Protecting our Water

uality with Livestock Waste Management

Introduction

The key to whether animal wastes help or hinder a livestock operation lies in proper management of manure. Livestock manure can be a valuable resource by providing necessary nutrients for crops and improving a soil's physical properties However, manure can become an environmental problem when it pollutes ground and surface water as a result of improper handling and storage. Manure also can create conflict between producers and neighbors due to runoff or odor problems. Proper management can help producers use manure as a valuable resource and not become an irritating or harmful pollutant.

Streams and other bodies of water have the natural ability to self-purify, but they may become polluted if manure runoff enters them. The main pollution problems with manure in surface water are associated with the organic matter, nitrogen, and phosphorus in the manure.

When runoff from animal operations enters a stream, the dissolved oxygen level may drop below the critical level in the water. Oxygen reduction occurs because bacteria in water use oxygen as they decompose the organic matter in the manure. If too much oxygen is used for decomposition, the dissolved oxygen level can drop below acceptable levels for fish and other organisms in the stream.

The dissolved oxygen level is raised naturally by various physical methods, and by photosynthesis. Aeration occurs as water flows over falls or rapids, by absorption, by wind action, and by dilution from other water sources.

Another surface water quality problem is the high ammonia level in feedlot runoff, resulting in reduced growth and gill damage to fish. The ammonia also forms nitrites and nitrates as it is oxidized bacterially. Both forms of nitrogen pose problems in surface water. Nitrites can harm fish, and excessive concentrations of nitrate may cause blue baby syndrome, or methemoglobinemia. Pregnant women and children younger than six months of age should avoid drinking water with high levels of nitrates.

High phosphorus levels in manure also can cause water quality problems. Plants, especially algae, are encouraged by too much phosphorus, which leads to *eutrophication* of surface water. Decaying algae will deplete the water's dissolved oxygen level and lead to acute fish kills. Eutrophication affects ponds and lakes more than streams and rivers.

It is essential to prevent feed lot runoff from entering streams and other surface water, and to properly manage manure until this resource can be used as part of an effective crop fertility program. This publication addresses ways to handle problems in runoff, storage, and application of livestock manure. Whether the livestock operation is small or large, all three areas must be considered for effective, responsible management of livestock wastes.

Feedlot runoff control

Begin a good manure management program at the source of the wastes, the feedlot. One of the most important ways to prevent manure runoff is to divert clean water away from the feedlot. This reduces the amount of water contaminated by manure that needs to be handled.

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Water has the ability to lift and carry manure into drainage ditches, streams and ponds. The use of berms or terraces can divert clean roof and surface water around the feedlot. Eave troughs, gutters, or mono-sloped sheds do an excellent job of keeping roof water off the feedlot. In cases where clean water runoff cannot be diverted around the feedlot, a sump system with an underground tile outlet can be used above the feedlot.

All solids in feedlot runoff must be removed. A common m is a setting basin, shown i **Figure 1**. The basin usual is designed to handle runoff from a 10-year one-hour storm, that is, a shor high-intensity rainstorm expected to occur once every 10 years. In Iowa, such a storm would produce between 2.1 and 2.5 inches of rain per hour. A properly designed settling basin will collect all feedlot runoff and slow the velocity of the runoff so that larger solids can settle to the bottom of the basin. Some feedlots require only concrete or wood curbs around the lot to handle such a storm **(see Figures 2 and 2a)**

The settling basin should have a porous dam or perforated pipe that allows the liquids to flow out as the solids settle. Dams can be made of lumber with gaps between the boards, concrete with holes in it, or expanded metal screen. Manure tends to plug openings over time, so the dam must be constructed so that it can be cleaned occasionally. The basin should have a spillway so that water will not back up into feeders or buildings in case the porous dam cannot handle the flow.

In most areas of the state, the bottom of the basin should be lined with concrete rather than soil. This allows the solids on the bottom to be scraped up and hauled away more frequently than is possible in soil-lined basins.

Liquids that drain out of the basin can be either infiltrated or stored to keep them away from surface water. Never discharge effluent from settling basins directly into a tile line, stream, or sinkhole because of possible pollution to a nearby stream or water supply.

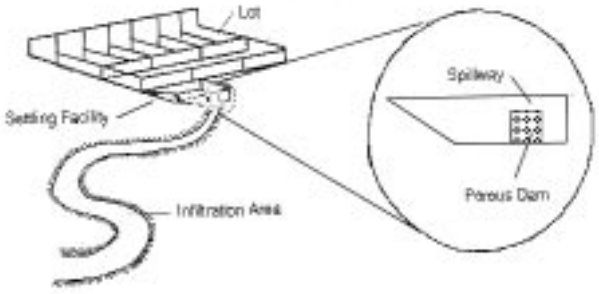

Fig. 1. Settling basin and infiltration area.

For most small lots (those that don't require runoff impoundment), effluent from a settling basin can be discharged into a vegetative infiltration area, usually a long, grassy, and gently sloping channel. This allows the liquid to soak slowly into the soil. The only water in this channel should be lot runoff that has gone through the settling basin, and direct precipitation. Do not use waterways that drain other surface water from a surrounding watershed. The volume of water is too great to allow enough time for the water to soak into the ground, and pollution in a nearby stream is possible.

If feedlot size or site conditions are such that an infiltration area cannot be used, liquids may be collected in a temporary holding pond. The contents usually are removed soon after a rainstorm to prevent overflow. Irrigation ɔment is often used to clean out holding ponds because of the large volume of liquid handled and the low concentration of nutrients.

Storage systems

Many livestock farmers select manure storage facilities that eliminate the need for daily hauling and allow timely application to row crops Properly designed systems also help reduce environmental problems associated with feedlot runoff.

Storage pits built under livestock buildings often are used in confinement operations. However, some producers prefer outside storage facilities because they usually can store more

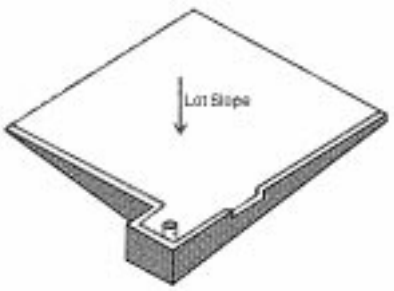

Fig. 2. Settling in corner of lot.

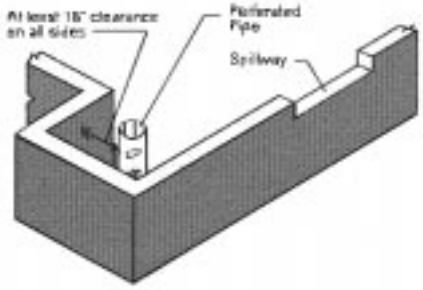

Fig. 2a. Perforated pipe and spillway.

manure and improve air quality inside the building. Adequate storage facilities allow producers to frequently scrape wastes off the lot so runoff losses are kept to a minimum, too.

Select a good location for storage facilities to reduce water quality and odor problems. Odors are strongest when the facility is emptied. Locate new livestock production sites and manure storage facilities as far away from neighboring resi- dences as possible and consider the direction of prevailing winds with respect to public use areas and residences.

Contact the nearest field office of the Iowa Department of Natural Resources for permit require- ments for manure storage facilities. There are minimum separation distance require- ments for earthen manure storage facilities. Dairy farmers should check with their milk inspector to determine other specific requirements. Generally, all manure storage facilities should be located at least 100 feet away from a well. Earthen storage basins and lagoons should be located as far as possible from a well.

When the site is chosen, evaluate soil conditions to help prevent groundwater contamination. Soil conditions below the storage area, and depth to bedrock will help determine whether the facility should be an earthen basin, a lined earthen basin or a concrete or steel structure. Use your county soil survey or check with your Soil Conservation Service office to get information on the suitability of your soil for construction.

Locate manure storage facilities for convenient filling and emptying. The storage facility should be adjacent to the feedlot if manure is to be scraped into it. The facility can be located some distance from the livestock if manure will be pumped or gravity-fed into storage. Easy, allweather access is essential, as is plenty of room for operation of large unloading equipment.

For liquid storage, the facility must have space around the perimeter for use of agitation equipment. Decay of manure produces a deadly gas, hydro- gen sulfide. Use extreme caution during agitation to prevent being overcome by this gas. **Never** *enter a manure pit until after agitation is complete and the pit has been ventilated. Always wear self-contained breathing tanks and an attached safety line. At least two people must be outside to pull you out if you have trouble.*

For safety, fence the entire storage facility from livestock and people. Keep the site neat to help reduce complaints from neighbors.

Carefully consider your economic situation, availability of appro- priate land and labor for spreading, and future expansion plans when you size your storage facility. A one-year storage capacity provides more opportunities for timely field applications than smaller capacities. It also allows for possible expansion of livestock numbers without building additional storage if a more frequent emptying schedule is used after expansion. The minimum storage provided for earthen storage should be six months and recommended minimum storage for other systems is four months.

Size the storage to include all manure produced, bedding, and any water that may enter the storage from runoff, snow-melt, milking center waste, waterer spillage. and water used for washing crates or equipment. Manure production can be estimated by using **Table 1 (back page).** For more information on sizing storage facilities, see the *Livestock Waste Facilities Handbook,* MWPS-18, from your county Extension office.

Application

An important part of manure management is proper appli- cation to row crops. To achieve the greatest benefit, producers must know how much manure to apply, when and where to apply it, and the best method to apply it without causing environmental problems

Poor application methods can result in the contamination of ground and surface water and inefficient use of nutrients. Surface runoff problems are reduced if the manure is incorporated during or shortly after application. Avoid surface application on frozen or snow- covered ground, near a stream or sinkhole, or on steep slopes.

Manure should be spread to maximize the benefits from its nitrogen, phosphorus, potas- sium, and organic matter. Test the soil to determine the amount of phosphorus and potassium required to reach a realistic yield goal. Apply enough manure to satisfy any of the three major nutrient requirements and supplement the other two with commercial fertilizers if needed.

Animal manure varies by animal, its age and diet. Test several representative manure samples

Table 1. Daily manure production.
Adapted from the 1990 ASAE Standards, D384.1.

	Animal size pounds	Total manure production lbs/day	cu ft/day	gal/day
Dairy Cattle	150	13	0.21	1.6
	250	22	0.35	2.6
	500	43	0.69	5.2
	1000	86	1.39	10.4
	1400	120	1.94	14.5
Beef Cattle	500	29	0.46	3.4
	750	44	0.69	5.2
	1000	58	0.92	6.9
	1200	73	1.15	8.6
Swine				
Nursery pig	35	2.9	0.047	0.35
Growing pig	65	5.5	0.088	0.66
Finishing pig	150	12.6	0.20	1.5
	200	16.8	0.27	2.0
Gestating sow*	275	11.6	0.19	1.4
Sow & litter*	375	39.5	0.64	4.8
Boar*	350	14.7	0.24	1.8

*Assumptions
Gestating sow = 1/2 of ASAE data for her weight because she is limit fed
Sow & litter = ASAE data for her weight + 8 pigs at 1.0 lb/day each pig
Boar = 1/2 of ASAE data for his weight because he is limit fed

to determine nutrient content. Too much manure can result In nitrates leaching into groundwater. Therefore, it is important to credit the nitrogen in the manure to avoid overapplication. The amount of nitrogen available from manure can vary greatly depending on how the manure is stored and spread. Approximately half of the nitrogen in liquid manure is in the ammonia form, which is subject to volatilization and can be lost to the atmosphere. Volatilization can be reduced by injecting manure, or incorporating it with tillage equipment immediately following application. Incorporation of manure also helps reduce odors.

It is often difficult to apply manure uniformly at an appropriate rate. Some producers want to save time when hauling manure, so they use it in fields close to farm buildings and spread it at high rates. However, this often results in overapplication, environmental damage, and it is an inefficient use of the valuable nutrients in the manure.

For more information about how to calculate the proper amount of manure for crops, see *Animal Manure: A Source of Crop Nutrients*, Pm-1164, or *Livestock Waste Facilities Handbook*, MWPS- 18, available at your county Extension office.

Summary
Use and management of livestock wastes create challenges for livestock producers. However, knowledge, proper procedures and facilities will help make livestock waste a manageable resource that can benefit livestock producers. Whether it's a help or hindrance, a problem or opportunity, is up to you.

This publication accompanies a series of video programs, Protecting Our Water Quality, available at county Extension and Soil Conservation Service offices. This publication was produced by Vincent J. McFadden, area Extension soil and water engineering specialist, and Stewart Melvin, Extension agricultural engineer; edited by Laura Miller and designed by Dennis Melchert, Extension communications specialists.

Illustrations used in this publication have been adapted with permission from ***Livestock Waste Facilities Handbook****, MWPS-18, 2nd ed., 1985, Midwest Plan Service, Ames, Iowa.*

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