Evaluation of Poultry Carcass Disposal Methods Used During an Avian Influenza Outbreak in Virginia in 2002

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INTRODUCTION

In 2002, Virginia Department of Environmental Quality (DEQ) was involved in managing a low pathogenic avian influenza (AI) outbreak in Virginia. A task force comprised of USDA's Animal, Plant Health Inspection Service (APHIS), Forest Service, Farm Services Agency, Natural Resources Conservation Service, Virginia's Department of Agriculture and Consumer Services (VDACS), DEQ and the poultry industry worked cooperatively to contain the low pathogenic avian influenza outbreak and prevent its spread.

During this outbreak, carcass disposal became a tremendous obstacle. In April 2002, as many as 40 flocks of AI positive birds remained in the field while appropriate disposal methods were evaluated and implemented. This report attempts to document the disposal methods that were used and identifies obstacles and recommendations for the application of these methods in the future.

DISPOSAL METHODS

Method: Landfilling

Summary of Method:

After infected flocks are euthanized on-site, they are loaded into transport vehicles that are double lined with polyethylene sheeting, sealed for transport, and thoroughly cleaned and disinfected. Transport vehicles then travel via routes approved by the State Veterinarian from the farm to the landfill. Upon arriving at the landfill, trucks are directed away from the active working face and towards an area specified for poultry

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carcass disposal. The disposal pit consists of a single trench excavated into existing waste. The removed solid waste is piled adjacent to the trench for covering the carcasses. Loaded trucks are directed to the edge of the excavated trench to deposit their loads. The carcasses are covered immediately with a minimum of two feet of excavated solid waste. Once emptied, trucks pull into a decontamination area where the entire vehicle is cleaned and disinfected before leaving the facility.

Volume Disposed:

Approximately 13,000 tons of infected poultry (3,103,000 birds) were landfilled.

Advantages of Method:

- Landfills provide a site that is lined, reducing or eliminating the environmental impact of poultry carcass leachate.
- The leachate collection systems in-place at most landfills allow for the proper handling and treatment of the leachate that is produced from the decomposition of the poultry carcasses.
- The burial of carcasses under a minimum of two feet of solid waste provides a protective barrier to eliminate the spread of the virus by scavengers.
- Landfills are a quick solution that does not require long-term management.

Disadvantages of Method:

- As the public's perception of avian flu becomes increasing shaped by media coverage of H5NI, transporting carcasses (even from low path strains of avian flu) may not be publicly acceptable.
- The transportation of infected carcasses from the farm to the landfill provides an opportunity for breaches in biosecurity.
- The smell and blowing trash from the excavated solid waste can create environmental concerns, complaints from neighbors, and the possibility of violating permit requirements.
- Large volumes of carcasses can generate excessive amounts of leachate and methane which may exceed the design capacity of the landfills control systems.
- The substantial cost associated with tipping and hauling fees.

Lessons Learned:

- A track-hoe or similar equipment is necessary for excavating trenches in compacted solid waste.
- Adequate lighting is essential when working after normal operating hours.
- Provisions need to be made for stabilization material--rip-rap, gravel, or mulch--for use during inclement weather.
- Trucks hauling carcasses should be equipped with hydraulic lines capable of dumping the load, or there should be equipment available to perform this task.
- Coordination of personnel is critical for excavating trenches, placement of stabilizing material, directing the off-loading of trucks, hooking up hydraulic lines, removing load covers, releasing tailgates, etc.
- Communication and coordination between landfill staff and depopulation crews is necessary to ensure that personnel are on-site when loads arrive at the landfill. One person should be appointed as the point-of-contact for the poultry companies and the landfill staff.
- Transport trailers must be double lined with plastic sheeting to facilitating the offloading of the poultry carcasses. Without two layers of plastic, the friction between the trailer bed and the carcasses prevents the load from dumping freely. As an alternative to double lining, placing an additional sheet of plastic on the bottom of the trailer allows the loads to slide out of the trailer bed.

- Overloading transport trailers can result in logistical and safety problems. As large loads expand during transport (bloat) they become too large to fit between the tailgate and the bed and are too heavy to slide out easily. Large loads can damage trailers, upset trucks and cause other safety or biosecurity problems.
- In order to maximize the utilization of limited trucking resources, it may be appropriate to obtain transportation waivers on operator hours and load weights.
- Gasketed dump trailers are necessary to ensure proper biosecurity and efficient loading and unloading.
- Bird control needs to be maintained at the landfill to keep gulls, vulchers and other scavenger birds away from poultry carcasses until they can be completely covered with solid waste.

Method: Controlled Slaughter

Summary of Method:

Flocks testing positive for Avian Influenza are quarantined and kept on the farm until the virus has run its course. Once the birds shed the virus and test negative, they are sent to slaughter. Trucks are netted and travel on pre-approved routes. Birds are processed at the end of a plant shift so the plant, trucks and equipment can be cleaned and disinfected.

Volume Disposed:

943,000 birds from 40 AI positive flocks were slaughtered. This practice stopped on April 22, 2002 when a new State disposal protocol was implemented requiring all flocks to be depopulated within 24-hours of virus confirmation.

Advantages of Method:

- Less waste and less environmental impact.
- Less expensive than traditional disposal methods.
- Growers receive some payment for their birds.

Disadvantages of Method:

- Consumer response to purchasing poultry products from infected flocks. Regardless of the pathogenicity of an AI outbreak, this method would not likely be publicly acceptable as concerns over H5N1 increase.
- Increased biosecurity and C&D required at the processing plant.
- Impact on the export market.
- Increases the chance of the virus mutating into a highly pathogenic strain. (Leaving positive birds in the field increases the change for virus mutation.)
- Biosecurity is harder to maintain when transporting live birds.
- Difficult to ensure absolute biosecurity while positive birds remain of the farm.

Lessons Learned:

- The use of this method was discontinued due to potential impacts on the State's export markets.
- Better communication and pre-planning is necessary for large-scale controlled slaughter including the decision to dedicate processing facilities or to process during a separate shift.
- Due to human health concerns, controlled slaughter will not likely be an acceptable method in future outbreaks.

Method: Rendering

Summary of Method:

Infected flocks are euthanized on the farm and loaded into leak proof trucks and sealed to prevent the blowing of infectious material during transport. Trucks are cleaned and disinfected before leaving the farm and traveling to the rendering plant. Once unloaded at the rendering plant, trucks are cleaned and disinfected. Traffic to and from the plant and the movement of personnel is controlled and appropriate cleaning and disinfecting is conducted.

Volume Disposed:

None.

Advantages of Method:

- The poultry industry owns some of the rendering plants, giving it more control over the disposal process.
- Rendering plants are closer to the poultry producing areas in the Shenandoah Valley than large commercial landfills.
- Tipping fees may be less than at landfills.
- Long term management is not required.
- No environmental impact.
- Produces a usable end product (market uncertain).
- If no market for the product exist, allows for the biosecure transport of rendered proteins to the landfill.

Disadvantages of Method:

- Because rendering plants are located close to other poultry operations, all possible sources of disease transmission must be identified and controlled.
- Plant capacity may not be adequate.
- Due to steps needed to ensure biosecurity at the rendering facility, a plant may need to be dedicated to rendering AI carcasses for the duration of the outbreak. This may not be economically feasible for a limited outbreak.
- Integrators without rendering capability would be at the mercy of a private rendering company.

Lessons Learned:

- This method may be used in future outbreaks with proper monitoring and management.
- Discussions with rendering companies and the poultry industry should occur at the highest levels prior to an outbreak.
- Most rendering facilities are privately-owned (not owned by the poultry industry) and are not required to accept AI birds.

Method: Incineration/Combustion

Summary of Method:

Large-scale incineration of euthanized poultry carcasses had not been attempted in the United States prior to the 2002 AI outbreak in Virginia. After Hurricane Floyd (1999), a large number of livestock (including some poultry) were disposed of in air curtain destructors in North Carolina. In 2002, as the need for carcass disposal methods became critical, USDA decided to use air curtain destructors to supplement other ongoing disposal methods. Two air curtain destructors were transported to a limestone rock quarry that was leased for use as an incineration site. Later, 3 additional destructors were added.

The contractor was responsible for operating the destructors and providing fuel wood. USDA was responsible for providing both physical security (access), and biosecurity (disinfection of vehicles, people, and equipment). DEQ issued emergency air permits to burn up to 10,000 tons of carcasses. DEQ inspected the trailers, weighed the trucks, and monitored water and air quality.

Based on air monitoring results, the operation did not pose health or environmental hazards. There were odor complaints from several residents located near the quarry. Runoff from the operation caused algae growth in the on-site quarry ponds. Water quality in the stream was not affected.

Fuel wood was transported to the site from as far away as 150 miles. Additionally, USDA conducted tests on a diesel fuel manifold to improve combustion efficiency. The diesel fuel manifold, as designed, did not significantly improve unit throughput.

Volume Disposed:

2,268 tons of carcasses were incinerated. This includes 132,200 chickens (528 tons or 23.3%) and 507,800 turkeys (1,740 tons or 76.7%).

Advantages of Method:

- Carcasses are transformed into a material (ash) that can be beneficially used.
- Limited impact on ground and surface water.
- Able to operate 24 hours a day, 7 days a week.

Disadvantages of Method:

- Large volume of materials that needs to be managed (2268 tons carcasses plus 10,000 tons of wood yielded over 5,000 tons of ash, scrap metal, rock, and unburned wood).
- Difficulty in obtaining the necessary volume of high quality fuel wood.
- Less biosecure than on-farm disposal methods.
- Difficulty in maintaining the optimum volume of birds for incineration. Receiving too many birds at one time allows them to decompose and release free liquid that could contaminate surface or groundwater.
- Loading birds into the destructors requires oversight by the government agency contracting the incineration. Improper loading causes lower burn temperatures and subsequent smoke and odor, and significantly decreases throughput.
- Odor complaints.
- Air emissions.
- Potential for surface and groundwater contamination from decomposition byproducts.
- More expensive than other methods.

Lessons Learned:

- Contracting agencies need strict oversight of wood procurement, scheduling, and destructor operation.
- The intensive demands on the equipment operator requires short shifts (no more than 4 hours) for effective destructor operation.
- More effort is needed to minimize leachate from decomposing birds. A 3-sided portable metal loading platform such as those used for unloading biosolids could be used to prevent runoff from stockpiled carcasses.
- Operation during atmospheric inversions (daily and front related) results in hanging smoke and odor.
- Due to the high potential for equipment fires and other malfunctions, immediate sources of back-up equipment should be identified.
- Extensive air monitoring is necessary to ensure the safety of the local residents.

Method: On-site Burial

Summary of Method:

Infected birds are euthanized on the farm. DEQ issues an emergency permit to dispose of solid waste authorizing the burial of poultry carcasses, litter, bedding and eggs that have been infected. A burial pit is excavated meeting the construction and set-back requirements of the permit. Approximately 1 foot of litter is placed in the bottom of the excavation. Birds are placed on top of the litter followed by an additional foot of litter. The excavation is covered with at least 2 feet of dirt placed with at least a 2% slope to prevent ponding of water. The exact placement of birds and litter is dependent on the conditions of the permit.

Volume Disposed:

One flock (13,800 birds) of turkey breeder hens and the daily mortality from a second flock of turkey breeder hens (approximately 1,000 birds).

Advantages of Method:

- Relative low cost.
- Highly biosecure—no off-farm transportation of infected carcasses.
- Local government approval not required.

Disadvantages of Method:

- Potential for groundwater contamination.
- Adverse public perception.
- Requires environmental permits.
- Not appropriate in many geologic settings.
- Many producers are opposed to having burial pits on the farm due to concerns about the impact on their property value.
- Requires maintenance of the pit to prevent ponding and erosion.
- May impact future land use decisions.

Lessons learned:

- The public is much more aware and concerned about environmental issues than they were during the 1984 outbreak.
- Discussion on the application of this method need to occur prior to an outbreak between all agencies and affected parties.
- The potential environmental/human health impacts of each burial pit should be considered prior to construction.

Method: Ag-Bag© Composting

Summary of Method:

The Ag-Bag© model CT-10 was used during this outbreak. It is a plunger type system with a large top fed hopper. The poultry carcasses and litter are removed from the houses using skid loaders. The mixture is then dumped outside and watered to the desired moisture content. An additional carbon source may be added if necessary. A pay-loader is used to load the Ag-Bag© machine. The equipment fills the bag and places two plastic ventilation tubes in the lower portion of the bag. After each 200' by 10' by 6' bag is filled, it is sealed and plastic vents are placed on both sides of the bag. The plastic vents are left open and air is forced through the plastic tubes by a high volume fan. The fan runs in cycles of 4 hours on and 10 hours off. Temperatures within the bag are recorded through bag vents with a 36-inch composting thermometer. Temperatures within the bags should exceed the recommended composting temperature of 130°F.

Volume Disposed:

One commercial turkey flock and one commercial layer flock were disposed of by this method. The commercial turkey carcasses totaled 200 tons (15,500 birds) and the layer hens totaled 25 tons (14,000 birds). The turkeys had previously been windrowed in the poultry houses for approximately one month but did not appear to be fully composted. At the layer operation, chicken carcasses, eggs, feed, and cartons were all composted.

Advantages of Method:

- Infected birds do not leave the farm.
- No adverse environmental impact.
- Usable end product.
- End product can be used when needed. Bags do not need to be opened immediately after the process is completed.
- Relative low cost after initial capital investment in equipment.
- Limited adverse public perception.
- Can be used regardless of soil type and proximity to environmentally sensitive features.
- Repopulation can be fairly rapid minimizing lost production time.

Disadvantages of Method:

- Disinfection of the machine and essential equipment is time consuming.
- Transportation of the oversized equipment takes time and requires special transportation permits.
- The machine can only operate at one farm at a time. Filling the bags takes between 24 and 48 hours depending on the size of the operation.
- If the equipment is purchased, it needs to maintained so that it is operational for an outbreak.
- The Ag-Bags© are 200 feet in length and require a relatively flat topography near the poultry houses.
- Open space around the farm could be tied up for several months until the composting process is finished.
- Mixing the water, litter, birds and any additional carbon occurs outside of the poultry houses and may pose a biosecurity risk by aerosolizing the virus.
- It is difficult to calculate the optimum moisture content at the time the bags are being filled and more difficult to adjust moisture after the bags have been filled.

Lessons Learned:

- Coordination is required to provide the necessary water trucks (if necessary), machinery, equipment, and personnel.

- The poultry and carbon source (litter) must be thoroughly mixed and not layered into the Ag-Bag© hopper. Layering creates sections of cooler temperatures, which hinders the composting process.
- The compost that is removed from the Ag-Bag© needs further windrow composting to produce a suitable product for land application.
- When assessing the need for additional moisture, account for the moisture within the birds carcasses. This method is less forgiving of excess moisture than traditional windrow composting methods.

Method: In-house Composting

Summary of Method:

In-house composting was explored early in the AI outbreak since on-farm methods are preferable from a biosecurity perspective.

In the 2002 outbreak, on-farm composting was given a low priority because, without proven methodology, it had greater logistical demands than off-site management options. During the early phase of the outbreak, as many as 40 farms were scheduled for euthanasia and disposal, severely taxing the resources of the poultry industry.

One company did take the initiative to in-house compost a grow-out turkey flock (15,500 10-pound birds). Another company also composted a flock of young turkeys (less than 5 pounds) after the older turkeys within the 2-stage flock went to controlled slaughter.

Procedure:

- Ensure that all personnel have appropriate personal protective equipment and training.
- Minimize ventilation; raise poultry feeders and waterers.
- Effective in-house composting must have a minimum of 1.5 pounds of carbon material (based on a 30 lbs/cubic foot material) per pound of bird. (1 lb. of carbon per lb. of bird in the mix and the remaining carbon for cap and cover.)
    - Determine total pounds (lbs.) of birds
        - lbs. birds = number of birds X average weight in lbs.
    - Determine pounds of litter in house
        - cubic feet of litter = length of house X width of house X depth of litter (in feet)
        - lbs. litter = cubic feet of litter X weight of a cubic foot of litter (Average = 30 lbs; Range = 25 to 35 lbs.)
    - Determine amount of additional carbon needed
        - total lbs. carbon needed = lbs. birds X 1.5

    - Cubic yards of additional carbon needed = (total lbs. carbon needed – lbs. litter in house)/(weight per cubic ft. of carbon material)/(27)
        - woodchips, litter or wet sawdust = 30 lbs./cubic ft.
        - dry sawdust = 15 lbs./cubic ft. (due to low density, volume can be reduced by 50%)
- Mobilize euthanasia, composting, and sanitation crews.
- Birds may be confined to a portion of the house for euthanasia. If whole-house euthanasia methods are used, windrow construction procedures will differ.
- Breeder and double-deck houses require alternate windrow designs.
- Unload additional carbon material (if needed) near doors so it is accessible during windrow construction.
- Follow industry guidelines for humane euthanasia.
- Till any excessively caked litter in the house to form a good base (4-6 inches) for the windrow (avoid compacting windrow base with equipment traffic).
- Use the skid loader and/or tractor to crush large birds within the euthanasia pen. May not be necessary for small birds (< 5 lbs.)
- Place any remaining feed on top the birds.
- Begin mixing birds and litter from the euthanasia end of the poultry house alternating 1 loader bucket of birds with 2 bucket of litter/carbon.
- Using the skid loader, begin constructing the windrow with the bird/litter mix on the tilled base at the other end of the poultry house.
- The windrow should be 4 to 6 feet high and 12 feet wide.
- As the windrow is being constructed, cap with 4 to 6 inches of litter from the sides of the windrow.
- Continue this process until all of the bird/litter mix has been added to the windrow.
- Any remaining litter should be used to cap the windrow.

Volume Disposed:

15,500 – 10-pound turkeys
13,000 – 2-pound turkeys

Advantages of Method:

- Highly biosecure since infected carcasses are not removed from the farm. Keeping the process in the poultry house minimizes the airborne dispersion of virus.
- Relative low cost.
- Minimizes the number of people necessary for disposal, lessening the potential exposure to virus.
- A skid loader is the only piece of equipment required for this method. Additional equipment may be necessary if other sources of carbon are needed.
- Local government approval is not required. An emergency was not declared during this outbreak. Without a declared emergency, options that required local approval become unreliable.
- State permits are not required.

- Composting produces a beneficial end product that can be utilized within the agricultural community.
- Limited adverse public perception.

Disadvantages of Method:

- The process requires longer-term management than other disposal methods.
- Additional, carbon material (sawdust, shavings, litter, etc.) may need to be brought from off-site. Vehicles transporting this material need to be cleaned and disinfected.
- Incentives may be necessary to facilitate the off-site use of the compost material when the infected farm does not have land application fields.
- Depending on the moisture content of the litter, additional water may be needed. Water may need to be hauled from off-site.

Lessons Learned:

- The poultry companies need to be actively involved in managing this process.
    a. Have experts (Extension Agents, DEQ, etc.) involved when an outbreak occurs.
    b. Determine, prior to an outbreak, which farms would likely not have sufficient litter on site, how much carbon material would be needed, and identify sources of carbon.
    c. Identify sources of water.
    d. Identify the equipment needed to construct and turn the windrows.
- Much of the opposition to in-house composting is the concern that this option would tie up the house longer than other methods. USDA records from the 2002 outbreak indicates that the average downtime (from date of depopulation to the quarantine release date) was 75 days (shortest, 25 days--longest, 177 days) utilizing off-site disposal methods.
- Rapid Response Teams should be formed, trained and equipped to compost flocks within 24-hours of virus confirmation.
- Written procedures should be prepared and disseminated to appropriate personnel.
- Protocols should be reviewed and updated as euthanasia procedures evolve (i.e. a shift from CO_2 to foam euthanasia).

CONCLUSIONS

Carcass disposal will be a critical issue in managing future outbreaks of avian influenza. Lessons learned during Virginia's outbreak in 2002 can help guide future responses to disease outbreaks; potentially saving time, money and exposure to disease organisms. DEQ's conclusions include:

- On-site management is preferred over off-site management when environmental impacts are reduced.
- Preferred order:
    1) In-house Composting

2) Out-of-house Composting on-site
3) Other on-site methods as availability allows (e.g. alkaline hydrolysis, anaerobic digestion)
4) Landfill off-site
5) Rendering, incineration, or composting off-site
6) Burial on-site under emergency permit

- Composting was not successful as a management tool during the 2002 AI outbreak, but recent research and practical application during a later outbreak on the Delmarva peninsula has brought this concept to the forefront as one of the most biosecure and environmentally sound options available.
- Continued in-house composting research, training and establishment of response teams within the poultry industry are currently being expanded to facilitate implementation.
- Biosecurity concerns must be properly managed regardless of the disposal method, and an outbreak of highly pathogenic AI will escalate this priority in order to protect public health.
- For large scale outbreaks, a combination of options implemented in a tiered approach may be necessary.
- Mobile equipment and technology has improved over the past few years, making new management options available, but in need of more research and experience for practical application.