WASTE MANAGEMENT ALTERNATIVES TO REDUCE NON-POINT POLLUTION

A.W. Renck*, D. Hite*, P. Intarapapong*, and L. Oldham**
*Department of Agricultural Economics, Mississippi State University
** Department of Plant and Soil Sciences, Mississippi State University

The poultry industry is an important enterprise in Mississippi. The industry contributes 32 percent of the total farm value of all agricultural products produced in the state. The majority of this income is provided by broiler production. More than 700 million broilers are produced in the state annually with a farm value of $1,370 million.

The production method of broilers has changed over the last several years. The industry is now commonly referred to as vertically integrated. This means an individual company performs or controls all or most production aspects. A contract system between growers and poultry companies is used to control the stages of production. Resources are utilized with maximum efficiency to produce uniform birds. Broilers are typically grown in enclosed houses that provide maximum control over the birds' environment.

A typical broiler house will produce 125 to 150 tons of litter material annually. Before building a poultry house, a producer must have a plan for poultry litter disposal. The normal practice is to apply the litter to pastureland as fertilizer. However, in areas of concentrated poultry production, overfertilization of land can occur. This may contribute to excess nutrient run off into the surface and ground water supplies.

One solution to overfertilization is to transport the litter from areas of concentrated broiler production in the state to areas with cropland that can use the litter as fertilizer. A study in Alabama found that using broiler litter as fertilizer, not exceeding 4 tons per acre is as environmentally safe as using any routine commercial fertilizer application. When poultry manure is applied to match the nutrient needs of crops, the economic value of nutrients in poultry litter can be maximized.

DATA

To analyze the economic viability of transporting the litter, many factors had to be considered. First, the areas of concentrated production had to be identified. The top five counties in broiler production are Scott, Smith, Leake, Simpson, and Jones. The amount of broiler litter produced annually in each of these counties was calculated. The next step was to identify the counties that could use the litter as fertilizer. The amount of litter each county could use annually was based on the acreage of corn, sorghum, wheat, rice, cotton, and pastureland in the county. The proper application rate of poultry litter differs for each crop and was considered in calculating how much fertilizer each county could use. Proper utilization of litter as a fertilizer is generally based on nitrogen rates. This was the method also used in this analysis to determine application rates. In the future, it is possible that phosphorous rates will also have to be considered in determining application rates. This could double or triple the land requirements for proper utilization.

It is unrealistic to assume that each county will completely convert from commercial fertilizer use to using broiler litter; therefore, different adoption rates were assigned to each county and the acreage of cropland adjusted accordingly. In assigning adoption rates to each county, the farm structure of each county was considered. Counties composed of mostly large farms (over 500 acres) were given a 25% adoption rate. Counties consisting of mostly middle size farms (150 acres or more) were given a 15% adoption rate. Finally, those counties with mostly small farms (less than 150 acres) were given a 5% adoption rate. The adoption rates were assigned this way due to the infeasibility of small farms adopting this practice due to increased costs, convenience, and other practical reasons.

MODEL DEVELOPMENT

The amount of litter that should be transported to each county was based on a least cost transportation model. The model estimated is of the following form:

(1) Minimize cost= $\sum_{i}^{m}\sum_{j}^{n} c_{ij}x_{ij}$

(2) $\sum_{j=1}^{n} x_{ij} \leq a_i(i = 1,2,....m)$

where m = 5 source counties;

(3) $\sum_{i=1}^{m} x_{ij} = b_j(j = 1,2,...n)$

where n = 39 destination counties; and

(4) $x_{ij} \geq 0(i = 1,2,....,m; j = 1,2,....n)$.

where a_i is the number of tons of litter available in the ith county; b_j is the maximum number of tons of fertilizer required at each destination county j; and c_{ij} is unit transportation and application cost from each source i to each destination j.

Equation (1) represents the minimization of total distribution costs, assuming a linear cost structure for shipping and application. Equation (2) is the constraint that the quantity of fertilizer shipped from source county i be less than or equal to the amount of fertilizer available in source county a_i. Equation (3) restricts the amount of fertilizer shipped to destination county b_j to be less than or equal to the maximum quantity of fertilizer which can be used in the county. Equation (4) ensures that each quantity shipped from source i to destination j is nonnegative.

This model is used to calculate how many tons of litter should be transported to each county in order to minimize the transportation costs. The distance and cost of transporting a ton of litter to each of the other counties in the state from each of the five concentrated source counties of poultry litter were calculated. The number of tons shipped from each source county to each of the other counties in order to minimize the transportation costs were then estimated.

The dual price per ton for each county was calculated using the cost incurred by broiler houses in the source county if the litter is not transported out of the county. This is the value of the litter per ton in the destination county after the transportation cost is accounted for, compared to the litter remaining in the source county (Hite, Forster, and Rausch 1999). This cost includes the storage and handling of the litter. The cost of cleanout was not included because it would be realized regardless of what was done with the litter. Using these estimates, an analysis of the economic viability of using broiler litter as a fertilizer can be conducted. However, the only costs that were considered in this analysis were tangible costs. The social cost of any pollution caused by overfertilization is not included in the cost of not transporting the litter out of the county.

RESULTS

The cost of using poultry litter was first compared to the cost of using commercial fertilizer. On average for all crops, the poultry litter was $1.23 lower per ton than commercial fertilizer. This translates into an average of $3.08 per acre reduction of costs. The cost of the poultry litter was estimated as the value of the nutrients Nitrogen, Phosphorous, and Potassium and the dual price found above. The comparison cost of commercial fertilizer is an average of the cost of fertilizer per ton for all crops.

The cost of transporting the litter compared to retaining it in the county was then considered for the growers. The average cost of keeping the litter for the grower is $18.20/ton. This does not include the opportunity cost of not selling the litter. The value of the litter in distant counties is an average of $34.40 per ton. The grower could realize a gain of $13.40 per ton of litter by transporting the litter to distant counties for use as fertilizer. This would be a revenue gain of $1,675 per year for the grower. A broiler house typically earns a net return of just $3,000 to $10,000 during the payback period of the investment in the house. The revenue from litter sales would be a considerable addition to the annual net return.

CONCLUSIONS

In addition to the problem of overfertilization in concentrated growing areas, the timing of production building cleanout does not always coincide with the availability or best timing of cropland application. Poultry houses are generally cleaned out annually and the timing of production building cleanout depends on flock scheduling, equipment availability, and operators' schedules. This is one drawback to the use of broiler litter of fertilizer. Poultry litter is most valuable when it is removed from the house and will decompose rapidly, losing nutrient value, if it is stored outside. Litter storage is one way to ensure the litter is applied under the proper conditions and to protect the environment. The nitrogen can be preserved if it is stored in an enclosed structure or in a covered pile (Fulhage 2000). This is an additional cost that would normally not be incurred. Another issue is the legality of this practice. There are currently no laws in the state that govern the use of broiler litter as fertilizer as long as the litter is generated and used on a producers' operation as part of an integrated system. However, anyone selling broiler litter as fertilizer is subject to Regulation 12 dealing with the use of animal waste.

A pilot program in Maryland has been established to help farmers make the transition to nutrient management mandated by the Water Quality Improvement Act of 1998. Farmers with excess litter can receive up to $20 per ton cost-share assistance to offset poultry litter testing, loading, and transportation costs. All farmers with inadequate acreage to apply the poultry litter at acceptable rates are eligible for the program. Incentives are offered to move the poultry litter from the counties with concentrated production.

The results of this analysis are meant to illustrate the feasibility and benefit of transporting poultry litter from areas of concentrated production to other areas in the state. Obviously, the grower's unique situation would have to be analyzed to determine the full benefits for their operation. However, the results of this analysis regarding the use of broiler litter as fertilizer are encouraging.

RESOURCES

Fulhage, C.D. Storing Poultry Litter http://muextension.missour.edu/xplor/waterq/wq0212.htm (May 30, 2000).

Hite, D., D.L. Forster, and J.Rausch. 1999. Optimal Use of Smokestack Scrubber By-Product. Journal of Agricultural and Applied Economics. (April): 123-132.

Mississippi State University Extension Service. 1998 Mississippi Poultry Industry. http://www.1998MississippiPoultryfacts.htm. (April 18, 2000).

National Agricultural Statistics Service. 1997 Census of Agriculture. Volume 1, part 24. United States Department of Agriculture. Pilot Poultry Litter Transport Project. http://www.Maryland Department of Agriculture Poultry Litter Transport Project.htm (April 18, 2000).