What Is A Waste Management System?

Douglas W. Hamilton
Waste Management Specialist
Biosystems & Agricultural Engineering

All livestock farms have a system for managing manure—some are elaborate, others simple and others virtually non-existent—but all farms have some way of removing manure from animal housing and placing it where it is useful.

A system, by definition, is a set of **interdependent components** working together to perform **a task**. The components are interdependent because you cannot change one part of the system without affecting the other parts. We deal with systems every day. An automobile is a mechanical system. Its task is to get you where you need to go. The transmission is a component (or a subsystem) of the automobile system. The engine will still run without the transmission, but the car will not move. The manure handling system, like the automobile, also is a set of interdependent components or parts.

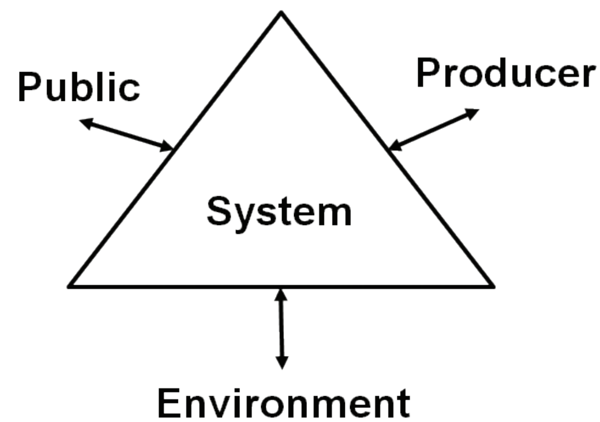

Figure 1. Three "clients" of a waste management system.

The Waste Management System's Task

The animal waste management system's task is to satisfy three "clients."

The Environment: The manure handling system prevents the farm from contaminating air, soil and water.

The Public: A well-managed system keeps neighbors from complaining about odor, noise and appearance of the farm.

The Producer: The waste management system makes the farmer's job easier, not more difficult.

Figure 1 shows the relationship among the three "clients." The double-headed arrows illustrate that the clients influence the system and the system influences the clients. For example, the system can impact the environment and the environment can impact the system. Temperature, rainfall, sunlight and wind all affect how the system operates. Manure handling has the potential to deliver organic matter and nutrient loads to the environment.

How a Waste Management System Performs Its Task

Figure 2 is a general schematic diagram of a manure handling system. The boxes represent components where actions take place. The arrows represent **Transport Operations** linking the components. Transport operations move material from one place to another. Notice, as in Figure 1, the transport arrows are double-headed. This means material can flow in both directions. Rain falling on a manure storage pond fills the pond. The overflowing pond pollutes the environment.

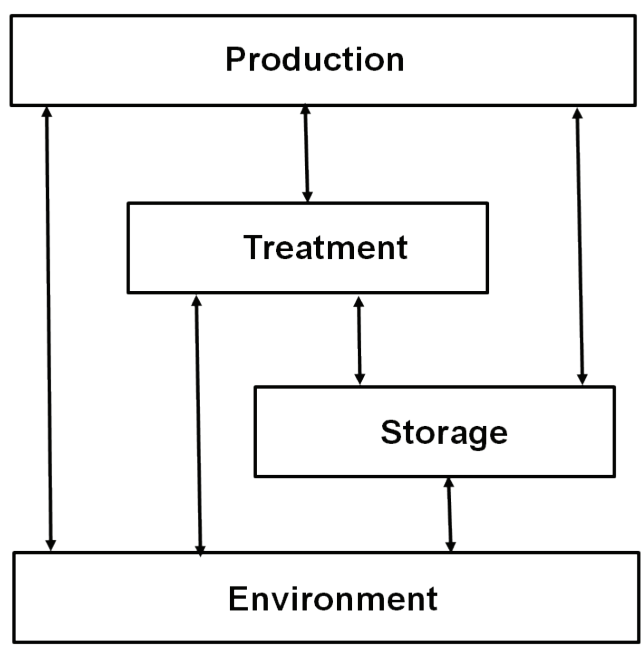

Figure 2. Animal waste management system schematic.

Properly designed components, linked by properly sized transport operations, make waste management systems extremely flexible. Let's look at the components and operations in more detail.

Production: Animals convert feed to feces and urine, but manure is not the only material produced in the system. Other waste volumes include: bedding, flush water, spilled feed and runoff. Careful management and regular equipment maintenance can reduce nonanimal sources of waste.

Storage: Storage is the system's shock absorber and adds flexibility. Storage allows the farm to temporarily hold material until the cropping cycle and field conditions are optimal for land application. Type of storage is determined by manure consistency and the intended use of the waste.

Treatment: Treatment components alter the volume or character of waste to improve handling, reuse, appearance or odor. Biological treatment components include lagoons, composters and anaerobic digesters. A solid separator is a physical treatment component. Chemical reactions also are part of treatment. Magnesium and alkalinity added to swine lagoon effluent increases precipitation of struvite, which is removed in a settling tank.

The Environment: Manure is too valuable a resource to throw away. Instead, think of recycling manure nutrients and organic matter back to the environment. Land application is the primary method of recycling. Spreading manure may improve soil water holding capacity and control erosion. It also greatly reduces the amount of commercial fertilizer required to grow a crop.

Transport Operations: A tipping bucket flushes manure from under a slatted floor to a lagoon. An irrigation system applies lagoon effluent to a field. Material transport is perhaps the most important factor affecting the smooth operation of waste handling systems. As with storage, manure consistency determines the type of equipment used to move material. OSU Fact Sheet BAE- 1751, *Consistency of Manure/Water Mixtures*, gives more details on choosing transport methods based on consistency.

Simple or Complex, It is Still a System

Every conceivable manure handling system fits the schematic in Figure 2. Don't believe it? Let's start with a simple system -- cows grazing pasture. The cows remove grass and water from the environment (upward arrow from The Environment to Production). The cows produce manure and return it to the pasture (downward arrow from Production to The Environment). Systems become more complicated as animal numbers increase. As stocking density increases, the cows start to alter their environment. "Horse weeds" begin to appear, and manure piles soon outnumber grassy areas. The farmer compensates by rotating cows through several pastures (The Environment is broken into several smaller environments). Let's say the cows spend part of the time in barns. We have added the need to muck out (transport arrow) the barns. Because he cannot get in the field every day, the farmer adds a dry stack (storage), and spreads manure onto a hay field (second transport arrow to the environment) after cuttings. Finally, the farmer realizes he can reduce the amount of manure he has to spread and decrease weed seeds by composting, so he adds a treatment component. From very simple to highly complex, systems are built component by component.

Think Systematically to Diagnose Problems

A dairy farmer is having problems with his storage pond. The darn thing keeps filling up faster than he thinks it ought to. Rather than jump to conclusions and dig a bigger pond, the dairyman takes some time to map the flow of material from cow to environment using boxes and arrows as in Figure 3 (page 3).

Cows spend most of the time on pasture, but they stand in a holding area as they wait to be milked. Manure scraped from the holding area and milking center wash down is stored in an earthen storage pond. The dairyman uses a hard hose traveling gun to spread waste onto a hay field. Manure flows through circle lock aluminum irrigation pipe from the storage pond to the traveling gun.

After looking at the problem systematically, the farmer discovers two additional solutions to his pond-filling problem. Rainwater running off the barn roof during spring storms fills the pond before he can get it pumped. One solution is to add rain gutters, and divert rainwater away from the holding area. He also realizes it takes too long to empty the storage pond. After a few calculations, the dairyman discovers he can reduce head on his pump by trading in the 4-inch aluminum pipe for 6-inch pipe. With higher flow through the nozzle, he can cut pumping time in half.

Thinking systematically almost always leads to better solutions.

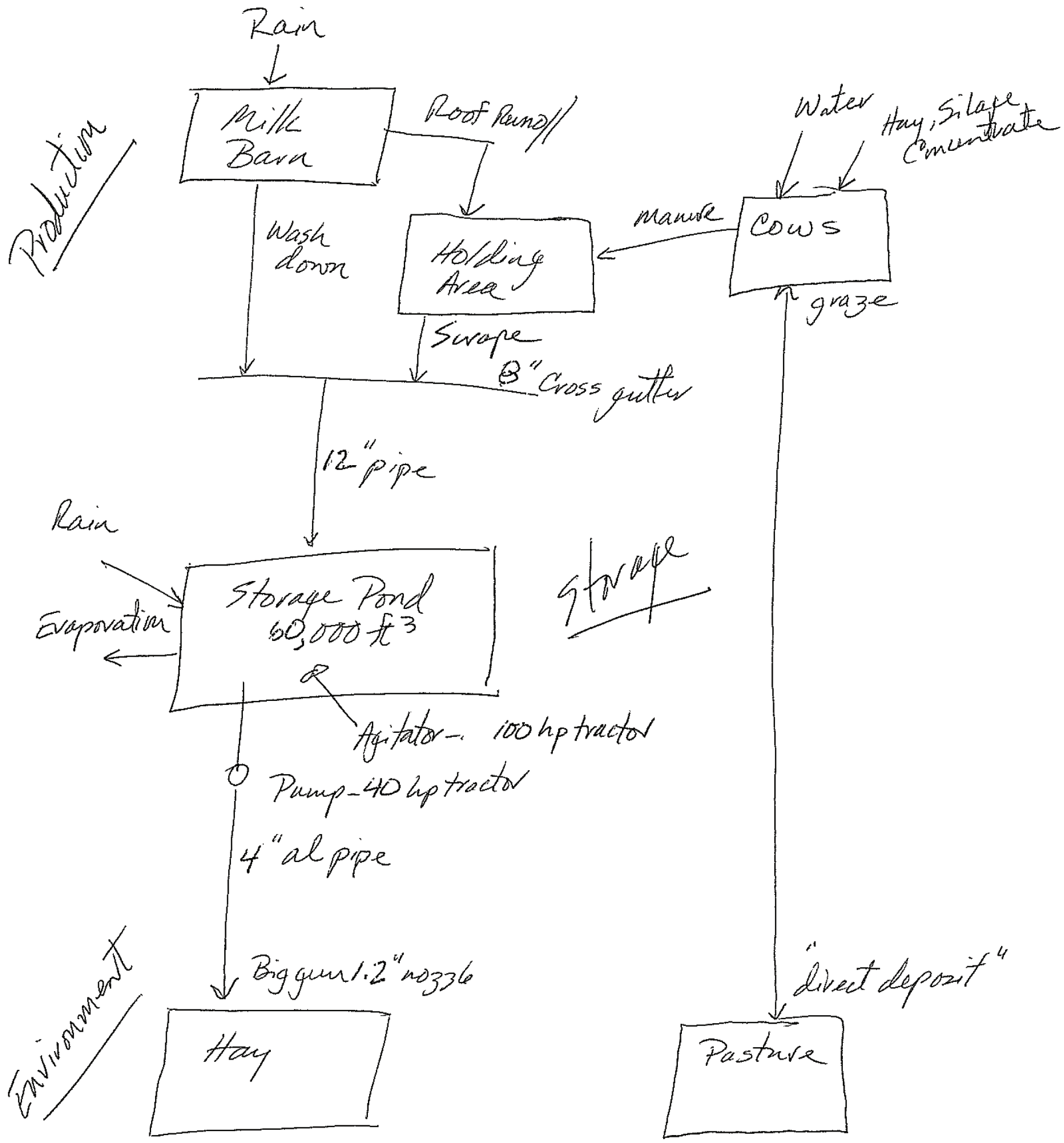

Figure 3. Farmer drawn schematic of a dairy manure handling system.

The Oklahoma Cooperative Extension Service
Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Robert E. Whitson, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 20 cents per copy. 1111 TE Revised