areas (regions that receive at least 600mm of precipitation from October 1st to April 30th), manure cannot be applied between November 1st and February 1st.

As a result, 3 months is the minimum recommended storage capacity producers should have to ensure manure application can be targeted for optimal crop growth and to avoid applying manure during the winter moratorium.

As farms in high-precipitation areas must complete an application risk assessment showing a 'Low' rating prior to manure application in October, February, and March, additional storage capacity over the three-month minimum recommendation is likely necessary.

Available Soil Nutrients & Crop Nutrient Requirements
The amount of supplemental nutrients a crop needs for optimal growth and yield is based on what is currently available in the soil. Soils with lower soil nutrient concentrations will need greater amounts of supplemental nutrients, while soils with greater soil nutrient concentrations will need little to no supplemental nutrients. Soil nutrient content can be determined by following the Soil Sampling Guidelines for British Columbia.

Supplemental nutrients are typically applied to crops as fertilizer, manure, or compost at rates based on their nutrient content.

Overapplication of nutrients can lead to the buildup of nutrients in the soil. This is particularly true for phosphorus, which may reach excessive concentrations in the soil from the frequent application of manure. Excess soil nutrients pose a threat to both water and crop quality.

The AEM Code regulates the application rates of both nitrogen (N) and phosphorus (P), described in (1) and (2) below, respectively, which may affect the amount of manure that can be applied.

(1) Under the AEM Code, the amount of available N from all sources, including the soil, must not exceed the crop(s) total N requirement for optimal growth and yield.

(2) Starting in 2024, fields that are included in a Nutrient Management Plan and have soil test P concentrations of 200 ppm (using the Kelowna extractant) or more will have limits on the total amount of P that can be applied ***to the affected field***. The limits are based on the amount of phosphorus (as P_2O_5) that the crop(s) remove plus an additional amount.

The threshold for soil test phosphorus and amount of phosphorus that can be applied ***to the affected field*** changes over the next five years:

- 2024: If soil test P is ≥ 200 ppm, producers can apply up to 80 lbs per acre (90 kg/ha) of total P_2O_5 more than the crop (or crops) remove per year;
- 2026: If soil test P is ≥ 100 ppm, producers can apply up to 80 lbs per acre (90 kg/ha) of total P_2O_5 more than the crop (or crops) remove per year;
- 2029: If soil test P is ≥ 100 ppm, producers can apply up to 36 lbs per acre (40 kg/ha) of total P_2O_5 more than the crop (or crops) remove per year.

In 2024, for example, a field with a silage corn crop that removes 75 lbs of P_2O_5/ac can receive up to 155 lbs of total P_2O_5/ac. This amounts to approximately 20,000 US Gallons/ac of liquid dairy manure. If a cover crop that removes 30 lbs of P_2O_5/ac were planted after a silage corn crop, the field could receive up to 185 lbs of total P_2O_5/ac, which amounts to approximately 24,000 US Gallons/ac of liquid dairy manure.

The amount of P_2O_5 removed by different crops is shown in Table 2 below.

Table 2. The annual amount of P_2O_5 removed by various crops.

Crop	P_2O_5 removal, kg P_2O_5/ha (lb P_2O_5/ac)
Alfalfa (3 cuts)	103 (92)
Annual ryegrass	34 (30)
Corn Silage	82 (73)
Fall rye	36 (32)
Forage Grass/Hay (4-5 cuts)	90 (80)

If manure application rates are increased so that total P_2O_5 applied exceeds the amount of crop P_2O_5 removed, ensure that the risk of P loss from the field is low using a P risk assessment, such as the BC P Index. Overapplication of P can lead to surface water contamination and affect crop quality.

Note that the limits on total P_2O_5 application rate described above applies to all fields that meet the relevant criteria, even if a P risk assessment shows a low risk of P loss.

Options for Excess Manure

Reduce P in Rations

Phosphorus is essential for the physiological and metabolic processes for all agricultural livestock. Phosphorus is a key element in energy transfer, as well as an important component of bones and teeth. In an effort to avoid phosphorus deficiency, dairy cows may be fed more phosphorus than they need. All P above an animal's requirement will be excreted in manure, increasing its P content and reducing the total amount that can be applied to land.

With improved estimates of P availability in feeds, combined with more precise analytical methods of feed/forage analysis, rations can be developed to decrease the amount of excess P in manure. The first step is determining how much phosphorus is in the feed. This can be done through feed tests on silage and hay in addition to the nutrient content information provided for grain.

The publication *Nutrient Requirements of Dairy Cattle* (NRC 2001) recommendations for lactating dairy cows range from 0.30 to 0.40% of the diet dry matter (DM), depending on milk production. Farmers should consult their nutritionists to discuss phosphorus requirements.

While not directly reducing the pressure of manure volume, reducing the P in rations will reduce the overall amount of P needing to be managed and allow for increased manure application rates. Additionally, increasing the rate of manure application will provide a greater amount of supplemental N, reducing the need for supplemental N fertilizer.

Increase Land Base
Another option to decrease manure and nutrient pressures would be to increase the land base to which to apply the nutrients to by leasing, renting, or purchasing additional land. However, in high population regions such as Metro Vancouver and the Fraser Valley, this is not always possible due to cost and availability.

In the process of obtaining additional land, it is important to understand how transportation costs can affect the economics of manure application. For example, if transporting manure to a newly acquired field increases application costs by 0.26 cents per liter (1 cent per US gallon), an application rate of 47 m^3 per hectare (5,000 US gallons per acre) would increase application costs by $124 per hectare ($50 per acre).

Export Manure
Another option to address excess manure is to export it off-farm. This may be done through a manure takeoff agreement where another producer could accept excess manure and apply it to their crops. While exporting manure as a "one-off" can work, having an agreement in place is advisable as it ensures each party has equal benefit and protections.

The AEM Code requires that producers keep records when distributing manure. When distributing 5 m^3 of manure or less, producers will need to record:

- Amount distributed
- Dates distribution started and ended, and
- The type of material distributed

If distributing more than 5 m^3, there are additional items to record in addition to those above:

- Receiver name and contact information
- Receipt must be signed by the receiver

Expand Manure Storage
Expanding existing manure storages may be required if the current storage capacity does not meet the farm's needs. In high precipitation areas (regions that receive at least 600 mm of precipitation from Oct 1 to April 30), a minimum storage capacity of 92 days is required to avoid spreading manure during the winter moratorium. An alternative and potentially cheaper option to expanding manure storage is to cover the storage with a roof. This would reduce the amount of liquid material to be handled and stored by reducing the overall volume of precipitation entering the storage.

However, it is important to note that expanding liquid manure storage does not reduce the overall amount of nutrients needing to be managed, and an appropriate land base or management plan will be required for applying or distributing manure.

The Beneficial Management Practices program provides cost-share funding for the expansion of manure storage facilities. More information can be found on the Beneficial Management Practices program webpage.

Solid/Liquid Separation
Separating raw dairy manure into a solid and liquid fraction has a number of benefits, including, but not limited to:

- Easier to pump and spread liquid manure on fields,
- Reduces the volume of solids settling in slurry storage, extending time between cleanouts, and
- Separated dairy solids can be transported and applied further than liquid manure, reducing the overall need for N fertilizers.

Over 85% of P in unprocessed liquid manure, otherwise known as manure slurry, is attached to the solid portion of the slurry. There are a number of manure processing technologies that can be used to separate the solid and liquid portions of dairy manure, thereby reducing the amount of P in liquid manure. The solid material is easier to manage or transport off-farm, while a greater amount of liquid manure can be applied on-farm due to reductions in manure P content.

Some of the most common types of manure processing technologies are roller and screw presses. Both types of presses separate the solid and liquid portions of the manure by squeezing out the water, producing separated solids that are about 20% dry matter. However, these presses aren't designed to recover nutrients and only recover approximately 15 – 20% of the manure total N and P in the separated solids.

While more expensive, centrifuges are designed to both separate solid and liquid manure and recover nutrients, particularly P. In the 2017 Nutrient Recovery Study, centrifuges were able to reliably recover approximately 50% of the P from the manure slurry in the separated solids.

You can learn more about manure processing technologies on the Ministry of Agriculture and Food's nutrient recovery webpage.

The Beneficial Management Practices program provides cost-share funding for the implementation of nutrient recovery technologies. More information can be found on the Beneficial Management Practices program webpage.

Composting
Composting solid manure, from a manure management perspective, can be helpful through the reduction of weed seeds, parasites, pesticide residues, and odours. The composting process also reduces the volume of material to be managed by 30-50%, which makes it more economical to transport.

You can learn more about composting on the Ministry of Agriculture and Food's agricultural composting webpage.

The Beneficial Management Practices program provides cost-share funding for the composting of agricultural wastes. More information can be found on the Beneficial Management Practices program webpage.

Resources

Beneficial Management Practices Program

https://bit.ly/3yZSLlY

Composting

https://bit.ly/4ci0VV1

High-risk areas

https://bit.ly/4bYHxfV

Nutrient Management Plans

https://bit.ly/4c0eAjS

Nutrient recovery

https://bit.ly/3VnIVSl

Soil sampling guidelines

https://bit.ly/3XfuwdA

For more information about manure or nutrients management, or any programs operated by the Ministry of Agriculture and Food, please reach out by email or phone.

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