On-Farm Carcass Disposal Options for Dairies

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Take Home Message

- Options for disposal of livestock mortalities are becoming more limited and increasingly regulated due to environmental and disease concerns.
- Before choosing a disposal method, first determine what is legally allowed at your farm location as regulations differ across provinces and municipalities.
- Cause of mortality, height of water table, proximity to open or ground water, topography of farm, soil type, prevailing wind direction, population density, relationships with neighbours, time, effort and advance preparation required will influence choice of disposal option(s).
- Composting and incineration are currently the on-farm mortality disposal options which offer the greatest biosecurity and the least potential for environmental contamination.

Introduction

Before the advent of BSE in Canada, disposal of mortalities was relatively straight-forward for many western Canadian dairies. A simple phone call to the local rendering company usually solved the problem. After BSE, rendering has become a fee for service industry with at least $75 charged per head for on-farm pick up. As well, rendering may not be an available option in some areas, an example being the province of Manitoba where rendering is currently only available for swine. Consequently, on-farm options for disposal of livestock mortalities are becoming increasingly attractive.

Along with the sudden shift in economics of mortality disposal comes a heightened on-farm concern for biosecurity. Rendering did an excellent job of removing pathogens from the farm environment and preventing the contamination of air, land and water. However, the situation changes for on-farm disposal of mortalities. Obviously, dead cattle died for some reason and any on-farm disposal method used should not lead to the spread of disease or negatively impact the environment.

When any new problem arises, researchers immediately leap into action. Unfortunately, speedy problem resolution by researchers is actively discouraged in the interest of preserving long-term research funding. Research into the environmental impacts, year-round feasibility and efficacy of pathogen elimination by the various methods for disposal of mortalities is mostly in its infancy. As well, some regulatory agencies seem to be stuck in the mindset of 1348 when burning was given the seal of approval for cases of the Black Death. As recently as 2001, smoldering piles of dead cattle and sheep decorated the U.K. after the outbreak of foot and mouth disease. Much better methods of mortality disposal than burning exist. Ignoring the contamination of air due to burning carcasses, it was later determined that the wind carrying hair and skin from funeral pyres actually helped to spread the virus (Gloster et al. 2001; Jones et al. 2004).

In this article, a variety of methods of on-farm mortality disposal will be discussed, although some will be given short shrift due lack of pathogen control or environmental concerns. Before a mortality disposal method is chosen, regulatory issues must first be addressed as regulations differ across province and sometimes by municipality within the province. On-farm mortality disposal options for dairies include (in no particular order) natural exposure, burial, burning or incineration, biodigestion and composting. For each option, the advantages, challenges and advance preparation required will be discussed.

Natural Exposure

Natural exposure involves taking dead cattle to an isolated part of the farm to be consumed by scavengers. No advance preparation is required and work/skill involved is minimal. In Alberta, natural exposure is a legal means of dead stock disposal (Anonymous 2002), although in practical terms legality is dependant on lack of complaints received by provincial regulatory officers.

As a disposal option, natural exposure can only be recommended in sparsely populated areas where huge tracts of land are available far removed from livestock. Problems associated with natural exposure are numerous and include transmission of foul odours, parasites and pathogens, conflicts with neigbours, contamination of water supplies and increased populations of scavengers and flies. Due to increased usage of natural exposure for disposal of cattle mortalities, outbreaks of cysticercosis, formerly a problem only in the third-world (Sani et al. 1997), have begun to appear in Alberta (Scandrett and Gajadhar 2004). With this condition, water or feed for cattle becomes contaminated with larvae from a tapeworm present in canine feces.

Cattle ingest the larvae and the larvae invade the skeletal muscles and lead to condemnation of the carcass. Completion of the lifecycle of the tapeworm requires that canines consume a carcass containing the larvae. If natural exposure is used as a method of mortality disposal, all farm dogs in the vicinity should undergo a rigorous parasite control program. Unfortunately, scavengers such as coyotes are very difficult to de-worm (at least on a regular basis).

On-farm Burial

Advance preparation: (hole digging) is required, including hiring machinery such as a backhoe. Digging a hole in frozen soil is impossible. Trenches to a depth of 1-1.2 metres are recommended as deeper holes are difficult to dig and may collapse. (Anonymous 2002) In most parts of Canada, burial pits must be covered by at least 3 ft (1 metre) of soil and some jurisdictions regulate the maximum weight of dead stock per hole.

Due to odour, vermin and possible contamination of drinking water mortalities should not be buried closer than 100 m from neighbouring homes or livestock facilities (barns, pens). Burial sites should be isolated from wells and streams or ponds. A distance of 150 metres or more is advisable between burial pits and wells (Anonymous 2002).

Water table, land topography and soil type of the available land will determine if burial is a valid option. Burial pits work best in heavy clay soils as there is less contamination of ground water. Burial pits should be located on flat land to avoid water erosion of the burial site and possibly contaminated run-off. If the water table is high at any time of the year (water in hole), burial is not recommended. Although burying one animal is unlikely to cause an environmental catastrophe, burying multiple animals has been shown to contaminate groundwater (Glanville 2000) and was not allowed for disposal of BSE suspect animals in Britain (Scudamore et al. 2002). As well, burial is slow to dispose of animals. Buried carcasses may not be fully degraded for years (Freedman and Fleming 2003) while production of noxious odours will continue unabated.

Other possible hazards of using burial for mortality disposal include danger of livestock, machinery or farm workers falling into open excavations. Open holes should be signed/flagged and covered as soon as possible. Unfortunately, burial pits are rarely covered after addition of each animal, which leads to scavenging of carcasses prior to complete burial and many of the same problems seen with natural exposure.

Incineration

Advance preparation: need to have incinerator (large barrel or burn pile is not incineration). Fuel for incinerators is often wood or natural gas. Although incinerators can be a mobile unit shared between farms, fuel source will determine location. Contamination of air is greatly reduced in high-temperature incineration as compared to burning, but common sense (knowledge of prevailing winds, distance to neighbours) should be used.

Other considerations: Time required will be dependent on the size of the incinerator. A small incinerator may take several days to completely incinerate a mature cow. Ash needs to be cleaned from the incinerator after use and disposal of ash may be a problem. Some localities such as Quebec require a second combustion chamber (after-burner) to reduce air contamination.

Advantages of incineration include: disposal of mortalities as they arrive – no need to stockpile. Residue from properly incinerated carcasses will not attract vermin and the mortality volume is almost completely reduced. As well, pathogen control from incineration is excellent, with incineration the method of choice in the EU for disposal of cattle (or parts thereof) possibly containing BSE prions (Scudamore et al. 2002; Paisley and Hostrup-Pedersen 2005). However, transport of highly infectious/dangerous materials to off-site high-capacity incinerators is also a biosecurity risk as would be sharing an incinerator between farms.

The primary obstacle to incineration is the major capital investment for equipment and the on-going expense for fuel. Maintenance costs for incinerators are also high. Safety hazards (starting new fires, injury to family members) are associated with high-temperature incinerators. As well, incinerators may not be legal in some jurisdictions, especially those in close proximity to urban areas.

Burning

Due to the excessive air contamination from burning carcasses and possibility of spread of pathogens due to incomplete combustion (Gloster et al. 2001; Scudamore et al. 2002; Jones et al. 2004) burning cannot be recommended as a means of disposal of dairy mortalities unless the dairy is in an extremely remote location with no near neighbours. As well, open burning of carcasses is a substantial fire risk and should not be attempted in dry or windy conditions. In most locales, burning carcasses is not a legal means of disposal. Dead cows are not prone to spontaneous combustion – considerable time and fuel will be required.

Biodigestion

Biodigestion is an appealing concept. In summary, livestock mortalities, manure, sewage sludge or other organic wastes are fed into an anaerobic chamber. Microbes then ferment the carbon sources into methane that can then be used to generate electricity, off-setting power usage at the farm. On the down-side, biodigestion technology is mostly in developmental stages in north America with a large capital outlay required (dependant on size of biodigester) and as yet low efficiency of methane production.

Successful operation of a biodigester relies on simple concepts from basic microbiology. In order to keep microbes happy, a steady flow of readily fermentable and similar substrates are required (whole cattle would require processing into a suitably small size for the digester). Microbes also prefer a constant temperature, which will require inputs of heat in the Canadian climate. Biodigesters have been shown to reduce efficiency at ambient temperatures of less than 30^{o} C (Dhaked et al. 2005). Currently most on-farm biodigesters use liquid manure as a feedstock (Amaral et al. 2004), although use of livestock mortalities in biodigesters has been proposed (Pedraza et al. 2002). The effluent from the biodigester is then used as a fertilizer, although the extent of pathogen/ parasite control from biodigestion remains to be evaluated.

Composting

Scientific methods of composting were first developed by the poultry (Rynk 1992) and pork industries (Henry 1995), with composting of cattle mortalities a more recent development (Mukhtar et al. 2003). Some advance preparation is required including a suitable area for composting (at least 100 m from wells, or bodies of water). Either bins (Stanford et al. 2000) or windrows (Fonstad et al. 2003) can be successfully used for mortality composting, although if windrows are used the composting area should be suitably secure to repel scavengers. As well, the composting site needs to be well-drained, have year-round access and able to contain run-off from rain or snow (Anonymous 2002). Turning the compost is essential to completely degrade the carcasses (Stanford et al. 2000). As a general rule, mature cattle mortalities should be turned at least 3 times at 3 month intervals. Specialized compost turning equipment is not required as a tractor with front-end loader works well for turning windrows containing cattle.

To build cow compost, besides the dead cows, a carbon source (sawdust, straw, wood chips) and solid or liquid manure are required. There are three requirements for successful composting of cattle mortalities: First, air must infiltrate the compost piles. Second, water content of the mixture should be 50-60%. The mixture should feel wet, but no moisture should drip from it if a handful is squeezed. Third, the carbon/nitrogen ratio should be between 20 and 40:1. Adding equal volumes of carbon source (straw, sawdust) and dead cattle will ensure that the carbon: nitrogen ratio is in the correct range.

Using manure in the mix allows year-round composting, with twice as much solid manure added as mortalities to the compost pile. If 'solid' manure is too wet when building the pile, oxygen is excluded and noxious odours are produced. For liquid manure systems the simplest approach is to build the straw base (at least 80 cm thick), lay the carcass on top of the straw and cover with another 80 cm of straw. Then, gently drizzle liquid manure over the straw, allowing the manure to percolate throughout the compost Do not add so much manure that it begins to run off the compost. Water may have to be added to the manure slurry. A general recipe is 1 front-end loader bucket of dairy slurry to 4.5 tractor buckets of straw, with approximately 500 litres of water added to the slurry to increase percolation of the manure through the straw (Sexton, Unpublished).

Compost is built in layers, starting with a layer of carbon source at the bottom of the pile. Dead cattle are placed on the straw layer and should be separated (not touching each other) and covered with a layer of solid manure (or straw if using liquid manure) shortly after addition to the compost pile.

Composting requires active management. Temperatures of the piles must be monitored and once the piles cool to 30^{o} C, the compost should be turned and water added to the pile if necessary. Turning the compost is essential to ensure complete breakdown of bones and tissues. Provided the compost heats to greater than 55^{o}C, most bacterial and viral diseases and parasites will be killed (Stanford et al. 2000; Fonstad et al. 2003). However, the effectiveness of composting at elimination of recalcitrant bacteria such as *Listeria* or prions is currently being evaluated, although preliminary studies have demonstrated the ability of composting to eliminate infectivity in scrapie prions (Huang et al. 2004).

Advantages of composting for mortality disposal include: relatively low cost, excellent pathogen and parasite control (although jury is still out on *Listeria* and BSE), year-round use, environmental neutrality and effectiveness for one animal or many. Once compost is actively heating scavengers are not attracted to mortalities. Compost that fails to heat from lack of oxygen or water can always be rescued by either turning or adding water (if necessary). In well-managed compost (properly heating), the odour is that of manure and no dead animal stench is present.

Composting may not be for everyone as it requires some labour/ management, time (3 months for calves, approximately 9 months for mature animals), and space. In wet climates, compost may have to be covered in vapour barrier to avoid over-wetting. In dry climates, piles that are too small may desiccate (mummified carcass). If placed too close to the edge of the pile, bones may not degrade and will have to be added to next batch of compost and bones of mature animals are more difficult to degrade than those of calves.

Conclusions

No single option for disposal of mortalities can be recommended in all circumstances, although composting and incineration are likely the two on-farm disposal methods most applicable to dairies. When choosing disposal option(s), transmission of pathogens or parasites to surviving herd mates, direct expense of the disposal method, indirect costs of the method (legal action by irate neighbours) and environmental impacts should all be considered.

References

Amaral, C.M.C, Amaral, L.A., Nascimento, A.A., Ferreira, D.S., Machado, M.R.F. 2004. Anaerobic digestion of dairy cattle manure with several hydraulic retention times. Ciencia-Rural 34: 1897-1902.

Anonymous 2002. Livestock Mortality Management (Disposal). Alberta Agriculture, Food and Rural Development, Agdex 400/29-1, 12pp.

Freedman, R. and Fleming, R. 2003. Water quality impacts of burying livestock mortalities. Ridgetown College, University of Guelph, Livestock mortality Recycling Project Steering Committee.

Dhaked, R.K., Ramana, K.V., Tomar, A., Wagmare, C., Kamboj, S.V., Singh, L. 2005. Immobilization of anaerobic bacteria on rubberized-coir for psychrophilic digestion of night soil. Anaerobe 11: 217-224.

Fonstad, T.A., Dmeier, D.E., Ingram, L.J. and Leonard, J. 2003. Evaluation and demonstration of composting as a option for dead animal management in Saskatchewan. Canadian Biosystems Engineering. 45: 19-25.

Glanville, T. 2000. Impact of livestock burial on shallow groundwater quality. American Society fo Agricultural Engineers, Mid-Central Meeting, April 28-29th.

Gloster, J. Hewson, H., Mackay, D. Garland, T, Donaldson, A, Mason, I, and Brown R. 2001. Spread of foot and mouth disease from the burning of animal carcasses on open pyres. Veterinary Record. 148: 585-586.

Henry, S.T. 1995. Composting – an innovation in dead swine disposal. Paper No 954506 presented at ASAE Animal Meeting, Chicago Illinois, June 18-23.

Huang, H., Spencer, L. Rendulich, J., Soutryine, A. and Balachandran, A. 2004. Degradation of scrapie prion proteins by composting procedures. Presented at the Canadian Animal Health Laboratorians Network, May 16-19 in Guelph, Ontario.

Jones, R. Kelly, L. French, N. England, T.l, Livesey, C. and Wooldridge, M. 2004. Quantitative estimates of the risk of new outbreaks of foot and mouth disease as a result of burning pyres. Veterinary Record. 154: 161-165.

Mukhtar, S. Auvermann, B.W., Helfin,.K. and Boriak, C.NM. 2003. A low maintenance approach to large carcass composting Paper number 032263 presented at the ASAE Annual Meeting Las Vegas Nevada, July 27-30.

Paisley, L.G. and Hostrup-Pedersen J. 2005. A quantitative assessment of BSE risk associated with fly ash from the incineration of meat and bone meal in a gas-fired power plant in Denmark. Preventative Veterinary Medicine. 68: 363-275.

Pedraza, G. Chara, J. Conde, N., Giraldo, S. Giraldo, L. 2002. Evaluation of polyethylene and PVC tubular biodigesters in the treatment of swine waste water. Livestock Research for Rural Development 14: 1-18.

Rynk, R..ed. 1992. On-farm composting handbook. Northeast Regional Agricultural Engineering Service Publication 54, Ithaca NY, 54 p.

Saini, P.K., Webert, D.W. and McCaskey, P.C. 1997. Food safety and regulatory aspects of cattle and swine cysticercosis. Journal of Food Protection 60: 447-453.

Scandrett, W.B. and Gahadhar, A.A. 2004. Recovery of putative taeniid eggs from silt in water associated with an outbreak of bovine cysticercosis. Canadian Veterinary Journal 45: 758-760.

Scudamore, J.M. Trevelyan, G.M., Tas, M.V., Varley, E.M. and Hickman, G.A.W. 2002. Carcass disposal: lessons from Great Britain following the foot and mouth disease outbreaks of 2001. Revue Scientifique et Technique Office International des Epizooties 21: 775-787.

Stanford, K., Larney,. F.J. Olsen, A.F., Yanke, L.J. and McKenzie, R.H., 2000. Composting as a means of disposal of sheep mortalities. Compost Science and Utilization 8: 135-146.