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EC727

Disposal Methods of Livestock and Poultry Mortality

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Nebraska statutes approve four methods for disposing of animals that have died from infectious disease. They are:

- **burying** the carcass at least four feet below the surface of the ground,
- **burning** the carcass in a permitted incinerator,
- **removal** by a licensed rendering company, and
- **composting**.

Additionally, dead animals must be disposed of within 36 hours on the premises where death occurred, unless the animal is disposed of by a licensed rendering establishment. Such animals shall not be moved or transported from the premises except by a licensed rendering establishment. However, an animal carcass may be transported to a veterinary clinic or diagnostic laboratory by the owner for diagnostic purposes.

Different sets of regulations administered by the Nebraska Department of Agriculture (NDA) and the Nebraska Department of Environmental Quality (NDEQ) apply to dead animal disposal.

Injection of liquefied animal remains is no longer an approved method of carcass disposal. Any animals suspected of dying from a contagious disease, such as a chronic wasting disease, must be inspected by a veterinarian before disposal.

While carcasses are not precluded from being accepted at landfills, the transportation from the facility to the landfill must be performed by a licensed rendering company, which makes it impractical as a legal disposal method.

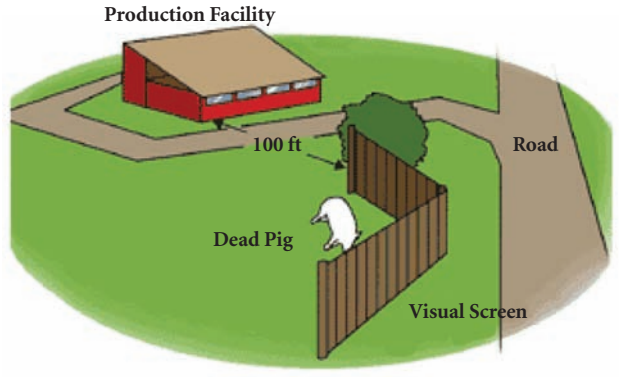

Figure 1. Carcass storage area for rendering pick up.

Rendering

Rendering companies have raised their fees and even discontinued service to some areas, due to changes in the animal byproduct market and new, federal Food and Drug Administration (FDA) regulations in 2009. Meat-packing plants have become more efficient in their abilities to recover and process byproducts, thus becoming more competitive with rendering companies. Export restrictions and FDA regulations prohibiting the use of certain ruminant byproducts in ruminant feeds have impacted the market for meat and bone meal.

If the rendering method is used, a carcass storage area *(Figure 1)* that cannot be seen from a public road is desirable. The storage area should be at least 100 feet from production facilities to lessen risk of disease transmission by rodents. The facilities should be located and managed to minimize the biosecurity risk imposed by rendering trucks carrying disease organisms.

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FDA Rules

A change in the ruminant feed rule imposed by FDA in 2009 increased separation requirements for rendering establishments. These new rules will have the most impact on cow-calf and dairy producers. The 2009 ban restricted, from all animal feed, brain and spinal material from any bovine animal older than 30 months. Not all rendering facilities have the necessary equipment to open carcasses and remove the brain and spinal cord before processing.

Additionally, the carcass must be in good condition to undergo the removal process, so deteriorated carcasses will likely be rejected.

As a result, rendering companies are likely to require strict adherence to timely notification, and producers should have a burial site established for rejected carcasses. (Burial is the only alternative remaining for these carcasses.) The new ban is expected to increase the cost of rendering service $5 to $15 per pickup.

Age Verification

Rendering companies will require age verification of beef and dairy carcasses and providing this is the legal responsibility of the livestock producer. Verification is expected to be done by an age affidavit that must be filed with the rendering company and marking of the carcasses to indicate age.

The National Renderer's Association recommends marking carcasses of animals over 30 months of age with a "X" and those of animals that are less than 30 months of age with a "U" using a paint stick. Rendering companies use this identification to judge whether or not to accept the carcass and segregate it for spinal cord and brain removal.

Misrepresentation of animal age is a federal offense; producers should check with their local renderer on any requirements for documenting the age of cattle. Some renderers may rely on examining cattle teeth to determine age.

Incineration and Open Burning

A mortality incinerator *(Figure 2)* is essentially a convection oven (starved-air combustor) that burns a carcass under a controlled environment at a very high temperature, reducing it to ashes. Incinerators can operate on diesel, natural gas, or propane. A diesel-fueled incinerator will require 1 to 3 gallons of fuel per 100 lb of carcass. Large carcasses are more difficult to burn in most farm-operated incinerators, which work best for carcasses smaller than 500 lb.

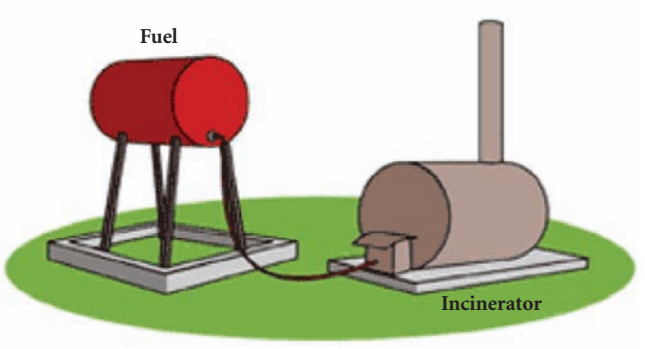

Figure 2. A mortality incinerator.

In 2005, the regulation in Chapter 42 of Title 129 governing animal mortality incinerators changed the permitting process for this special class of incinerator to "by rule." "Permitted by rule" means that so long as notice of operation is given and the facility is operated as required by regulation, permits are not needed. The maximum capacity of a "permit by rule" small animal incinerator is 200 lb per hour. For incinerators larger than this, an air-quality construction permit and operating permit is required.

Incinerator Operating Rules

To own and operate an incinerator in Nebraska, you must follow these abridged and simplified guidelines:

- A notice of intent must be filed with the NDEQ no later than 45 calendar days prior to the installation of the incinerator. A notice of operation of the incinerator also must be given to NDEQ within 15 days of operation.
- The incinerator must have an afterburner, with a temperature gauge that ensures the chamber is operated above 1,400°F. The stack height of the incinerator must be a minimum of 7 feet above the ground.
- Natural gas, propane, or diesel fuel can be used. However, the sulfur content of the diesel fuel cannot be more than 0.05 percent sulfur by weight. For every load of fuel delivered to the incinerator, the operator must maintain a record of the sulfur content of the diesel fuel used.
- Only deceased animals and medical waste are allowed to be incinerated and the medical waste cannot exceed 10 percent by weight of any single load.
- Incinerator operation must be monitored for excessive smoke that remains visible beyond the premises. Repair the incinerator if this condition develops.
- In addition to recording the pounds of carcasses and medical waste incinerated, records of maintenance and inspections must be maintained for a minimum of five years on site and be made available to NDEQ

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Table I. Required record keeping items for every load placed in a small animal incinerator

A. Estimated pounds of carcasses incinerated	B. Pounds of medical waste incinerated	C. Burn time	D. Incineration rate (A + B)/C	E. For diesel fuel only, sulfur content	F. Repairs made (both preventative and corrective)

if the site is inspected. A listing of items needed for record keeping is shown in *Table I*.

- You may need to perform an emissions test on your incinerator to verify that it is in compliance. You may not have to conduct the test if you submit documentation from an emission test of an identical or similar unit to yours to NDEQ. Emission tests would generally be needed for a homemade or a modified commercial incinerator.

In addition to state law (NDEQ), there may be county and city ordinances in place concerning incinerators. It is the producer's responsibility to know of and comply with local regulations.

Other Considerations

The incinerator must have a timer or other automatic shut-off so that when the carcass is consumed, the burners shut off. Even though burning carcasses in open pits is mentioned in state animal mortality disposal laws, it does not comply with NDEQ air quality standards and is thus not an approved mortality disposal method. NDEQ has developed guidance documents, record keeping, and reporting forms to help you comply with the permit-by-rule. The notice of intent forms and guidance documents are located on the NDEQ Web site at *www.deq.state.ne.us* under the Air Quality Publications. You also can contact the NDEQ air permit hotline at (877) 834-0474 for the notice of intent and forms needed to operate a small animal incinerator or permit a large animal incinerator in Nebraska.

Burial

Safety Issues

Livestock carcasses must be buried at least 4 feet below the ground within 36 hours of the animal's death. There are many challenges and risks associated with this disposal method. A common, but unsafe, practice is to dig a trench and then, starting at one end, fill the trench in, over time, with carcasses and soil.

Countless individuals have died due to cave-ins and immediate burial from vertical trench wall failures, and the federal Occupational Health and Safety Administration (OSHA) regulates open trench requirements, which involve bracing equipment made for trenches.

However, maintaining an open trench still poses a serious occupational hazard. Given this risk to human life, the burial method should be used primarily for occasional or catastrophic losses and discouraged for routine disposal of livestock.

The burial site should consist of deep, fine-textured soils (such as clay and silt) with an underlying geology that poses little risk to groundwater contamination. The burial pit should be at least 100 feet away from production facilities to lessen risk of disease transmission by rodents. Nebraska law requires that excavators call the Diggers Hotline at (800) 331-5666 before beginning any type of excavation.

Groundwater Issues

Earth-moving equipment must be used to excavate a hole or trench for the carcasses. This means that during Nebraska's winter months it is difficult, if not impossible, to bury the carcasses in frozen soil, and the liquid from decomposing carcasses can pose a risk to groundwater.

In areas of shallow groundwater (less than 10 feet), burial is especially problematic as the carcasses will likely come into contact with the seasonal fluctuation of groundwater tables.

While not formally prohibiting burying carcasses in groundwater, Nebraska state groundwater regulations prohibit environmentally impacting groundwater resources. Therefore, burying carcasses in groundwater or in any way as to degrade groundwater quality could result in imposed groundwater monitoring requirements and possible regulatory action by NDEQ.

For large carcasses (greater than 600 lb), where rendering is not available, and where the premise burial site is within 10 feet of groundwater, no economically feasible or environmentally sound disposal option exists. The authors suggest obtaining expert advice and legal counsel.

Composting

Composting was approved by the Nebraska Legislature in the 1999 session; and NDA currently regulates mortality composting along with local law enforcement. New legislation in 2001 increased the carcass weight restriction from 300 lb to 600 lb. However, composting

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has been used to successfully dispose of larger carcasses, such as mature dairy cattle, in other states.

The concept can be described as burying the animal aboveground, in a mound of sawdust or other carbon source, and allowing the animal to decay. In the composting process, carcass tissue is broken down aerobically by bacteria, fungi, actinomycetes, and protozoa to produce water vapor, carbon dioxide, heat, and an end product of stabilized organic residue. High temperatures indicate good microbial activity and will reach 120°F to 160°F.

An internal pile temperature of 130°F for three days is needed to destroy disease-causing organisms. Small animals, such as stillborn pigs, are composted in as little as two weeks, where large carcasses, such as dairy cattle, may take as long as nine months to fully compost.

Site Selection

Facility site selection is important to successful composting.

- Select a site so that surface water and groundwater sources will not be adversely affected.
- It's best to locate the facility away from neighbors and human dwellings.
- The facility should be at least 100 feet away from production facilities to lessen the risk of disease transmission by rodents.
- Consider the drainage of the site. There should be no surface water contacting the compost area. Clean water diversions should be built to control runoff water.

Starting a Compost Pile

Always place a fresh layer of carbon source at least 2 feet in depth to start a new compost pile. The particle size of the carbon source should be small but still allow for air to enter the pile, as the compost process needs oxygen to work. Add carcasses and finished compost, if available, to inoculate the pile, and keep carcasses covered with at least a foot of cover.

The base layer of amendment should be approximately 12 to 24 inches thick across the bottom of the pile or bin. This base layer's primary function is to absorb moisture released from the decomposing carcass to prevent leaching and provide pore space for air flow.

Place the carcasses on the base layer. Small carcasses can be layered, large animals will compost in one layer. Maintain a minimum buffer of 12 inches from the outer edges of piles and bin walls.

Cover the carcasses with amendment. Moisture content of compost should be at least 50 percent, which for sawdust is roughly when the material just begins to make a ball stage with your hands, but no more water can be squeezed out. Compost that is too dry will not make a ball. Add water as necessary.

Although the carcasses supply considerable water, it may not be sufficient to support decomposition of the amendments. In addition, water released from the carcasses concentrates in small regions within the amendments. While sawdust is the most preferred carbon source, chopped/ground straw, chopped/ground hay and chopped/ground cornstalks can also be used successfully.

Large carcasses should be lanced to release gas generated from decomposition and expose the inner carcass to the microbes (which occur naturally in the environment).

Composting can be done in static piles, bins, or windrows. The internal temperature needs to reach 130°F for three days, and once the pile cools down, it can be turned. For bin and static pile systems, turning consists of moving material from one bin or pile to another.

When starting new piles in cold weather, and when carcasses are frozen, continue building piles. Once temperatures rise above freezing, the microbes will become active again and the process will resume. Compost can be reused in the pile, but eventually it will turn black and putrid, and it should be land-applied before reaching this condition. Spread mortality compost thinly on crop fields as it has a high carbon-to-nitrogen ratio and, if spread heavily, will bind nitrogen fertilizer to the soil, making it unavailable to the crop.

Composting Equipment Needs

While composting can be accomplished fairly easily and economically, it does require additional time and equipment compared to the other disposal methods.

- A bucket loader or skid steer is needed to transport carcasses from buildings or lots to the compost facility, and build and move piles from the primary to the secondary stages. Equipment to haul and unload the incoming carbon source is also needed.
- Finished compost can be spread on crop ground with a solid manure spreader.
- While not necessary but helpful in monitoring compost operations, smaller composting thermometers (2 feet in length) can be found in "lawn and garden" departments at many hardware stores.
- For larger piles, longer thermometers (3 to 5 feet in length) can be found through mail-order specialty stores.

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For more information on composting mortalities, visit the national extension Web site, *www.extension.org*, and type in the search box "mortality composting."

Deciding Which Option Best Fits Your Livestock Operation

Each livestock operation is different and the resources available vary. Carefully consider each disposal method in the context of how each would work in a specific situation. Then, estimate the cost to implement each of the feasible methods. The result should be an environmentally sound and cost-effective method for your operation.

Evaluate the Logistical Factors

Consider the following factors first to determine which disposal methods are logistically and environmentally suited for a specific operation. The economics of each viable method can then be used to make the final selection.

Incineration

- ☐ Smoke and odors will not be a nuisance to neighbors.
- ☐ Carcasses are smaller than 600 lb.
- ☐ Detailed records must be kept (fuel sulfur content, pounds of carcass and medical waste incinerated, maintenance).
- ☐ Operator will abide by operating requirements necessary for compliance with permit-by-rule.
- ☐ A notice of intent must be filed with the NDEQ.
- ☐ A permit is required from NDEQ for operating a large animal incinerator.

Burial

- ☐ Access is to backhoe or other earth-moving equipment.
- ☐ Labor is available for daily trenching and covering.
- ☐ Land is available year-round for burial.
- ☐ Burial pit is at least 100 feet away from production facilities.
- ☐ Burial site consists of deep, fine-textured soils.
- ☐ Underlying geology poses little risk for groundwater contamination.
- ☐ Trench-bracing equipment is available.
- ☐ Operation can function in winter, when frozen ground is problematic.
- ☐ Carcasses can be covered with 4 feet of earthen cover.

Composting

- ☐ Ample carbon sources are available.
- ☐ If not using sawdust, there is access to a bale processor or other means to chop corn stalks, wheat straw, hay, etc.
- ☐ Labor is available to process carcasses and turn compost.
- ☐ Location is appropriate for the composter.
- ☐ Composter site is at least 100 feet away from production facilities.
- ☐ Composter does not pose a risk to surface water.
- ☐ Clean water is diverted from the composter site.
- ☐ A manure spreader is available to land-apply compost.
- ☐ A bucket loader is available for loading and turning compost.
- ☐ Land is available for spreading finished compost.

Rendering

- ☐ Pickup service is available.
- ☐ A renderer may not accept the carcasses of bovines more than 30 months of age. Use burial sites for these carcasses.
- ☐ For beef and dairy, an age affidavit of the carcasses must be on file with the rendering company.
- ☐ Beef and dairy carcasses must be marked for age, "X" for over 30 months of age and "U" for under 30 months of age, if this is required by the local renderer. Some renderers may rely on examining the teeth of cattle to determine age.
- ☐ Rendering service and ensuing collection must be prompt.
- ☐ Carcass can be removed without compromising biosecurity.
- ☐ Carcass storage area is at least 100 feet from production facilities.
- ☐ Carcass storage area is well screened from public view.

Evaluate the Economic Factors

After considering the logistical and environmental factors, the next step is to compare the cost of disposal methods that otherwise fit a specific situation. Factors which influence costs are the volume of mortality, management, site layout, and size of the production unit.

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Table II. Budgeted annual costs for disposing of mortality from a pork production system (40,000 pounds of mortality per year — 300-sow farrow-to-finish system).

	Incinerator With Afterburner and Fuel Tank		*Composting Bin System*		*Rendering - Four Pickups per Week*	
	$2.00/gal diesel fuel	*$3.00/gal diesel fuel*	*Low investment*	*High investment*	*$25/ pickup*	*$75/ pickup*
Disposal equipment	Incinerator and fuel tank	Incinerator and fuel tank	Compost bins	Compost bins and roof	Screen storage area	Screen storage area
Capital investment	$7,626	$7,626	$7,465	$18,500	$300	$300
Other equipment needed			Skid Steer Loader	Skid Steer Loader	Skid steer loader	Skid steer loader
			Tractor	Tractor		
			Manure spreader	Manure spreader		
Labor hours per year	60.7	60.7	125.9	115	60.7	60.7
Budgeted annual costs						
Fixed costs — disposal equipment	$1,372.68	$1,372.68	$1,020.22	$2,528.33	$46.50	$46.50
Machinery costs						
Fixed			$622.57	$527.38	$531.44	$531.44
Operating			$415.05	$351.59	$354.29	$354.29
Other operating costs	$2,276.72	$3,404.92	$600	$600	$5,200.00	$15,600.00
Labor	$910	$910	$1,888.20	$1,725.20	$910	$910
Total cost per year	$4,559.40	$5,687.60	$4,546.04	$5,732.50	$7,042.23	$17,422.25
Total cost per pound of mortality	$0.114	$0.142	$0.114	$0.143	$0.176	$0.436

Disposal costs were estimated for a swine production system that needs to dispose of 40,000 lb per year or 110 lb per day, as would be the case in a 300-sow farrow-to-finish operation with average death losses. The total annual cost, as well as the cost per pound of mortality disposed of, are the basis for comparison among the alternatives presented in *Table II*. Costs of each method vary from farm to farm, depending on the resources available.

Although the example provided may be used as a guideline, cost estimates for a specific operation should be made for the disposal methods that are being considered.

The costs do not include labor or loader use for removing dead animals from the production facility. It is assumed that this would be the same for all alternatives. Labor costs were counted when the method required moving dead animals more than a few yards from the production facility. The cost of labor for all disposal methods was $15 per hour, which includes the employer's Social Security contribution.

Fixed costs in *Table II* include depreciation, interest on the undepreciated balance of the item, repairs, property taxes, and insurance. Fixed costs reflect the annual cost of owning an asset that has a life of more than one year.

Incineration

The incinerator used as a basis for the cost estimate has a 500 lb capacity, is lined, and is thermostatically controlled. The cost of the incinerator with afterburner, a fuel tank, and fuel lines is $7,626.

The incineration rate was assumed to be 78 lb per hour, with fuel consumption at 2.2 gallons per hour. Since the price of diesel fuel fluctuates, and its cost is a major part of the total incinerator cost, *Table II* shows costs reflecting diesel fuel prices of $2.00 and $3.00 per gallon. The incinerator with afterburner consumes 1,128 gallons of diesel fuel per year.

The cost of electricity was calculated, but it was negligible.

The life of the incinerator was estimated at 5,000 hours (approximately 10 years with this size of operation).

An interest rate of 7 percent, and an annual repair cost equal to 3 percent of the original investment were used in the calculations.

It was assumed that the incinerator would be near the production facility, and no additional labor would be required to move the dead animals to the incinerator.

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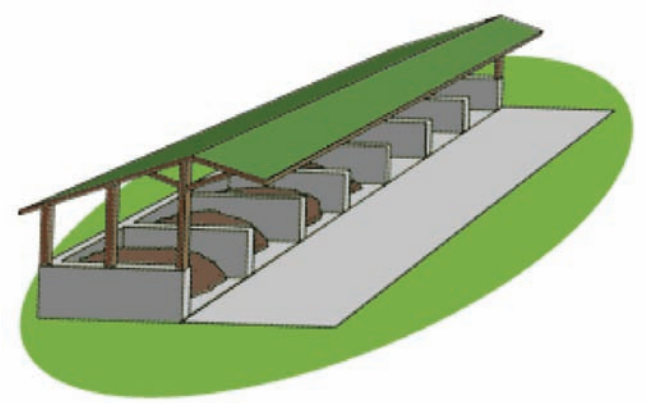

Figure 3. Roofed composting unit (high investment option).

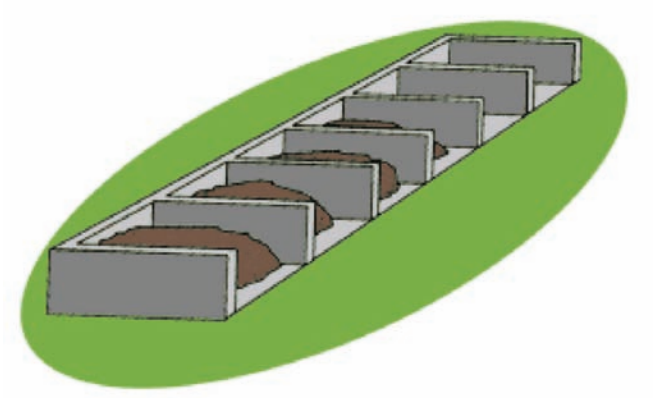

Figure 4. Composting unit (low investment option).

A labor requirement of 10 minutes per day was assumed for the operation of the incinerator.

Composting

Costs were estimated for two types of composting facilities, both having concrete floors and bin walls. The high investment version includes a roof and sidewalls above the concrete bin walls, as well as a concrete apron in front of the facility *(Figure 3)*. It is a seven-bin facility, with sawdust or other carbon source stored in the seventh bin. Each bin is 10 feet by 14 feet with 6 foot high walls. Estimated construction cost was $18,500. This assumed that the concrete work was hired and the wooden portion was constructed with farm labor.

The low investment version does not have a roof and sidewalls above the concrete bin walls, does not have the concrete apron in front, and is a six-bin facility *(Figure 4)*. Each bin is 10 feet by 14 feet with 6 foot high walls. With only six bins, the sawdust or other carbon material would need to be stored in a pile outside or in a nearby building. The investment cost of this composting facility was estimated at $7,465.

The useful life of both composters was estimated at 15 years. An interest rate of 7 percent and an annual repair cost of 2 percent of the original investment were used. An estimated 80 cubic yards of sawdust would be needed each year, at a cost of $7.50 per cubic yard.

A skid steer loader with a one-half cubic yard bucket would transport dead animals, move sawdust from the storage bin, move material from primary to secondary bins, and load material on the manure spreader. The total cost of using the loader was $14.60 per hour.

The composters were sized so that it would take 90 days to fill a primary bin. The material would remain for an additional 90 days and then be moved to a secondary bin. After 90 days in the secondary bin, one-third of the original volume of sawdust would be recycled and the remainder would be spread. Labor and machine requirements were estimated as follows:

Daily loading with sawdust and dead animals: 1.83 hours of labor per week; 0.67 hours of loader time per week.

Moving material from primary to secondary bin: 1.25 hours of labor and loader time, four times per year.

Moving material to recycling bin and spreading the remainder: 3.67 hours of labor, four times per year; 2 hours of loader time, four times per year; 1.67 hours of tractor and spreader time, four times per year

Labor and machine costs were estimated to be slightly higher for the low investment facility since the carbon source is not stored in the composter.

Rendering

Two alternatives were budgeted, using costs of $25 and $75 per pickup, with four pickups per week. Rendering costs are quite variable depending on the location and the situation. The cost per pickup, as used in this analysis, may include a monthly fee prorated per pickup, plus the quoted per pickup charge.

A holding area would need to be located away from the production facility to minimize chances of disease transmission. The estimated cost of building a fence to screen the storage area was $300. Since the holding area would be located away from the production facility, an estimated 70 minutes of labor and loader time per week would be required for transporting dead animals to the holding area.

The estimated cost per pound of mortality, based on four pickups per week by a rendering service, is listed in *Table II* as $0.176 for the $25 per pickup cost and $0.436 for the $75 per pickup cost. Four pickups per week was selected as an average number to ensure that

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dead animals were disposed of within 36 hours. The number of pickups per week affects the cost per pound of mortality.

Burial

The procedure for properly disposing of dead animals by burying is not well defined. Soil type, topography, distance to wells, depth of groundwater, available equipment, and weather are some of the variables that will influence the type of burial system feasible for a swine operation. Thus, costs for this alternative do not appear in *Table II*.

A budget was developed for a sample burial system to get a general idea of its cost.

- A trench would be dug once a year to hold one year's mortality. The cost of hiring a backhoe to dig the trench was estimated to be $600.
- The ditch would need to be braced to prevent cave-in and a safety fence would need to be built around the ditch.
- Since the burial site would likely be some distance from the production facility, 70 minutes per week of labor and loader time was assumed to be required for transporting dead animals to the burial site.
- An additional 85 minutes per week of labor and loader time would be required for covering the dead animals with soil.
- The estimated cost of the burial alternative was $5,121 per year and $0.128 per pound of mortality.
- Approximately 135 hours of labor were required per year.

While this indicates that burial may be within the range of economic feasibility, it is not recommended for routine disposal except when no other method is available. Both incineration and low-investment composting are now cost-effective disposal methods for the example facility.

Comparing the Costs

Based on the assumptions stated for each alternative, the incinerator and low investment composting option are the lowest cost methods if diesel fuel prices are below $2.00 per gallon. If diesel prices are over $2.00 per gallon, the low-investment composting alternative is the least expensive alternative. The incinerator at a $3.00 per gallon diesel price and the high-investment composting alternative result in nearly equal costs, at 14 cents per pound of mortality. Even the low investment composting option and incineration (less than $2.00 per gallon) are 1.4 cents per pound less expensive than burial ($0.128). Rendering is the most expensive, at costs ranging from $0.176 to $0.436 per pound of mortality. As stated above, this assumes four pickups per week. If only one or two pickups per week are used, rendering may become more competitive.

The costs in *Table II* were budgeted based on reasonable assumptions for investment cost, labor, and machine use.

Making the Decision

Selecting a mortality disposal system is an important decision, as it impacts animal and human health. Several factors should be considered when making this decision. These include logistical factors, such as the quantity of mortality, location of production facilities, soil type, topography, amount of labor available, and access to equipment. The estimated cost of alternative disposal methods for your operation, your attitude toward environmental issues, and management preferences are also important considerations.

Contact the Nebraska Department of Agriculture's veterinarian's office at (402) 471-2351 for regulatory information concerning disposal of livestock mortalities. To file a notice of intent to operate a small animal incinerator, contact the air quality section of NDEQ at (402) 471-2189 or the toll-free NDEQ air permit hotline at (877) 834-0474. For more information on mortality disposal methods, contact your local extension educator.

Acknowledgment

This publication has been updated from a previous NebGuide. Robert Wills, who also contributed to this publication, is currently Associate Professor, College of Veterinary Medicine, Mississippi State University.

This publication has been peer reviewed.

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