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Poultry Litter Management in the Illinois River Watershed of Arkansas and Oklahoma

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Background

During the past decade, ongoing lawsuits between Oklahoma and several entities in Northwest Arkansas have focused attention on water quality impairment by upstream wastewater treatment facility discharges and the application of poultry litter as a fertilizer. The main concerns center on phosphorus (P) levels in streams in Northwest Arkansas that flow into Eastern Oklahoma. The lawsuit settlement in the Eucha-Spavinaw Watershed, adjacent to the Illinois River Watershed (IRW), requires users of poultry litter to have a nutrient management plan that determines appropriate rates of application based on the potential for P loss in runoff. The court case covering the IRW is still awaiting final rule. However, the application of poultry litter to pastures is now regulated by the States of Arkansas and Oklahoma and requires that litter be applied by a state-certified applicator and according to a P-based nutrient management plan. Thus, both in-house and land management of poultry litter is of importance to this area, as well as other areas of the U.S. with localized concentrations of livestock production; for example, the Delmarva Peninsula, Coastal Plains of North Carolina and the North Bosque River area of Texas (Daniels et al., 2009, and Pennington et al., 2008).

This fact sheet describes how poultry litter is utilized and managed in the Illinois River Watershed, how poultry producers have adapted to P-based nutrient management and how this has affected litter export programs, all of which are helping to reduce the risk of water quality impairment.

In-House Litter Management

Poultry litter is a mixture of manure and bedding material, typically rice hulls, wood shavings or a combination of the two. Fresh bedding is placed in the house following clean-out. The objectives of in-house poultry litter management include maximizing bird health, maintaining air quality and reducing energy costs. Some factors influencing litter management are beyond the control of the producer and include weather, specifically temperature and humidity, and feed content, which is controlled by the integrator company for which the producer raises birds. Other factors, such as in-house environmental controls and litter conditioning practices, can be managed by the producer. Between flocks of broiler chickens, producers in this region often remove the top layer of the litter known as "cake." Periodic removal of this "cake" has the benefit of reducing in-house moisture and ammonia, both of which can decrease broiler productivity and bird weight gains.

Instead of removing the "cake," some producers choose to till the litter to mix the wetter upper layer in with the drier lower layer. For optimum results with tilling, the "cake" needs to be broken into small particles and blended with the remaining litter to create a uniform mixture. With some types of equipment it may take three to four passes to get the desired blend. After this, the house is usually well ventilated to remove excess moisture and ammonia.

A newer practice being supported by some of the integrator companies is windrowing litter between flocks.

Litter is formed into two rows the length of the poultry house, with each row being at least 3 to 4 feet high for best results. With proper conditions, windrowing litter can result in biological activity and heat production that partially composts the litter. If the heat production reaches 130ºF in the piles, it can reduce pathogen populations that are a threat to bird health. For optimum effectiveness, the rows are turned after 72 hours and allowed to heat a second time. Following the second cycle, windrowed litter is redistributed in the house for the next flock of birds. Ideally, temperatures should reach 130ºF both times. Again, it is important to ventilate the house well after windrowing to avoid ammonia-induced health problems for the next flock of birds. Windrowing necessitates a downtime between flocks of at least 10 days, with additional days needed to prepare the house for the next flock.

Example of windrowed poultry litter

Broiler producers utilize one or a combination of the practices above for in-house litter management between flocks and typically remove all of the litter from the house once per year. Turkey producers typically remove the cake or remove all of the litter between flocks, as their grow-out periods are much longer than for broiler chickens. Chicken hen and pullet producers generally remove all of the litter between flocks.

When birds are present, litter moisture and ammonia are managed using heaters and ventilation fans to maintain ideal in-house conditions for bird health. Outdoor weather conditions influence the moisture and temperature of the incoming ventilation air and greatly impact the intensity of this management, determining the need for either heating or cooling.

Nutrient Content and Fertilizer Value

Poultry litter is not typically managed to increase its fertilizer value; however, in-house management does affect the nutrient content of litter and its value as a fertilizer for pastures and crops, when removed from the house. Thus, determining the nutrient content of litter is an important consideration when using litter as a fertilizer. Determining nutrient content requires collecting a litter sample either in-house before clean-out or from stacked litter after clean-out (Wilson et al., 2006, and Zhang et al., 2011) and submitting the sample to the University of Arkansas Diagnostic Testing Laboratory or the Oklahoma State University Soil, Water and Forage Analytical Laboratory in Oklahoma through your local county Extension office.

Poultry litter that is used in the Arkansas IRW as a fertilizer for pastures, haylands and crop fields must be analyzed for nutrient content every 5 years, as required by state law. In Oklahoma, state law requires that litter be analyzed annually. Litter that is exported off the farm is analyzed each time it is hauled. The nutrient content of litter varies with feed management, which is controlled by the integrators along with in-house feeder pan, brood feeding and litter management, as mentioned above and by Sharpley et al. (2009) and Zhang et al. (2011). As feed and litter management can vary from year to year, values used to estimate total nutrient production, current fertilizer value and pricing for markets are based on the previous year's litter analyses averages by bird type. Table 1 lists the averages for 2011 based on litter analyzed by the University of Arkansas Soil Testing Laboratory and provided by Nathan Slaton, director of the University of Arkansas Division of Agriculture's Soil Testing Program.

TABLE 1. Mean nutrient content of poultry litter analyzed by the University of Arkansas Diagnostic Testing Laboratory in 2011 (Slaton, personal communication 2012).

Bird Type	N	P_2O_5	K_2O	% Moisture
	lb/ton on an as is basis			
Broiler	64	55	58	25.8
Hen	47	60	43	27.0
Pullet	49	66	42	26.1
Turkey	65	63	49	26.4

Similar trends and nutrient contents of poultry litter were obtained for prior years (Sharpley et al., 2009, and Zhang et al., 2011). Based on average nutrient content, the value of poultry litter, as compared to commercial fertilizer prices, can be estimated. Table 2 lists the values as of January 15, 2012.

TABLE 2. Average value of poultry litter based on its nutrient content and commercial fertilizer prices from four fertilizer dealers in Eastern Oklahoma as of January 15, 2012.

Litter Type	N[1]	P_2O_5	K_2O	Total
	$/ton on an as is basis			
Broiler	$25	$26	$31	$82
Hen	$19	$29	$23	$71
Pullet	$19	$32	$22	$73
Turkey	$26	$30	$26	$82

[1]N value is based on 70% availability.

Management of Poultry Litter Removed From Houses

Average litter production by bird type is influenced by many factors and is most accurately documented based on the quantity removed annually as cake and clean-out. Table 3 lists watershed-based estimates of the annual quantity of litter generated by bird type and removed from the house. These estimates were based on the current number of houses provided by the poultry industry. Average tons of litter removed per house annually were estimated from data based on individual load weights provided from poultry litter trucking companies gathered during 2006 through 2011 and compiled by BMPs Inc.

TABLE 3. Estimated annual litter production in the IRW (Data compiled by BMPs Inc. from data provided by poultry litter trucking companies).

Bird Type	# Houses in IRW	Avg. Tons Removed Per House Annually	Total Tons Removed Annually
Broiler	1,133	195[1]	220,935
Hen	211	120	25,320
Pullet	195	100	19,500
Turkey breeder	27	75	2,025
Turkey growout	53	132	7,000
TOTAL	1,606		274,780

[1]Average tons removed per broiler house annually is the sum of 140 tons of clean-out and 55 tons of cake litter.

Removed litter that cannot be immediately land applied or exported from the watershed is stored temporarily on-site beneath litter stacking sheds, which keep litter stored on top of concrete and under cover as a means of containment and keeping the litter dry.

Poultry litter stacking sheds provide safe, temporary on-site storage of litter by keeping the litter dry and contained. ***(Photo courtesy of Rich Mountain Conservation District)***

Poultry litter is ultimately land applied as fertilizer or exported via trucking out of the watershed. Land application of poultry litter in the IRW in Arkansas and Oklahoma is regulated by state laws, both requiring analyses of soil and litter to determine application rates, which minimize the risk of P loss in runoff. Arkansas tracks litter application in the IRW through the nutrient management planning process, which is supervised by Washington and Benton County Conservation Districts. Nutrient management data has been compiled by the Arkansas Natural Resources Commission (ANRC), dating back to 2007, to evaluate the impact of using the Arkansas Phosphorus Index (ARPI) on litter application rates in the IRW. The index was recently updated and planners began using the newly revised version in 2010.

Since 2007, almost 740 nutrient management plans have been developed, covering 46,920 acres. The average litter application rate prior to the implementation of the revised ARPI was 2.3 tons/acre. If all the planned acres received litter at the average rate, it would amount to 107,920 tons utilized annually in the Arkansas portion of the IRW. Starting in 2010, the average litter application is 1.6 tons/acre using the revised ARPI, resulting in 75,080 tons planned for application annually in the Arkansas portion of the IRW.

Oklahoma tracks litter application in the IRW through required records submitted by Oklahoma Registered Poultry Feeding Operations and licensed waste applicators. Current data is for 2009 and 2010, as compiled by the Oklahoma Department of Agriculture, Food and Forestry. Land application of litter in the Oklahoma IRW dropped from 31,660 tons in 2009 to 7,770 tons in 2010.

While reductions in litter application rates have occurred, it is difficult to create an accurate mass balance due to the difference in the methods used by each state to collect litter utilization data.

Litter Export Program

In 2005, the five primary poultry integrator companies in Northwest Arkansas committed to the Oklahoma Scenic Rivers Commission (OSRC) to export 202,500 tons out of the IRW over a 3-year period. This commitment was the catalyst for the creation of the coordinated litter export program, which now transports over 100,000 tons annually from the IRW. This litter is transported to non-nutrient sensitive watersheds, mainly in Oklahoma and Kansas, for use primarily on cropped fields (Penn et al., 2011).

To assist with meeting the commitment to OSRC, both Oklahoma and Arkansas committed EPA 319h funds to offset a portion of the trucking costs and pay poultry producers for their litter, in the amount of $1.3 million in grants and matching funds. The grants were administered by BMPs Inc, a nonprofit corporation established in 2004 for the purpose of creating a poultry litter export industry. Following the grant projects, ANRC administered an additional $300,000 of federal, state and local funding for the export program in Arkansas (Fisk, 2009). Through this grant funding process, a coordinated, large-scale litter hauling system was created, including scheduling, marketing and transportation. Although grant subsidies are no longer available, local independent trucking companies continue to operate today, transporting litter in 23-ton capacity semi-trailers. Litter exports are tracked using certified scales to weigh each load.

Table 4 summarizes the tonnage documented by independent haulers and poultry integrators as exported out of the watershed since 2006 and may not be a total accounting.

TABLE 4. Tons of litter exported out of the IRW (from BMPs Inc.).

Year	Tons Exported
2006	59,520
2007	70,970
2008	78,680
2009	87,990
2010	101,600
2011	105,750
Total	**504,510**

Summary

Responses to environmental, legal and livestock production concerns, as well as increasing costs of bedding materials, have resulted in changes to poultry house and poultry litter management. Producers are implementing litter management practices to improve the quality of their bedding material. Nutrient management plans are reducing the maximum litter and therefore P application rates. This, combined with a successful litter export program, has resulted in a significant reduction in the amount of litter applied in the watershed.

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