

Manure Management Planning for Small Farms

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Why Manure Management?

Proper management of manure will improve sanitation on your farm, reduce odors and diseases to you and your animals, and allow for beneficial use of the nutrients in the manure. Manure contains many needed nutrients and organic matter, which helps improve our soil. Proper management of your manure will not only reduce the need to buy fertilizers and help protect the environment, it will also reduce pest problems, neighbor complaints, and prevent violations from the State or EPA.

Calculating Manure Production

Manure management begins with determining how much manure is produced on your farm per season. Different animals produce varying amounts of manure. Manure production averages by volume and lbs. can be found in Table 1.

Table 1. Average Daily Manure Production and Size of Various Livestock

Livestock Type	Avg. wt. (lbs.)	ft ³ /day/1000 lbs. animal	lb./day
Dairy, milking	88	1.89	150
Beef cow	750-1,250	1.7	64
Swine, grower	154	1.1	10
Swine, gestating sow	440	0.41	11
Poultry	2.6	0.93	0.23
Sheep	100	0.63	1.05
Horse	1,100	0.83	57

(Koenig et al., 2013; Fronczak et al., 2020)

Your farm's manure volume can be calculated by using the following equation:

$$\text{Manure Volume (ft}^3\text{)} = \text{No. Livestock} \times \text{Avg. wt. (lbs.)} \div 1000 \times \text{Days} \times \text{Production Value (Table 1)}$$

This should be calculated for each breed of animal you raise, and then totaled. Calculate based on 365 days per year or per growing season. If your animal numbers fluctuate each month, you can calculate your monthly manure production and add the months.

The weight of your manure produced on your farm can also be calculated using the following equation:

$$\text{Overall manure wt. (lbs./time)} = \text{No. Livestock} \times \text{lb./day (Table 1)} \times \text{Days}$$

Example:

You have 20 broilers with an average growing period of 48 days, growing 5 flocks per year.

$$20 \text{ poultry} \times 2.6 \text{ lbs.} \div 1000 \times 48 \text{ days} \times 5 \text{ flocks} \times 0.93 \text{ ft}^3/\text{day}/1000 \text{ lbs. of animal} =$$

$$11.61 \text{ ft}^3 \text{ of poultry manure / year}$$

Or

$$20 \text{ poultry} \times 0.23 \text{ lbs./day} \times 48 \text{ days} \times 5 =$$

$$1,104 \text{ lbs. poultry manure / year}$$

Manure Collection

Collecting manure starts with how your animals are contained. Are they in a barn, cage, or free-range pasture? If they are pasture, manure is directly applied to the field, though unevenly. This is the lowest management option but has reduced nutrient benefits. These nutrients should still be accounted for in your fertilization plan of that field. Housed animals such as those in a dry lot, shed,

stall, exercise/turnout lot, or riding arena will have their manure gathered to be stored for later use at regular time intervals according to your need.

Manure Storage

Once manure is gathered, it needs to be stored safely until it is time to use it. The goal of manure storage is to prevent water running onto and off of the pile. It can also help reduce gas emissions such as ammonia and methane. Reducing runoff and gas output will increase the nutrients that you retain in your manure for later use, saving you money in fertilizer costs. This will also prevent ecological damage from nutrient contamination into streams, groundwater, and the air.

Options

Solid manure storage is usually in piles. These piles should be on a concrete pad, asphalt, or packed dirt. Do not place a manure pile on gravel or sand as significant nutrient loss may occur through leaching. If possible, add walls and a covering to your manure pile. Berms and buffer strips can also be used to contain and direct runoff away from your manure pile and bodies of fresh water. Smaller manure volumes may be stored in ringed heaps, bins, or barrels. Open sided sheds help contain the manure and prevent extra moisture from getting on the manure

Liquid manures may need to be stored in tanks or basins with clay, plastic, or concrete liners.

Location

Consider the location of your manure storage. Locate your manure storage somewhere convenient and accessible to where the manure is produced. It should be accessible year round, and not have any water running onto the manure, or any manure pile runoff.

Keep piles out of sight of neighbors to avoid complaints. Distance away from property lines and residences according to local ordinances, approximately 50' from fencing and 200' from buildings. Manure storage must be 100' away from wells, streams, and ponds or greater depending on municipality and/or state guidelines.

Size

Manure storage size can be determined by calculating your total manure volume produced between applications.

$$Capacity = Length \times Width \times Height = Manure Volume (ft^3/time period)$$

How often will materials likely be removed? Do you fertilize fields every month, 6 months, or yearly? If you have a smaller plot of land and a high volume of manure, consider how you might dispose of, or share, the excess. You will want to build a structure with 20% excess space to your expected capacity.

Additional considerations should be made regarding equipment used to transport manure to and from storage. If composting manure, equipment will be necessary to turn the piles throughout the process. Don't forget to leave clearance!

Winter Storage

At a minimum, you will need manure storage adequate to sustain you during the winter months when application of manure to a field is not an option. Table 2 outlines the number of days to plan for your winter storage volume, based on climates in Utah. Calculate your manure storage during these days to determine how large of a manure storage is required.

Table 2. Utah Winter Storage Periods

No. Days of Storage	Location, Climate Similar to:
150	Randolph, Tabiona
120	Manti, Logan, Heber, Roosevelt
90	Cedar City, Delta, Ogden
45	Kanab

(Koenig et al., 2013)

Temporary run off catch basins are also a good idea when considering large weather events in

winter. Berms, and hay, straw, or other absorbative materials can also be placed around the pile to contain and/or absorb small amounts of liquid. Remember to prevent any runoff from leaving your property or getting to a water of the state.

Management Practices

Composting Manure

Composting of manure is a beneficial treatment technique which can reduce the manure volume by half, breaks down bedding material, and stabilizes nutrients for plant use. Pathogens and many weed seeds are killed during the composting process. This makes it easier to safely sell or share excess manure. Composting also reduces odors, flies, and dust, which will reduce neighbor complaints. Spreading raw manure on fields can introduce parasites and weed seed and is not recommended.

Active composting is the processing of organic matter by aerobic microorganisms into a stable humus material. Compost piles should be maintained at a temperature between 120-160°F and must be at a minimum 3 ft³ to maintain required heat. Too hot of a pile will kill microorganisms and stop the composting process, whereas a pile that is too cold will not kill the weed seeds and pathogens. Compost piles should be turned to incorporate oxygen and keep the aerobic bacteria alive. Aim for a moisture content of 40-60% -- feels like a damp sponge. Turn if too wet and add water if too dry.

Compost requires a C:N ratio C:N ratio of 25-30:1. A good rule of thumb is 3-4 scoops of manure for every 1 scoop of bedding material.

Movement and Application

Manure must be moved to and from the storage area and to the field. Ensure you have adequate pathways to navigate. Additionally, consider what equipment you will use to spread manure or compost onto the field. Solid manure may use a box spreader, semi-solids a flail spreader, and slurries or liquids can be spread via tanks and sprayers. Equipment should be calibrated to

output the correct application quantity for your nutrient management plan.

Manure applications should be incorporated within 3 days. If within 150 feet of surface waters or in areas subject to flooding, incorporate within 48 hrs. For perennial crops and no-till where incorporation is not an option, be aware that more nitrogen will be lost due to volatilization. Take extra precautions to prevent runoff in these situations.

Prevent Runoff

Preventing runoff of manure into waterways is crucial to good land stewardship. If your field has sloping ground >6%, do not apply manure. Consider weather forecasts when planning manure applications and do not apply right before rain or snow events. Additionally, do not apply in winter. Saturated or frozen ground will not incorporate manure nutrients. If absolutely essential to apply in winter, check [Utah Manure Application Risk Index \(UMARI\)](#) to determine if it is legal in your area on that day.

Analyze Soil and Manure

How does one determine how much manure to apply to a field? First, one needs to determine the nutrient content of the manure and the nutrient content of the soil where you will apply the manure. For the manure one can use an average nutrient value (see Table 3), but it is better to have the manure tested to get more accurate values. A soil test should be taken to determine the nutrients in the soil. Manure and soil samples can be tested at the USU Analytical labs: <https://www.usu.edu/analytical-laboratories/>. Read their instructions for appropriate sampling technique.

Table 3. Nutrient Value of Manures

Pounds per Ton			
Animal	N	P ₂ O ₅	K ₂ O
Beef	11.3	8.4	9.5
Chicken	27.3	23.5	13.2
Goat	22.0	5.4	15.1
Horse	12.1	4.6	9.0
Sheep	22.5	7.6	19.5

(book values, values may vary)

Determine your nutrient needs based on the crop that will be grown and the results of your soil test. Previous legume crop and manure applications need to be taken into account to avoid overfertilizing. Using the nutrients needed, you can then determine the amount of manure you can apply per acre.

Manure application may be limited based on the phosphorus levels of your soil test report.

0-50ppm – N or P needs of the plant
50-100 ppm – P needs of the plant
100-150 ppm – 50% of P needs of the plant
>150ppm – NO MANURE APPLICATION

The amount of manure to fulfill that requirement can be calculated using your manure test report or by using the values in table 3.

If additional nutrients are needed for plant growth, subtract the amount of a nutrient applied via your manure, and supplement with other fertilizers.

Without large amounts of land, you will likely have excess manure after fulfilling your field nutrient needs. Manure should not be applied in excess as this overloads the soil with phosphorous (and salt), creating environmental contamination and soil imbalances. Alternative uses for excess manure include: 1) selling or giving the manure away (a manure test report should be provided to the recipient of the manure); 2) change your cropping system to use more nutrients; or 3) manage your livestock feed to reduce nutrients excreted.

Odor & Pest Management

If in a populated area, managing the smell of manure application can be crucial to creating good neighbor relations. Spreading manure during the week and in the morning, can help as fewer people will be home and the warm air rising can help carry odors away. Additionally, quick incorporation will greatly reduce the time odors persist. Avoid applying on weekends, holidays, and on days when wind drifts towards residential areas to prevent complaints. Tree wind breaks and help force the odors upwards, and notifying neighbors of when you plan to spread are odor management techniques.

Flies are another common nuisance. Composting is an effective way to control fly populations as the heating process also kills fly larvae. Biological predators are another option. Keeping the manure pile aerated with good drainage can also help.

Other Considerations

If fields have a high ground table or are very permeable (i.e., sand, gravel), manure may not be the best practice as many of the nutrients will leach into the groundwater. Additionally, a farmer should manage irrigation efficiently to reduce nutrient loss into groundwater.

Grazing can be an option to reduce the need for manure storage, handling, and spreading. If so, one needs to make sure that there is adequate plant growth to utilize the nutrients. If livestock will have direct access to the water, it is imperative that “adequate and desirable vegetation” is present throughout the pasture. In general, that means the plants should be 4” or taller all the way to the edge of the water source.

Do not overfill loads when transporting manure. In the event of an emergency spill of manure, attempt to contain the spill and prevent its entry into human pathways and waterways. Dam the area using dirt, straw, or hay bales. Then contact the Utah Department of Environmental Quality. Documenting the spill and being up front will protect you from later issues.

Records and Record Keeping

Applications of manure and nutrient applications on fields is important for any farm, no matter the size. This can be simple and kept with your soil test reports and a written plan of your nutrient management strategy. Documentation should be filed each time you apply manure, and should include the:

- Date and time
- Weather (include wind direction, speed, and precipitation/wetness of the soil)
- Applicator name
- Location (including acreage)
- Application volume or weight
- Type of manure applied

References/Additional Resource

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Nutrient management plans (NMPs) are the method to determining yearly fertilizer needs and improving your farm's soil health and fertility. Developing an NMP will not only help you maximize profits but is important as a land steward who can reduce environmental pollutants. Small farms which raise animals have the added benefit of being able to fertilize with manure, which will improve soil organic matter, texture, water holding capacity, and overall soil fertility.