ALABAMA A&M AND AUBURN UNIVERSITIES

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Animal Waste Management To Protect Water Quality

Animal Waste Management Systems

For an animal waste management system to effectively prevent pollution, every aspect of the system must be planned to protect water quality. In addition, the system must be designed to fit the needs, resources, and capabilities of the producer and the animal operation itself, and the system must be properly maintained and operated.

Options for animal waste management systems are constantly improving because waste-handling technology is changing rapidly. If producers can check periodically for new developments that will fit the purposes and resources of their individual operation, their waste management systems can effectively meet new environmental regulations that protect water quality.

An on-farm animal waste management system has five components: collection, transfer, storage, treatment, and application. Only the first four components are discussed here. Land application is discussed in another article in the water quality series.

Collection

Collection of animal waste from pens, lots, or houses is the first component of a waste management system. Collection methods vary, ranging from scraping to washing and flushing. Farm machinery and manual labor are commonly used in scraping. Scraping may also be accomplished by the installation of scrapers on cables. Regardless of the collection method, after animal waste is moved to a designated point, it is then transported for storage or treatment.

Transfer

Transfer of manure to storage or treatment involves the movement of the manure. Depending upon the system selected to handle the waste, this can be accomplished with cross-conveyors, augers, pumps, wagons, or manure spreaders.

Storage And Treatment

The most important decision in choosing a waste handling system is whether to store waste temporarily for later use or to treat waste for a longer period of time before disposal.

The objective of storing waste for later use is to conserve nutrients so the waste can be more effectively used as a fertilizer or soil conditioner. If stored too long, the manure breaks down (decomposes), nutrients are lost, and the fertilizer value of the waste will decrease.

The objective of waste treatment prior to disposal is to promote decomposition by storing wastes for long periods (6 months to 1 year or more). Decomposition lowers the concentration of nutrients so that the liquid portion can then be land-applied with less risk of over fertilization and pollution of streams through surface water runoff.

The type of storage or treatment system chosen will determine the amount of nutrients lost before land application. Nitrogen content of manures stored in lagoons can be reduced as much as 50 percent through dilution with water and through losses as ammonia gas and from denitrification. Losses of phosphorus and potassium range from 5 to 20 percent for all systems except the open lot and lagoon waste handling systems where losses can reach up to 70 percent for P and 60 percent for K. If the feedlot is covered and the manure is stored in a manure pack or deep compost pit, losses can be reduced.

Safety hazards exist with practically any waste handling system. Precautions must be exercised to prevent accidental entry into storage or treatment areas by other livestock, pets, and humans. Fences and gates should be installed to restrict access to the system, and warning signs should be posted. Pits should never be entered unless properly ventilated because gases formed during decomposition are extremely dangerous. Otherwise, entry should be only with a self-contained breathing apparatus and with properly attended lifelines.

Storage Ponds Or Pits. The most common storage facilities are storage ponds or concrete pits. These facilities are designed to store wastes for a relatively

short period of time (such as 60 days) before land application and to conserve nutrients that would be lost under treatment and decomposition. These storage facilities must have scheduled maintenance of the structure and spreading equipment is required to clean them out on a regular basis. The sludge and liquid mixture can be spread on land with a liquid manure spreader or irrigation equipment. This system requires a fairly small land area for holding the wastes, and the initial cost to construct it is low.

Dry Storage. Another storage method is dry storage, where the manure collects on litter at the ground level or under cages built on a "high rise" or second floor by some poultry operators. The floor is scraped and the waste is then stored temporarily before it is land applied. Fans are necessary to ventilate such houses to prevent vapors from accumulating.

Lagoons. The most common method for treating dairy, swine, and some poultry wastes is the lagoon. Lagoons are classified as liquid systems since they collect not only the manure but also the wastewater from washing areas, flush water, and rainfall on the lagoon surface. The addition of water for flushing may result in a four-fold increase in the volume of wastewater that a lagoon will have to handle. There are two types of lagoons—anaerobic and aerobic.

Anaerobic lagoons break down waste material without oxygen or aeration and can handle all wastes from a poultry layer hen operation with the exception of human waste. These lagoons should be constructed deep enough to promote anaerobic waste breakdown, and they require the addition of waste on a regular basis for the system to function effectively.

Aerobic lagoons break down waste material with oxygen provided by mechanical or natural aeration. This type of lagoon creates less odor than anaerobic lagoons when naturally aerated. Aerobic lagoons require more surface area, shallower depth, and regular additions of waste to function properly.

Both anaerobic and aerobic lagoons reduce the concentration of nutrients and, therefore, require less acreage for spreading. The reduction of solution phosphorus is as much as 90 percent through settling; the reduction of nitrogen is 60 to 90 percent through settling and biological breakdown. When properly designed, both types of lagoons allow disposal of the wastewater either by irrigation or by controlled gravity flow to a grass filter strip between the lagoon and stream. Both lagoon types accumulate solids or sludge in the bottom that must be periodically removed (every 10 to 15 years for anaerobic lagoons, more frequently for aerobic); these solids can then be land applied.

One type of lagoon that serves more for storage than treatment is shown in Figure 1. Wastes from the lagoon can be pumped directly to cropland or pastureland at regular intervals or further treated through wetland cells.

Best Management Practices for waste or wastewater retention structures include the following:

• The retention structure should be able to contain the solid wastes, the wastewater, and all rainfall and stormwater runoff from a 25-year, 24-hour frequency storm if the facility is outdoors.

• Manures and solid waste should be stored under a cover so as to be protected from rainfall especially

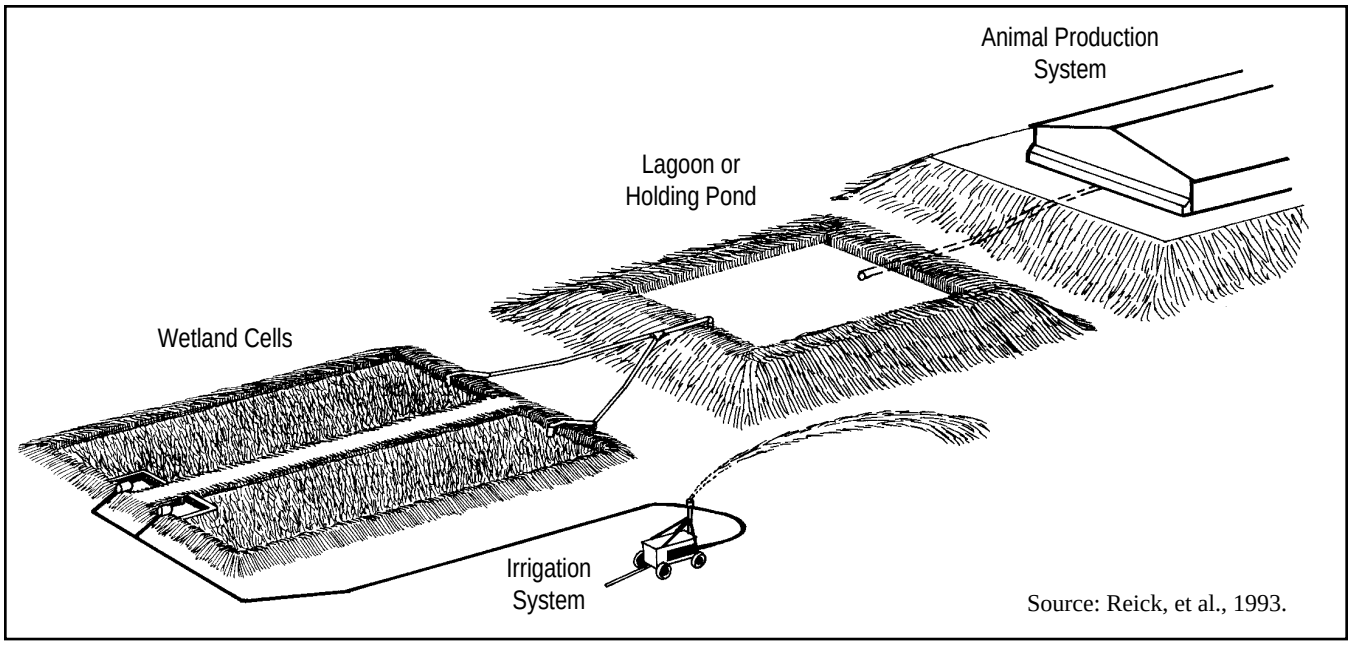

Figure 1. Example of lagoon and constructed wetland system for animal waste management

if facility runoff is not controlled. The cover may be a permanent structure or temporary cover such as plastic sheeting.

• The stored waste should be isolated from all stormwater runoff by dikes, terraces, berms, ditches, or other similar structures.

• The location of new structures should be based on the following site conditions: susceptibility to flooding or erosion, depth to groundwater, soil conditions, and climatic conditions. New structures should not be in a floodplain or a wetland.

• The following setback distances apply to new structures:

– 250 feet from private water wells.

– 500 feet from public water wells.

– 500 feet from property lines.

• Constructed basins or lagoons should meet certain design criteria including embankment wall width and slope, emergency spillway, and freeboard storage. Engineers with USDA Soil Conservation Service can provide this information.

Estimating Waste Storage Needs. Planning for new waste and wastewater storage or treatment structures means that producers may need to estimate how much waste will be generated. Table 1 gives estimated quantities of livestock and poultry manure produced yearly. These quantities are commonly used for calculating storage volume and equipment requirements and do not indicate quantities available for land application.

Other Ideas In Animal Waste Management

Converting To Silage. In intensive poultry production areas, where adequate land area is not available for application or incorporation into the soil, it may be necessary to implement alternative practices. Fresh poultry manure or broiler litter can be a component of ensiling mixtures or added to other silages. Poultry manure contains nitrogen as uric acid and ammonia which other animals can convert into protein.

A University of Georgia entomologist at Tifton, GA is studying the use of soldierflies to reduce manure volume by 50 percent from poultry caged layer-hen facilities. The larvae of the flies, which contain 42 percent crude protein, can then be fed to swine, poultry, or fish.

Drying Or Composting. Other alternatives for animal waste disposal may be drying for use as houseplant fertilizer or composting to produce an organic fertilizer. If the producer sells the waste to others, proper management will allow for a product that is higher in value to both the buyer and seller.

Dynamic Lifter of Danville, AL offers area growers free cleanout in exchange for their broiler litter. The company processes litter into fertilizer pellets, which it sells. The fertilizer usually carries an analysis of 3-4-2. The company also has plans for turning pelleted broiler litter into cattle feed. Other companies may soon follow suit in turning animal waste into income-producing products.

Table 1. Estimated Quantity Of Livestock And Poultry Manure Produced Yearly.

Animal Type	Manure Quantity[a]			Total Solids Content (Percent)
	Vol. Per Year (Gal.)	Weight Per Animal-Year (Ton)		
		Wet	Dry	
Dairy	3,614	14.94	1.89	12.7
Beef	1,614	6.70	0.77	1.6
Swine	548	2.38	0.21	9.2
Sheep	168	0.73	0.18	25.0
Layers[b]	986	3.86	0.96	25.0
Broilers[b]	657	2.62	0.65	25.0
Turkeys[b]	2,446	10.22	2.55	25.0

[a]The quantities are based on average animal weight as follows: dairy and beef, 1,000 lb; swine, 200 lb; sheep, 100 lb; layers, 4 lb; broilers, 2 lb; and turkeys, 10 lb. The quantities do not include bedding or other materials such as spilled feed, spoil, or water from precipitation. Neither do they reflect the decomposition processes that begin as soon as the manure is voided by the animal.

[b]Per one hundred birds.

Source: USDA and U.S. EPA. 1979.

Treating With Constructed Wetlands. Constructed wetlands wastewater treatment (WWT) systems cost one-tenth to one-half as much to build and operate as conventional systems, are simple to operate, provide reliable treatment to meet permit limitations under varying loading rates, and provide aesthetic and secondary benefits. Constructed wetlands, however, are limited in the waste load they can accept, and a sizeable land area with appropriate soils will be needed for very large animal operations. Water from wetlands must be recycled or applied to land since its discharge to streams has not been permitted. Figure 1 demonstrates how wetland cells may be used in conjunction with lagoons.

Disposing Of Dead Animals. Dead animals should be disposed of within 24 hours. Animals may be buried or composted in accordance with health department standards. If animals are buried, the site must be a minimum of 150 feet from any drainage way with a minimum of 3 feet of cover.

Composting is a very effective way to dispose of dead broilers or layers. Composting is a controlled natural process in which beneficial microorganisms reduce and transform organic wastes into a useful end product: compost. Thermophilic bacteria use nitrogenous and carboniferous materials (dead birds and manure, and straw, respectively) to synthesize bacterial biomass. In the process, bulk is reduced 35 to 40 percent, heat is generated, and water and carbon dioxide are released without offensive odors or noxious pests. When whole broiler chickens are incorporated into compost mixtures, their soft tissues are rapidly broken down and made soluble, leaving only bone and feather residues after 12 to 14 days of digestion. Refer to Circular ANR-580, "Poultry Waste Management Manual," for further details.

Animal Waste Management Systems In Alabama

Animal waste producers in Alabama include dairy, beef, hog, broiler, and layer operations. In a survey conducted by Auburn University's Department of Agricultural Economics and Rural Sociology, animal waste producers were asked about their animal waste management systems.

Collection. Only 55 percent of the beef operators reported a method for collecting waste on their farms. Of the other producers, more than 82 percent reported a collection component in their systems.

The collection components of the systems were rated highly by most of the sample. More than 90 percent of broiler operators gave high ratings to this aspect of their system, but only slightly more than 60 percent of the dairy and hog operators did so.

Transfer. About 86 percent of dairy operators had some mechanism for transferring manure to storage or treatment, as did 71 percent of the hog operators. Less than 45 percent of broiler and beef farms had such facilities.

More than 65 percent of the respondents gave high ratings to the transfer aspect of their systems. Almost 90 percent of the broiler operators gave good or better ratings.

Storage. More than 50 percent of the dairy and hog operations had waste storage systems for later use on the land; less than 50 percent of the other operations had waste storage systems. Dairy farmers were most concerned about the storage of animal waste for later use; only 40 percent rated this part of their facilities as good or better. About 65 percent of the remainder of the sample rated their waste storage systems as good or better.

Treatment. Hog and dairy operators were most likely to have some kind of facility for storing and treating animal waste. Almost 65 percent of the dairy operators had treatment facilities, as did 30 percent of the hog operations. Almost 80 percent of the beef operators reported no facilities. About 50 percent of the poultry operators had no system.

Lagoon and storage pond systems were commonly found on dairy and hog farms. Dairy farms were more likely to use lagoon complexes, whereas hog farmers were more likely to employ some type of storage pond arrangement. Broiler operators were more likely to store chicken waste within the building where the animals are confined. Almost half the dairy farmers reported other kinds of systems, often some type of concrete or block pit.

All the broiler operators rated their treatment system as good or better, but only 50 percent of the other operators felt the adequacy of their system was good or better. The treatment or biological reduction of animal manure was viewed as the most inadequate or vulnerable component of the animal waste management system by the respondents in this study.

A majority of all respondents reported that their facilities were not fully utilized. More than 33 percent of dairy and layer operators indicated that their facilities were at capacity. Dairy and hog farmers were most likely to report facilities receiving more waste than they were designed to handle.

Most operators disposed of their dead animals in an excavated or constructed pit while poultry operators were somewhat more likely to use incineration. Recently, poultry operators have begun to switch to composting.

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