## Considerations in Planning and Managing Manure Storage Facilities

Many considerations influence the decisions regarding manure storage facilities. These considerations may begin with the type of livestock or species in the enterprise and include factors such as manure collection, transport, treatment, nutrient retention, and finally, land application and nutrient utilization. Thus, manure storage facility decisions should be made in concert with many other decisions and considerations that reflect the entire manure management system. Regulatory considerations are also important in planning manure storage facilities. Since regulations vary from state to state, it is not possible to delineate a set of regulations applicable in all cases. Check with your state regulatory agency for specific requirements in your state. Many states address the following issues with regulations.

- Classification of operation according to animal units or animal numbers
- Public notice requirements prior to construction of a manure storage facility
- Permit for construction and/or operation of a manure storage facility
- Manure storage facility design, size, or required storage period
- Buffer distances from a manure storage facility to non-owned dwellings, public use areas, or other areas as required
- Separation distances to wells or to groundwater connections, such as sinkholes or surface water supplies
- Geological investigation or evaluation of a manure storage site
- Soils evaluation, required soil materials for liner construction, liner thickness
- Location of manure storage facility relative to floodplain and/or water table
- Recording of manure storage facility inspections and water or manure levels
- Preparation of design plans and specifications by a qualified professional

Appendix E is a checklist that may help producers evaluate the impact of regulations in planning manure storage facilities.

...manure storage facility decisions should be made in concert with... . [the] regulatory considerations...[in your state.]

### What type of manure storage facility should I select?

Manure storage facilities are one component of an overall manure management system. The design of the overall system considers the production unit, the relationship between manure production and available crop/land resources, and the producer's goals and objectives. The type of manure storage selected for a particular operation depends upon many factors and considerations. Some of the primary factors and considerations are listed below.

1. Manure form or consistency. Manure is usually handled and stored as a solid (> 15% dry matter), slurry (5%-10% dry matter), or liquid (< 5% dry matter). The form or consistency of the manure handled will influence the type of manure storage facility selected. Figure 20-1 shows the relative consistency (solids content) of various types of manure excreted by the common animal species.
2. Land application handling method and equipment. If manure is hauled, a solid or slurry is more ideal than a liquid, because more solids and nutrients are contained in each load. If manure is irrigated, a lower solids content may be more ideal for the pumping and nozzle

Manure form or consistency, land application handling method and equipment, and nutrient conservation are the main considerations in selecting a particular type of manure storage facility.

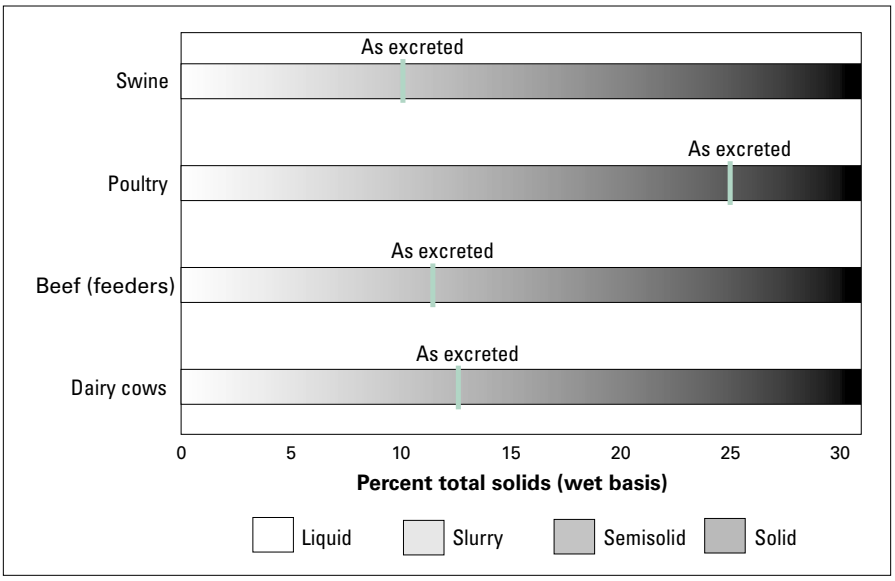


**Figure 20-1. Relative consistency of various types of manure.**
Adapted from the NRCS Agricultural Waste Management Field Handbook 1996.

equipment used. Labor and equipment requirements are significantly different for solid vs. liquid or slurry manure land application systems. A different type of manure storage might be used in either case.

3. Nutrient conservation. Solid and slurry systems generally conserve more nutrients than a liquid system. Bacteria can thrive in a liquid system, which results in stabilization and treatment of the manure, but with more nitrogen loss due to volatilization than with a solid or slurry. If nutrient conservation is a high priority (sufficient land availability, high-value crops), then a manure management system that retains a higher portion of the nutrients might be selected. Conversely, if land availability is limited or manure will be spread on low-value crops, nutrient conservation may be a lesser priority than time/labor/equipment requirements for spreading. Table 20-3 shows typical values of nitrogen retention and loss when manure is handled and stored in different types of systems.
4. Need for treatment. If treatment is needed for odor control or solids degradation, a lagoon may be considered for both treatment and storage.
5. Space limitations. Limited space at a manure storage site may favor a manure tank rather than an earthen impoundment since less area is required for a tank.

In addition to the primary features noted above, other determining considerations may be associated with different types of manure storage facilities.

## Cost and economics of manure storage facilities

The cost of different types of manure storage facilities should be considered in selecting a type of storage structure. However, cost considerations should be integrated into an economic analysis of the entire manure management system. A complete analysis may not support the lowest cost manure storage facility as the best economic choice. Hence, the cost of a

**Table 20-3. Nitrogen lost and retained in various types of manure handling and storage systems.**

| System | Nitrogen Lost, % | Nitrogen Retained, % |
|---|---|---|
| Daily scrape and haul | 20-35 | 65-80 |
| Manure pack | 20-40 | 60-80 |
| Open lot | 40-55 | 45-60 |
| Deep pit (poultry) | 25-50 | 50-75 |
| Litter | 25-50 | 50-75 |
| Under floor pit | 15-30 | 70-85 |
| Aboveground tank | 10-30 | 70-90 |
| Holding pond | 20-40 | 60-80 |
| Anaerobic lagoon | 70-85 | 15-30 |

Adapted from MWPS-18, Livestock Waste Facilities Handbook 1993.

manure storage facility should be only part of a group of inputs to a complete economic analysis of the manure management system.

Manure storage facility costs are related to factors such as materials required (concrete, steel), earthmoving and excavation required, labor costs, size of the facility, appurtenances required (pumps, agitators), and a number of additional factors. Costs associated with these factors can be highly variable from one location to another and will change over time. Without specific data on local costs of the inputs noted above, an actual cost for a given type of manure storage facility cannot be accurately estimated. Table 20-4 shows the costs of different types of manure storage facilities on a "per unit" and comparative basis. Actual facility costs at a given location may vary considerably from the costs given in the table. However, the relative cost of the different types of facilities may be more consistent and accurate from one region to another and over time.

**Table 20-4. Comparison of costs of different types of manure storage facilities.**

| Storage Type | Approximate Cost $/1,000 gal | Relative Cost |
|---|---|---|
| Naturally lined earthen basin | 36 | 1.0 |
| Clay-lined earthen basin using clay onsite | 70 | 1.9 |
| Clay-lined earthen basin using clay from off-farm borrow site (varies with hauling distance) | 88 | 2.4 |
| Earthen basin with plastic liner | 76 | 2.1 |
| Earthen basin lined with concrete | 88 | 2.4 |
| Aboveground precast concrete tank | 141 | 3.9 |
| Circular aboveground concrete tank poured in place | 163 | 4.5 |
| Aboveground glass-lined steel tank | 198 | 5.5 |

Cost estimates based on 500,000-gallon storage capacity. Cost per 1,000 gallons will usually be less for larger storages and more for smaller storages. Data from a Minnesota Natural Resources Conservation Service survey of manure storage facility costs in 1993.