E-1027

Poultry Litter Nutrient Management: A Guide for Producers and Applicators

Oklahoma Cooperative Extension Service
Division of Agricultural Sciences and Natural Resources
Oklahoma State University

Poultry Litter Nutrient Management: A Guide for Producers and Applicators

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Introduction

Over the past 50 years, much of the animal production in the United States has successfully transitioned from small-scale farms to large-scale feeding operations. This movement has resulted in a substantial increase in production, efficiency and geographic concentration, providing job opportunities, economic revenue and an affordable source of protein for humans worldwide. The economic success of the poultry industry has been attributed to its evolution into a vertically integrated business having the capacity to raise large numbers of birds in environmentally controlled production houses.

In Oklahoma, poultry production is concentrated in the eastern tier of the state, serving as a major source of employment in rural areas. The success of the poultry industry in eastern Oklahoma is directly related to the success of poultry companies (integrators) located in western Arkansas. Eastern Oklahoma has benefited from the integrator's expansion to capitalize on increased consumer demand for poultry products. In 2007, poultry production was the second largest agricultural revenue generator in Oklahoma, only trailing income from cattle and calves. Poultry receipts have grown dramatically in the past 10 years to nearly $749 million in 2007, compared to $447 million in 1997. Production tends to be localized in a relatively small radius around an integrator's feed mill, hatchery and processing facility. This production practice, and the ability to raise large numbers of birds in confinement, ultimately generates large amounts of manure in the form of poultry litter over a limited geographic area. Manure management remains an ongoing challenge to the industry.

What is Poultry Litter?

Poultry litter consists of manure, bedding material and other components such as feathers and soil. Wood shavings, sawdust, and soybean, peanut, or rice hulls are all common manure carriers added to the poultry house floor and utilized for raising four to eight flocks on a single placement prior to complete cleanout. If multiple flocks are grown, the houses are usually "caked-out" (removal of the denser or wetter areas) between flocks. After removal from the poultry house, litter is generally applied to land as a nutrient source to pastures and cropland.

Benefits from Litter Application to Soil

Poultry litter is recognized as an excellent source of plant nutrients and organic matter. Organic matter can improve crop production by potentially increasing the infiltration of water and water holding capacity, enhancing the retention of nutrients in the soil, reducing wind and water erosion, and promoting the growth of beneficial organisms. Continual applications of litter also have been shown to maintain soil pH and may increase soil pH in some instances.

Figure 1. Poultry bedding material.

Environmental Considerations

In the past, manure or litter was often applied at rates to meet crop nitrogen (N) needs, which could result in soil phosphorus (P) buildup. Because the nutrient ratio in litter is different from that of plant nutrient requirements, careful consideration must be taken when land applying to avoid over-application of certain nutrients, primarily P. If poultry litter land application is not properly managed, excess P application could degrade water quality through runoff into surrounding surface water resources. Depending on application rate and timing, soil type and crop condition, there may be a concern of nitrates leaching into groundwater. Both N and P transport into waterways contribute to eutrophication.

Figure 2. Poultry house during cleanout.

Eutrophication, caused by nutrient enrichment of a water body, is characterized by excess plant growth and oxygen depletion in water and can result in algae blooms, taste and odor problems, and fish kills. This not only reduces attractiveness for recreation but also creates water quality concerns for drinking water supplies. Such impacts have led to environmental regulations and litigation.

Raising large numbers of birds in confinement can generate air emissions. Air emissions commonly associated with commercial poultry production include: gases (ammonia, nitrous oxide and carbon dioxide), odor and particulate matter (PM).

Gases

Nitrogen is excreted from birds in the form of uric acid in the manure. Ammonia—a colorless, highly irritating gas—is formed through the microbial decomposition of uric acid. Ammonia levels above 50 ppm are detrimental to both bird and worker health. Proper ventilation should be considered.

Odor

Unpleasant smells associated with animal manure decomposition can be classified as odor. Manure decomposition can generate gases and volatile organic compounds that contribute to odor. Air temperature, relative humidity, manure accumulation time, poultry house ventilation, weather conditions and dust levels can affect odor generation and distribution.

Particulate matter

Particulate matter (PM) is considered a pollutant and consists of dust and liquid aerosols. Dust can originate from feed, manure, dander and feathers, while liquid aerosols can originate from bird respiration, high pressure washing of buildings and cool cell pads. Particulate matter can absorb odor, gases and bacteria and may transport them offsite.

Air pollutants can negatively affect air quality both inside and outside the poultry house. At certain levels, gases and PM can negatively impact human and animal health and cause environmental concerns. Odor emissions also can lead to negative public perception and neighbor nuisance complaints.

Regulations

In the spring of 1998, the Oklahoma legislature passed the Oklahoma Registered Poultry Feeding Operations Act, pertaining to poultry farmers producing more than 10 tons of poultry waste per year and confining birds for 45 days or more in any 12-month period. Additionally, the Oklahoma Poul-

Figure 3. Algae bloom in a lake.

try Waste Applicators Certification Act was passed affecting individuals land applying more than 10 tons of poultry waste per year. The Oklahoma Department of Agriculture, Food and Forestry (ODAFF), Agricultural Environmental Management Services (AEMS) is responsible for developing rules and enforcing these acts. The Oklahoma Cooperative Extension Service is responsible for producing training curricula and conducting the required training.

To summarize these Acts, poultry **producers** must:

- Register their poultry feeding operation annually,
- Obtain and follow an animal waste management plan, and
- Allow their operation to be inspected by ODAFF staff.

Poultry litter **applicators** must:

- Obtain a license from ODAFF to apply litter, and
- File an annual litter application report to ODAFF.

Both poultry **producers** and litter **applicators** must:

- Maintain waste management reports and records,
- Attend 9 hours of initial waste management training,
- Attend 2 hours of annual continuing education,
- Follow Natural Resource Conservation Service Nutrient Management Standards, and
- Obtain recent soil and litter tests prior to litter application.

For more detailed information regarding Oklahoma's poultry waste management regulations, refer to OSU Fact Sheet AGEC-202, Broiler Production: Considerations for Potential Growers.

Valuing Litter

The nutrient value of poultry litter is commonly estimated based on current commercial fertilizer prices (reported as price/lb nutrient) and the litter nutrient analysis (reported as lbs/ton). For example, if calculating the N, P and K value of broiler litter, we know that on average broiler litter contains 63, 61 and 50 lbs/ton of N, P_2O_5 and K_2O, respectively.

Using July 2011, commercial N, P_2O_5, and K_2O prices of $0.64, $0.48 and $0.51 per lb, respectively, and assuming long-term N availability is 70 percent, and P and K availabilities are 100 percent, we can determine the potential major nutrient value of the litter.

Litter N: $0.64/lb x 63 lbs/ton x 70% availability =	$28/ton
Litter P: $0.48/lb x 61 lbs/ton =	$29/ton
Litter K: $0.51 x 50 lbs/ton =	$26/ton
Total Potential Value:	$83/ton

Note: The actual value to the end-buyer depends on nutrient needs of the field. For example, there would be no P value if soil test P is already adequate. There may be additional value derived from organic matter and other nutrients found in litter, which is hard to quantify. Due to the nutrient variability in poultry litter, obtaining a recent litter nutrient analysis is critical when determining litter value. Two online tools available to assist producers when comparing the value of litter to commercial fertilizer include the poultry litter value calculator found at http://littermarket.okstate.edu/ and the fertilizer blending and cost calculator found at www.soiltesting.okstate.edu/Interpretation.htm. Finally, loading, transportation and application costs affect the end buyer's total cost and should be considered when comparing the cost and benefits.

To encourage appropriate use of the nutrients in litter, government programs may be available to subsidize litter management costs. These programs can help reduce transportation costs, increasing litter value as it is more fully utilized as a fertilizer source where it is most needed. Information about current litter incentives and cost share programs can be found at www.ok-littermarket.org or at the local OSU County Extension office.

Nutrient Management Plan

Basics of nutrient management and whole farm nutrient balance

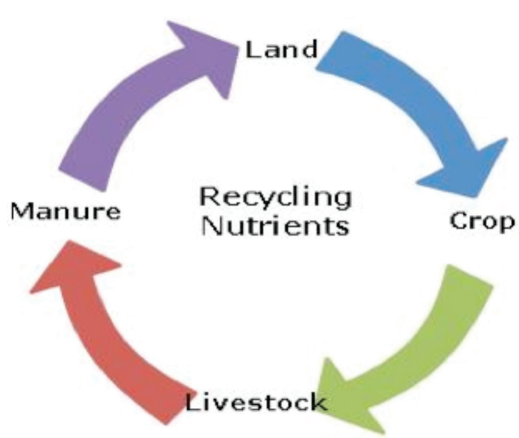
Animal manure and poultry litter contain all 16 essential plant nutrients as well as organic matter. They can be an economical source of plant nutrients and a valuable soil amendment to improve soil quality and maintain soil pH. Thus, manure can be a valuable asset to a poultry operation if its nutrients and organic matter are recycled through land application properly.

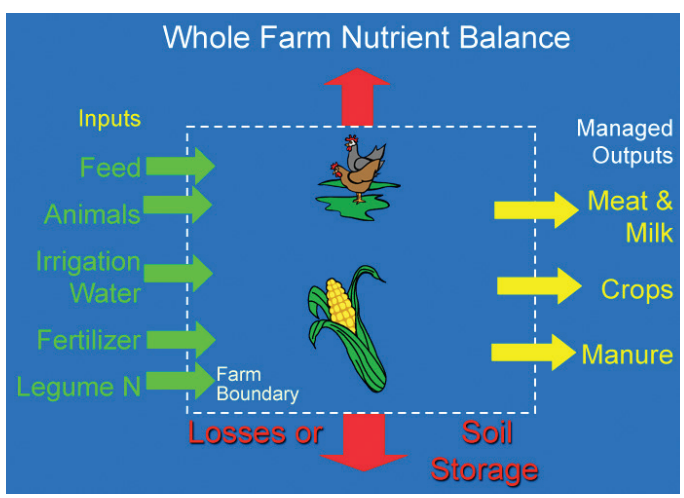
Poultry litter may cause surface and groundwater pollution if mismanaged or over applied. The key to proper management is to determine the nutrient content of the manure, the percentages of those nutrients that are available to crops, and the nutrient requirements of the crop at a realistic yield goal. These three factors will help you apply the proper amount (agronomic rate), but the method and timing of application will ensure the nutrient effectiveness. It is important to know the nutrient balance of the operation (as shown in the diagram). The difference between nutrient inputs and outputs is approximately the amount of nutrients in the manure to be land applied. Litter should be marketed or given away if the nutrients generated are more than the available land can receive. In addition, best management practices (BMPs) need to be considered to minimize the impact of manure land application on the environment.

Crop nutrient requirements

There are more than 100 chemical elements known today. Only 16 of them have been identified to be essential to plant growth:

Basic Nutrients:	chlorine, hydrogen, oxygen
Major Nutrients:	nitrogen, phosphorus, potassium
Secondary Nutrients:	calcium, magnesium, sulfur
Micronutrients:	boron, chloride, copper, iron, manganese, molybdenum, zinc





Soil, water and air can supply part of the plant nutrient needs. The rest need to be provided through other sources. The amount of each nutrient to be supplied through commercial fertilizer or animal manure depends on the type of crop, yield goal and soil available nutrient content. Soil testing is the first step to obtaining information on crop nutrient needs. OSU Fact Sheet PSS-2225, Soil Test Interpretations, lists nutrient requirements for common crops grown in Oklahoma. You also can obtain recommendations by using the following interactive program for a particular crop: Soil Test Interpretation and Fertilizer Decision Support.

Soil sampling, testing and results interpretation

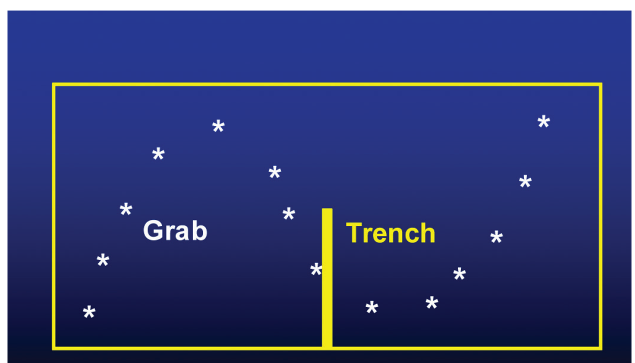
Soil testing is the best guide to the wise and efficient use of fertilizers and animal manure. The first step in soil testing is the collection of a representative sample. Soil properties vary a lot in a field. The soil sample must accurately represent the whole field where manure or other fertilizers are going to be applied. A minimum of 15-20 sub-samples collected randomly is needed to make a composite sample for a field. The sampling depth in Oklahoma is 6 inches. For details on soil sampling, refer to OSU Fact Sheet, PSS-2207, How to Get a Good Soil Sample.

Sample bags, soil probes and other assistance are available at the local OSU County Extension Office. Soil samples should be submitted through your County Extension office, and then the office will send your samples to OSU Soil, Water and Forage Analytical Laboratory in Stillwater, Okla. More information on agricultural testing and interpretation is available at www.soiltesting.okstate.edu.

Litter sampling and testing

The nutrient content of poultry litter should be determined by laboratory analysis annually or when manure management procedures change. The analysis report should at least include information on dry matter percentage, soluble salts or electrical conductivity, total N, total P and total K to calculate litter application rate.

The key to an accurate litter analysis is to obtain a representative sample by using proper sampling techniques. The diagram shows two recommended methods to sample in the house. The first one is a random method to collect multiple subsamples for a composite sample, and the second is a trench method by collecting a narrow band of materials on a tarp and then taking samples from the mixed pile. A soil probe may be used to collect samples from a poultry litter pile following house clean-out. See OSU Fact Sheet, PSS-2248, Sampling Animal Manure, for additional information.



Sampling in the house using trench and zigzag methods

Nutrient availability in the litter

Nutrients in animal manure cannot be substituted for those in commercial fertilizers on a pound-for-pound basis because not all the nutrients reported on a manure analysis are readily available to a crop in the year of application. Therefore, an availability factor is used to accurately determine the amount of litter needed.

a. Availability of nitrogen

Nitrogen in the organic form must be converted (mineralized) into inorganic forms (ammonium and nitrate) before it can be absorbed by roots. In general, about 50 percent of the organic N may become available the year of application. Organic N released during the 2^{nd} and 3^{rd} cropping years after application is usually about 15 percent and 6 percent of the original N content, respectively. Nitrogen availability may be higher if the manure is incorporated shortly after application. Inorganic N such as ammonium-N in the litter is readily available to plants although in small quantity. Therefore, the total available N for the first year is about 50-70 percent of the total N in the litter (50 percent not incorporated, 70 percent incorporated).

b. Availability of phosphorus and potassium

In general, at least 90 percent of the P and K in manure is considered available in the year of application compared with commercial P and K fertilizers, so typically a 90 percent availability factor is used for the amount of P and K in manure.

More details on manure nutrient availability can be found in OSU Fact Sheet, PSS-2246, Using Poultry Litter as a Fertilizer.

How to calculate poultry litter application rates

a. Agronomic rate

The agronomic rate is the amount of manure applied based on the nutrient requirement of the crop being grown. Agronomic rate ensures efficient use of manure nutrients and minimizes nutrient loss by leaching and through surface runoff. Soil testing, manure analysis and proper estimation of yield goal are necessary to calculate proper agronomic application rates of manure and fertilizers. The Agronomic Manure Application Rate Calculation Worksheet (Table 1) illustrates the steps of calculating the proper amount of manure needed to meet the crop N or P requirement.

b. Maximum amount of poultry litter allowed to apply

In some cases, litter may be allowed to be applied even if soil test P is agronomically sufficient. Manure application rates are limited by state regulations based on: 1) not exceeding the crop N requirement, 2) not exceeding specific soil test P levels, and 3) certain field conditions such as slope. Please refer to OK NRCS Nutrient Management Code 590 Standards for P based manure application rates, and use the Oklahoma Phosphorus Assessment Worksheet to calculate the highest amount of litter that can be applied for a specific field. The rules in nutrient limited watersheds are more restrictive than those of non-nutrient limited watersheds. The P based limits are summarized in the Tables 2 and 3 (page 8).

Refer to Code 590 for exact amounts of full rates and half rates shown in the tables. The amount allowed by Oklahoma regulations to land apply is not the same as the agronomic rate discussed earlier. Phosphorus will build in the soil if excess P is applied. This may eventually lead to limited or no application in the future.

Litter application methods and applicator calibration

Poultry litter can be applied to land by surface broadcasting using a manure spreader, broadcasting and incorporation, or by knifing under the soil surface. Maximum nutrient benefit is realized when manure is incorporated into the soil immediately or soon after application. Immediate incorporation or injecting of manure minimizes N loss to the air and allows soil microorganisms to break down the organic fraction of the manure. It also minimizes potential nutrient runoff losses and increases their agronomic values. Incorporation of either solid or liquid manure also reduces odor prob-

Table 1. Agronomic Manure Application Rate Calculation Worksheet.

		Example:	*Your Numbers:*
1a	**Nutrient needs of crop (lbs/acre)** Recommendations based on soil test results and a realistic yield goal	N = 200 P_2O_5 = 80 K_2O = 40	N = P_2O_5 K_2O
1b	**Nutrients carried over in last 2 years' applications (lbs/acre)** 15 percent of last year's and 6 percent of the year before last year's litter N application	N = 25 P_2O_5 = 0 K_2O = 0	N = P_2O_5 = K_2O =
1c	**Nutrient needs to meet with litter** Subtract line 1b from line 1a	N = 175 P_2O_5 = 80 K_2O = 40	N = P_2O_5 = K_2O =
2	**Total nutrients available in litter (lbs/ton)** Based on litter analysis of representative sample collected close to time of application	N = 64 P_2O_5 = 55 K_2O = 43	N = P_2O_5 = K_2O =
3	**Determine available nutrients (lbs/ton)** Multiply the value in step 2 by availability, 50 percent for N, and 90 percent for P and K.	N = 32 P_2O_5 = 50 K_2O = 39	N = P_2O_5 = K_2O =
4	**Calculate application rates to supply N and P_20_5 needs (tons/acre)** Divide values from Step 1c by values from Step 3	N = 5.5 P_2O_5 = 1.6	N = P_2O_5 =
5	**Choose between N or P_2O_5 application rate (tons/acre)** Select highest rate in Step 4 to use litter as complete fertilizer. Select lowest rate to maximize nutrient use efficiency	Rate = 1.6 (based on P)	Rate =
6	**Determine amount nutrients applied at the chosen rate (lbs/acre)** Multiply the rate chosen in Step 5 by available nutrients in Step 3	N = 51 P_2O_5 = 80 K_2O = 62	N = P_2O_5 = K_2O =
7	**Determine supplemental nutrients (lbs/acre)** Subtract the nutrients applied (Step 6) from nutrients needed (Step 1c). If the difference is negative, enter 0	N = 124 P_2O_5 = 0 K_2O = 0	N = P_2O_5 = K_2O =

Table 2. Oklahoma NRCS Annual Waste Application Rates for Non-Nutrient Limited Watersheds.

Rating	*Soil Test P Index*	*0 – 8% Slope Soil > 20″ Deep*	*8 to 15% Slope Soil > 20″ Deep*	*0 to 15% Slope Soil 10″ to 20″ Deep*
Low	0 – 65	Full Rate	Full Rate Split Application	Half Rate
Moderate	66 – 250	Full Rate	Half Rate	Half Rate
High	251 – 400	Half Rate	Half Rate	Half Rate
Very High	> 400	Plant Removal	Plant Removal	Plant Removal
Severe	*	No Application	No Application	No Application

* Denotes any soil text P level

Table 3. Annual Manure Application Rates for Nutrient Limited Watersheds.

Rating	*Soil Test P Index*	*0 – 8% Slope Soil > 20″ Deep*	*8 to 15% Slope Soil > 20″ Deep*	*0 to 15% Slope Soil 10″ to 20″ Deep*
Low	0 – 65	Full Rate	Full Rate Split Application	Half Rate
Moderate	66 – 120	Full Rate	Half Rate	Half Rate
High	121 –300	Half Rate	Half Rate	Half Rate
Severe	> 300	No Application	No Application	No Application

lems. Nitrogen loss by ammonia volatilization from surface application is greater on dry, warm, windy days than on days that are humid and/or cold. Regardless of application method, calibration of litter spreaders is imperative to determine application rates.

Properly calibrated spreader trucks help to make the most efficient and economical use of litter as a fertilizer by allowing controlled applications that meet crop needs. If litter is under-applied, crop needs may not be met, while over-application of litter can pose environmental risks and lead to litter wastage. Calibration is the process of making the proper adjustments to the manure spreader to deliver the desired amount. Litter flow rate, travel speed and distribution pattern all affect the amount of litter that is land applied. Increased flow rates, decreased travel speeds and narrow distribution patterns result in higher litter application rates; while decreased flow rates, increased travel speeds and wide distribution patterns result in lower application rates. For instructions on how to properly calibrate a litter spreader, refer to Calibration of Litter Spreading Trucks at http://poultrywaste.okstate.edu/Publications/Calibrating%20Litter%20Spreader%202016.pdf.

Application Timing and Litter Availability

Ideally, poultry litter should be applied during active forage growth to reduce environmental contamination risks and maximize nutrient use efficiency. Vegetative

Figure 4. Spreader truck applying poultry litter.

cover helps reduce sediment and nutrient runoff. Plants actively uptake nutrients during the vegetative growth stage. For warm-season grasses, such as bermudagrass, late spring application is optimal. However, early fall applications work best for cool-season grasses, such as ryegrass and tall fescue.

Consideration should be given to poultry litter availability as the supply and demand fluctuates based on transportation costs, commercial fertilizer prices, replacement bedding material availability, timing of house cleanout and other factors. With this in mind, producers wishing to apply litter should have a flexible range of application dates. Some producers may wish to purchase litter during the fall when demand is low and store it under cover for a later application. This practice would help reduce the uncontrolled variables associated with litter availability allowing for application when needed at the producer's convenience.

Best Management Practices

If mishandled, manure may contaminate water supplies with nitrogen, phosphorus, inorganic salts, organic solids and microorganisms. If present in sufficient quantities, those contaminants can cause considerable problems. Phosphorus is one of the most common and serious surface water contaminants causing eutrophication, while N loss as ammonia is a common air contaminant. Best management practices (BMPs) are site specific strategies implemented to address environmental issues. There are numerous BMPs proven to be effective in improving nutrient use efficiency and reducing nutrient losses.

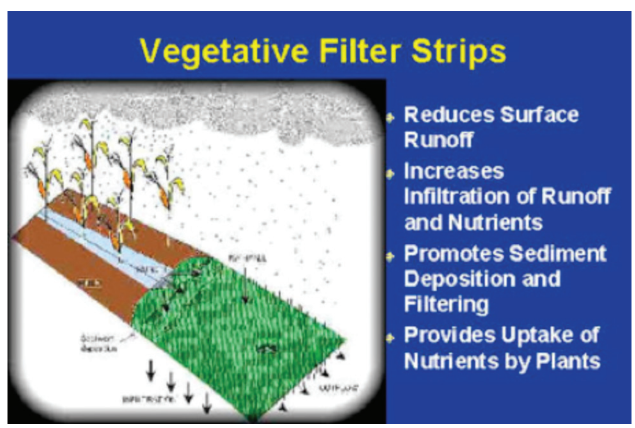
Riparian zone protection

Riparian buffer zones are vegetated areas along both sides of water bodies that generally consist of trees, shrubs and grasses, and are transitional boundaries between land and aquatic ecosystems. Riparian zones act as buffers to protect surface waters from contamination and are habitats for a large variety of animals and birds. They need to be protected from grazing because they serve many functions in the landscape, such as controlling upland sources of non-point source (NPS) pollution and protecting stream banks from erosion.

Figure 5. Riparian area.

Filter strips

Filter strips are vegetated areas that are situated between surface water bodies, (i.e., wetlands, streams and lakes) and cropland and grazing land. It is effective in filtering sediment, organic material, nutrients and chemicals from the runoff water. Filter strips are also called vegetative filter strips or buffer strips. To be effective, the filter strip should be maintained according to OK NRCS Nutrient Management Code 590 Standards.



Set-back distances

Set-back distances from waterways help reduce ground and surface water contamination by establishing a minimum distance between water bodies and manure land application areas. When properly maintained, set-back distances help filter contaminants moving toward a water body. In Oklahoma, state regulations require set-back distances when land applying poultry litter. These requirements are outlined in the OK NRCS Nutrient Management Code 590 Standards. For example, litter may not be applied within 100 feet of a perennial stream, well, pond or sinkhole, unless an established buffer is present. Additionally, litter may not be applied within 50 feet of an intermittent stream unless an established buffer is present.

Treating poultry litter with alum

The water soluble P in poultry litter can be easily subject to runoff or leaching loss after land application. Alum (aluminum sulfate) added to poultry litter in certain concentrations can precipitate water soluble P and reduce the amount of P lost to water bodies. Alum addition to poultry litter has also been found to reduce ammonia emissions within the house, which results in improved air quality and bird performance. OSU Fact Sheet, PSS-2254, Alum-Treated Poultry Litter as a Fertilizer Source provides additional information.

Figure 6. Sprayer applying alum in poultry house.

Using forage to remove excess soil nutrients

It is difficult to lower soil P once it is built to a high level. Vegetative mining of nutrients (phytoremediation) has been attempted, but it is a slow process. It may take more than 10 years to reduce soil test P by 100. The amount of P removed depends on the yield and P content of the plant used. The biomass has to be removed from the fields to be effective. Therefore, grazing has little impact on soil P even though the forage may grow very well. Both warm-season and cool-season forages in the same field are more effective at nutrient mining than a single species grown in the field. OSU Fact Sheet, PSS-2251, Selecting Forages for Nutrient Removal from Animal Manure, provides additional information about nutrient composition of selected hays.

Figure 7. Harvesting hay to remove excess soil nutrients.

Pasture management

Pasture management is important for optimum hay production and minimum nutrient losses. Maintaining the proper stocking rate can help reduce nutrient runoff. Fields that are overgrazed or overstocked contain less vegetative cover to trap sediments and nutrients during runoff events. One of the first signs of an overgrazed field is increased weed growth. Managing livestock by limiting access to waterways helps reduce erosion and manure nutrient inputs. Heavy use areas should be located away from streams. This may include providing mineral feeders, hay rings and shade in other areas of the pasture, which lessens the likelihood of livestock congregating near a waterway or stream.

Poultry mortality disposal

Proper management of on-farm animal mortalities is vital to every farming operation. Improper disposal of dead animal carcasses can negatively impact surface water and groundwater from carcass leachate. If the animal died of an infectious disease, pathogenic bacteria and viruses may be present within the carcass. These pathogens can be spread by insects, rodents, predators, and subsurface or aboveground water movement, as well as through direct contact with other livestock or poultry leading to increased disease transmission risks. In addition, Oklahoma has rules regulating the disposal of livestock and poultry mortalities. Specific to poultry producers, the animal waste management plan imposes restrictions on poultry mortality disposal. Concerns associated with improper disposal can be avoided by practicing state approved carcass disposal methods.

In the event of a catastrophic mortality loss, ODAFF must be notified immediately. Catastrophic mortalities are defined as any death loss that exceeds the capacity of the current disposal system to accommodate those losses within 24 hours.

For both routine and catastrophic mortalities, the state approved methods for carcass disposal are:

- burial
- landfills
- incineration
- rendering
- composting

For more information on proper livestock and poultry mortality disposal, refer to Extension Fact Sheet ANSI-8219, Proper Disposal of Routine and Catastrophic Livestock and Poultry Mortality.

Litter storage

Oklahoma law regulates proper litter storage. Following removal from the poultry house, all litter being stored must be covered overhead or surrounded by a compact soil berm. Some producers construct litter storage sheds for proper storage until an appropriate time for land application. Improper

Figure 8. Litter storage barn.

storage of poultry litter can increase the risk of nutrient runoff. Furthermore, litter that has become wet due to excessive rainfall is prone to increased N loss from ammonia volatilization. Wet litter also is more difficult to apply with a manure spreader.

In-house air emissions control strategies

Proper house ventilation and litter management can be used to control air emissions inside the poultry house. Litter amendments can be utilized to reduce ammonia levels by lowering litter pH, creating a neutralizing effect on the ammonia released. Sodium bisulfate, sulfuric acid and aluminum sulfate products are all common treatments that accomplish this task. Controlling litter moisture content through proper ventilation and the prevention of leaks from water lines ensures dryer litter. Dry litter will have less gas and odor emissions compared to wet litter. However, if the litter is too dry and dusty, PM levels may increase. Reducing manure accumulation time through annual cleanouts serves as another control strategy for reducing emissions.

Air emission control strategies during storage and land application

Covering stored litter is not only a requirement in Oklahoma, but also it helps maintain dryness, thus reducing air emissions. When land applying poultry litter, incorporating or knifing the litter into the soil can reduce air emissions. If surface applying poultry litter, avoiding hot, dry, windy conditions helps reduce N losses and transportation of odor and PM off-site. Research has shown that applying litter shortly before a light to moderate rainfall also helps reduce ammonia losses.

Litter Commerce

Marketing poultry litter to more distant nutrient-deficient areas or for further processing offers one solution to the nutrient surplus problem associated with high production areas. Nutrient deficient soils suitable for litter application are abundant in farmland at a distance of 50 to 100 miles from the intensive production areas of northwest Arkansas and eastern Oklahoma. This proximity coupled with recent increases in commercial fertilizer prices has created increased demand for poultry litter as a fertilizer source. If transport distance is not too great, poultry litter may be a cheaper source of nutrients than commercial fertilizer. A self-sustaining poultry litter market can benefit sellers, buyers and service providers of poultry litter by increasing the amount of poultry litter transported out of the nutrient surplus areas and nutrient sensitive watersheds to areas with nutrient needs. Oklahoma Cooperative Extension Service hosts an Oklahoma Litter Market website http://littermarket.okstate.edu/, which includes a self-listing service for litter buyers, sellers and service providers. Additionally, the website provides fact sheets along with information on current transportation incentives, regulations, nutrient limited watershed maps and a litter value calculator, which will help the user determine the suitability and value of the product.

Summary

When properly managed, poultry litter provides an excellent source of plant nutrients and organic matter for application to pastureland and cropland. Continual applications also may raise the pH of acidic soils in some cases. Many variables affect the overall value and cost of litter to the end-buyer and should be carefully considered before purchasing. Due to air and water quality concerns, regulations and proper nutrient management must be followed to reduce environmental impact. There are a number of BMPs that can help reduce nutrient losses during production and land application, while increasing producer profitability.

Appendix A. Related Extension Fact Sheets:

AGEC-202, Broiler Production: Considerations for Potential Growers
ANSI-8219, Proper Disposal of Routine and Catastrophic Livestock and Poultry Mortality
PSS-2225, Soil Test Interpretations
PSS-2207, How to Get a Good Soil Sample
PSS-2248, Sampling Animal Manure
PSS-2246, Using Poultry Litter as a Fertilizer
PSS-2254, Alum-Treated Poultry Litter as A Fertilizer Source
PSS-2251, Selecting Forages for Nutrient Removal from Animal Manure

Appendix B. Related Websites:

eXtension Animal Manure Management: http://www.extension.org/animal_manure_management
Oklahoma Litter Market: http://littermarket.okstate.edu/
OSU Poultry Waste Management: http://www.poultrywaste.okstate.edu/
OSU Soil and Manure Testing: www.soiltesting.okstate.edu
OSU Waste Management: http://www.animalwaste.okstate.edu/

Appendix C. Other Related Material:

Oklahoma Phosphorus Assessment Worksheet
OK NRCS Nutrient Management Code 590 Standards
Calibration of Litter Spreading Trucks

OKLAHOMA STATE UNIVERSITY

EXTENSION