PERSPECTIVES ON POULTRY WASTE MANAGEMENT

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Chief among problems facing the poultry industry are those of waste management and associated environmental issues. Today the poultry industry is larger, more concentrated, and more technically advanced than it was one or two decades ago. The concentration of the poultry industry has resulted in the production of large volumes of by-products including: manure, farm mortalities, hatchery, and processing plant wastes that require daily attention. The poultry industry has responded well in objectively evaluating economically and environmentally sound management principles in dealing with by-product utilization as opposed to disposal. Many of the so-called wastes, if managed and processed appropriately, have the potential for increasing the economic profitability of the poultry operation. Disposal of poultry by-products has been identified by the poultry industry as a priority. Poultry producers must plan and manage their operations in a way that is safe for the environment. Poultry wastes, if improperly managed, can cause problems in the environment and can create hazards to human and animal health.

MANURE MANAGEMENT

Non-point source pollution has become a major environmental problem in many areas of the United States, especially near intensive confined livestock and poultry operations. Increases in human population and changing human diets have demanded rapid increases in livestock and poultry production, and most of these increases are taking place in areas containing many intensive confined production enterprises. The broiler industry in the Southeastern United States produces an estimated 7.5 million tons of litter annually. In order for livestock and poultry expansion to be compatible with an increasing human population and not adversely affect the environment, new and innovative waste management systems must be developed and adopted by industry and grower alike.

AFO/CAFO Requirements

Poultry and livestock producers will be faced with mandatory nutrient and waste management planning as a result of impending AFO (Animal Feeding Operations) and CAFO (Confined Animal Feeding Operations) regulations. The producer must ensure that all of the manure from his population of birds can be spread at acceptable rates on available land according to best management practices and nutrient management plans. Proper management of animal wastes to prevent contamination of surface and ground water is a necessity if continued expansion of the poultry industry is expected. All Animal Feeding Operations will soon be required to have a Conservation Plan for Waste Management Systems that meets or exceeds Natural Resources Conservation Service (NRCS) technical standards and guidelines. Operations which require registration must have a comprehensive Conservation Plan and will be required to maintain detailed records to ensure proper application of waste on and off farm.

According to the Alabama Rule, operations defined as *Concentrated Animal Feeding Operations* (CAFOs) will need to have a waste management plan, actively apply the plan, and receive an annual certification. Operations defined as *Animal Feeding Operations* (AFOs) will be required to meet the same standards, but will not be required to be certified. CAFO, as defined for poultry, is an animal feeding operation where more than 125,000 broilers, laying hens or other poultry will be confined or concentrated and fed or maintained for a total of 45 days or more in any 12 month period. An AFO as defined for poultry has 37,500 or more broilers, laying hens or other poultry confined or concentrated and fed or maintained under similar provisions. These facilities will be required to invoke Best Management Practices (BMPs) but will not require certification under the new regulations.

Where Can Animal Feeding Operations Be Located?

AFO confinement buildings with a liquid waste/wastewater handling system, liquid waste storage settling basins, lagoons, holding ponds, sumps or pits, and other animal liquid waste containment structures for new operations shall be located to meet or exceed NRCS technical standards and guidelines, but in no case shall be constructed within 1,320 feet of the nearest existing non-owner occupied dwelling, church, school, hospital or park, or within 500 feet of any property line. Any new additional confinement buildings with a liquid waste/wastewater handling system cannot be constructed within 660 feet of the nearest existing non-owner occupied dwelling, church, school, hospital or park, or within 500 feet of any property line.

AFO confinement buildings with a dry waste handling system or dry waste storage/containment and treatment structures for new operations can be located no closer than 330 feet from the nearest existing non-owner occupied dwelling, school, church, hospital or park, or within 165 feet of any property line. Any new or additional confinement buildings with a dry waste handling system cannot be constructed within 165 feet of the nearest existing non-owner occupied dwelling, church, school, hospital or park, or within 165 feet of any property line, or within 165 feet of any property line.

Are There Educational or Training Requirements?

Proof of satisfactory completion of up to 16 hours of group or individualized training and education must be obtained no later than 1 year after the effective date of the initial registration. All managing owner/operators and onsite supervisors of all CAFO operations must provide certification of satisfactory completion of annual refresher training in the areas of general BMPs, comprehensive waste/wastewater management, land application, dead animal disposal, and other areas as described for up to 8 hours annually.

Waste Management Planning

Poultry producers must plan and manage their operations in a way that is safe for the environment. Poultry manure and mortalities, if properly managed, can cause problems in the environment and can create hazards to human and animal health. Developing a sound Conservation Plan for Waste Management Systems is an important first step towards an environmentally responsible poultry operation. Such a plan ensures that all manure from the producer's population of birds can be applied on the land at acceptable rates. The location and sizes of fields are considered, along with the nutrients required for the cropping system of these fields. A map identifying field usage may also be produced. If more land area is required, the producer must supply statements from neighboring landowners who will use excess production. The plan should also provide details on application rates, timing of applications, and split applications, if appropriate. Recommendations for manure storage may also be included. The plan should also describe the type of system used for the disposal of carcasses resulting from normal mortality. Site specific plans may be required.

Value of Poultry Manure

To land apply poultry waste in an environmentally responsible manner requires a well-planned program that balances the nutrients present in the materials with a cropping system capable of using the same nutrients. A plan must include a soil and waste analysis, calculation of application rates based on plant nutrient needs, and application timing and placement to promote plant nutrient uptake. When litter is to be applied to crop land, the nutrients in the litter should be determined prior to application. A minimal analysis should include moisture, ammonia nitrogen, organic nitrogen, phosphorus, and potassium. This allows a calculation of the nutrient content of the litter and the amount that should be spread on the crop. A good estimate of the fertilizer content of litter can be used if chemical analysis is not available. A ton of broiler litter (wood shavings and manure) with 20 percent moisture contains 60 lbs of nitrogen, 60 lbs of phosphate, and 40 lbs of potash; equivalent to a 3 - 3 - 2 fertilizer.

Determining Crop Nutrient Needs

Nutrient needs of the crop should also be determined. Soil testing provides the best estimate of residual phosphate and potash in the soil and the need for soil additions such as lime that should be applied for meeting optimal yields and nutrient use efficiency. Exceeding the recommended rates by more than 30% could result in excessive nitrogen leaching in some soils or the potential for surface run-off into streams. By calculating the availability of nitrogen in the manure, one can calculate the rate of application that is consistent with the requirements from the soil test report. In areas of intense poultry production, over-fertilization of pasture or crop land can result in surface or ground water contamination as a result of nutrient runoff or leaching. To obtain maximum economic value of plant nutrients in poultry manure and to protect water quality, the manure should be applied according to crop needs. Sampling, testing , and calculation of nutrient balance should be the responsibility of the person who produces the manure or the responsibility of the person who sells or spreads it for somebody else. Landowners should never accept manure for "free" or for purchase until the appropriate soil and manure analyses have been performed and a nutrient balance for the crop or pasture land has been calculated.

Nutrient Management

The poultry industry is now entering the era of "Nutrient Management" regarding the use of nitrogen and phosphorus. A poultry company and its producers aim to maximize bird growth and production efficiencies resulting in less waste. In nutrient management, the poultry producer tries to utilize as much nitrogen and phosphorus as possible for crop production and at the same time minimizing excess nutrients which could get into surface or groundwater. In order to accomplish this, the producer has to balance nutrient inputs and nutrient needs of the crop. That is, one needs to know where the nutrients are coming from (feed, fertilizer, manures, crop residues, etc.), where they are going (harvested and sold as a crop, sold as animals, tied-up in the soil, runoff into surface water, leached into ground water, etc.), and how much excess (or deficit) exists.

Nutrient management sound complicated but is quite simple. Many producers are already following good management practices and have the tools required for doing a good job of nutrient management. There are four basic steps to nutrient management.

Step 1. Know your soils

Study the soil map of the land where you anticipate nutrient application. Identify waterways, wells, streams, sensitive soils, etc. Obtain a soil sample to assess the nutrients, primarily phosphorus, already in the soil.

Step 2. Know your crops

Different crops and the level of management require different levels of plant nutrients. This information is usually provided on a soil test report. Higher levels of nutrients are usually recommended for hay type crops as compared to pastures because greater levels of nutrients are removed in the harvesting of hay. Irrigated crops have a higher nitrogen recommendation than low-yielding rain-fed crops.

Step 3. Know the source of nutrients

A simple calculation if you use chemical fertilizers. You read the bag or have the nutrients custom blended to match soil test recommendations. For poultry manures, sometimes an average value will suffice, but if the litter is composted, stored for a prolonged period or handled differently, its nutrient value could change. Samples of manure should be submitted for testing periodically.

Step 4. Know how much you are applying

After obtaining information concerning the soil and crop needs, the application rate needs to be established. Unfortunately, this is where most land application programs fail. Good spreader calibration and operation is essential for proper nutrient management. In practice, most producers do not know exactly how much manure they are spreading or how uniformly they are applying the litter to their crop or pasture land. Spreading equipment can discharge litter at varying rates, depending on forward travel speed, PTO speed, gear box settings, discharge opening, width of spread, overlap patterns, and other variables. Through simple calibration procedures to define settings and travel speed, farmers can determine the rate and uniformity of litter being applied.

Manure Storage

Improper management of litter after removal from the poultry house can result in losses of valuable fertilizer nutrients and could have potential for contaminating ground and surface waters. The method of stockpiling manure, uncovered, on the soil during the winter season before application on crop land can result in a five-fold reduction of nitrogen content. The nitrogen lost represents a loss of farm income because manure nitrogen can be used to replace purchased fertilizer nitrogen.

The cleaning period of a poultry house depends on flock scheduling, which does not always coincide with land availability allowing for the distribution of manure. A sensible solution is to provide suitable storage for manure until it can be properly land applied. The storage method must protect manure from prolonged contact with rainwater. This requires a surface on the stockpile that sheds water. A protective surface can be provided by covering the pile with plastic sheeting or providing a permanent roofed structure. A deep well-rounded stockpile of compacted manure will also shed water. An open uncovered stockpile should be used only for very brief temporary storage. Stockpiling manure or litter in plastic-covered windrows is a low cost method, but specific attention to make certain that the litter is weather-protected and will not cause environmental harm is necessary.

A roofed structure, especially when built on a concrete pad, provides the safest and most effective long-term storage for manures. A clear-span building allows for the most convenient movement of the product. Litter contains both wet and dry organic materials that produce heat when stored in confined piles. Storage structures with confining walls may be subject to spontaneous combustion within manure. Limit manure contact with wood or provide for concrete wall construction. Several techniques exist for the storage of poultry litter with a great range of investment costs. All available storage techniques and structures must be managed carefully to fully realize their potential for nutrient retention and environmental protection.

POULTRY CARCASS DISPOSAL

Disposal of poultry carcasses has been identified as one of the major problems facing the poultry producer. A fresh broiler carcass contains approximately 34.2% dry matter, of which 51.8% is protein, 41.0% is fat, and 6.3% is ash (Malone *et al.*, 1987). As the poultry industry expands, so also will the amount of waste generated on the farm. If poultry carcasses resulting in death by natural occurrences at such high levels of production are not disposed of by environmentally acceptable methods, future industry expansion will be limited or regulatory constraints will be imposed. Therefore, the poultry industry must aggressively pursue efforts to protect the environment in order to maintain a good public image.

ON-FARM DISPOSAL

Burial

Burial is an original method of disposal and is usually the most convenient. Open-bottom burial pits are presently the most commonly used method for the disposal of poultry carcasses. Disposal pits have been used with varying degrees of success by the poultry grower and can be fabricated from concrete block, monolithic concrete, or treated wood. However, increased production capacity per farm, high mortality rates, and increased market weights may attribute to slow decomposition rates and failure with this type of system. Ground water quality where open-bottom pits are located is of concern. Residue remaining in pits after years of use is also recognized as an emerging reason for considering alternative methods of disposal.

In the state of Arkansas, legislation was enacted to prohibit the use of burial pits as a method for the disposal of poultry carcasses beginning July 1, 1994. In the state of Alabama, the State Veterinarian mandated that no new burial pits could be established for the disposal of poultry carcasses after July 1, 1996. After July 1, 2000, burial will no longer be permitted for poultry carcass disposal. Other states are considering the passage of regulations to further limit the use of burial as a method for poultry carcass disposal.

Digestor

Dead bird digestors are a totally enclosed system utilizing a pre-cast septic tank or large capacity (3,785 liters) plastic tank designed to contain poultry carcasses and to promote microbial breakdown of the organic material in addition to eliminating harmful bacteria that are present in the carcasses. Typically, a commercially available bacterial culture with enzymes is added to the dead bird digestor to facilitate organic decomposition. In a long-term study (15 months) of six units, Macklin *et al.* (1997 and 1998) concluded that high levels of enteric bacteria exist in the dead bird digestors and that potentially pathogenic bacteria were continuously isolated from samples of the decomposing material throughout the course of the trial. Three units were infiltrated by ground water and were filled to capacity. Because of the potential threat that exists due to the presence of pathogenic microorganisms, the Alabama State Veterinarian's Office currently prohibits the use of dead bird digestors in Alabama.

Incineration

Incineration is recognized as one of the biologically safest methods of disposal. Wastes can be disposed of as rapidly as they accumulate, and the resultant residue is easily disposed of and does not attract scavengers or insects. Incineration eliminates the threat of disease and resulting residue will not cause water quality problems. The most acceptable method of incineration is one in which complete combustion is accomplished. Commercial units are available with oil or gas burners and are usually equipped with automatic timers. Smoke discharge stacks for such equipment may also be fitted with after-burning devices that complete gas combustion and recycle fumes to reduce odors. In some cases, a permit may be required to install and operate an incinerator.

Although incineration represents the safest biological disposal method, it tends to be slow, expensive, and nuisance complaints are likely as pollution is generated (Murphy and Handwerker, 1988). After initially purchasing an incinerator, the average poultry grower will spend approximately $7.72 to incinerate 100 kg of carcasses above installation, based on a propane cost of $0.16/liter (Donald and Blake, 1992). Also, certain maintenance costs are incurred with incinerators, such as grate replacement every two to three years or in some instances the entire unit may require either refurbishment or replacement every five to seven years.

Composting

Composting is a controlled, natural process in which beneficial microorganisms (bacteria and fungi) reduce and transform organic wastes into a useful end-product called compost. Initial work conducted by Murphy (1988) indicated that composting poultry carcasses provides an economical and biologically safe means of converting carcasses resulting from daily mortality into an odorless, humus-like material useful as a soil amendment.

On-farm composting of poultry carcasses requires two types of composting bins: a primary or first-stage composting bin and a secondary composting bin (Murphy and Handwerker, 1988; Donald and Blake, 1990). Daily, carcasses are sequentially layered into the primary bin with used or caked litter and water at a ratio of 1:2:0.25 by weight, respectively (Blake *et al.*, 1991). A six inch layer of litter is first placed on the concrete floor of the bin, then a single layer of carcasses is placed into the bin and water is added to maintain a moist, but not saturated condition. Finally, the layer of carcasses is covered with manure for subsequent layering. Thereafter, successive layers of litter, carcasses, and water are layered into the primary bin. Once full, a final cover of manure is placed over the carcasses.

Temperatures of the compost increase rapidly as bacterial action progresses, rising to 54 C plus within 5 to 10 days. The increase in temperature has two important effects: 1) it hastens decomposition; and 2) it kills microorganisms, weed seeds, and fly larvae. Temperature begins to decrease in the primary bin 14 to 21 days later. At this point, material is moved to the secondary bin, aerated in the process, and allowed to proceed through a second temperature rise. After the second heating cycle, composted material can be safely stored until needed for land application.

For composting to be a viable method for the disposal of poultry carcasses, it is paramount that the compost process completely inactivates pathogenic (avian and human) microorganisms prior to land application. Studies by Murphy (1990) and Conner *et al.* (1991 a,b,d) indicated that two-stage composting effectively inactivates poultry-associated bacterial pathogens. When properly managed, composting is a biosecure, relatively inexpensive, and environmentally sound method for the disposal of poultry carcasses. Its use is becoming more widespread as an alternative to a rendering facility.

SUMMARY

As the poultry industry grows, one of its major priorities is the protection of our natural resources. The industry demands new technologies in poultry by-product development and utilization in its efforts to protect water quality and foster a cleaner environment. A number of positive efforts are underway in the United States to address educational needs of the poultry industry relative to environmental concerns and to ensure voluntary compliance with environmental guidelines. The poultry industry must be aware of management procedures which will have a direct effect on maintaining the quality of surface and ground waters, soil, as well as human and animal health.

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