How Much Is Poultry Litter Worth?

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Abstract

Land-applying poultry litter to nutrient-deficient soils instead of commercial fertilizer could absorb nutrients from concentrated poultry production areas and help crop farmers. A survey of potential litter users showed that although farmers have used/are interested in using litter, there are still some problems that prevent the market from fully developing.

Keywords: poultry litter, survey, nutrient excess, new markets

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Introduction

For over five millennia, animal manures have been a key ingredient in maintaining the productivity of continuously farmed land (Beaton). Manure, such as poultry litter, is commonly referred to as animal waste (Parker), a derogative term that incorrectly conveys the idea that this byproduct has no value, so much so that many people, including scientific authors, refer to manure use as "waste disposal" (for example see Gollehon et al., Wohl, and O'Donoghue, MacDonald and Nehring). Increasing fertilizer prices could be a key ingredient in reeducating crop farmers and convincing them that poultry litter is far from being trash and, in fact, may very well be a treasure. No one knows this better that the Northwest Arkansas poultry growers, who have relied on it as a source of nutrients and organic matter for their pasturelands so that cattle can be produced on otherwise poor land (Leonard). However, recent concerns regarding soil phosphorus accumulation and water quality have triggered lawsuits (see *City of Tulsa v. Tyson Foods, Inc.* which was vacated due to a settlement; another pending lawsuit was initiated by the Oklahoma Attorney General in June 2005) that may threaten land application of litter in Northwest Arkansas because limited phosphorus removal from local land by crops and pasture are alleged to result in nutrient runoff into surface water.

The intrinsic worth of litter consists of its content of nutrients and other materials. Specifically, many studies value poultry litter in terms of nitrogen and phosphorus content (Gollehon et al; Jones and D'Souza; Kaplan, Johansson and Peters, Lynch and Tjaden); depending on the author, potassium and/or calcium may also be included (Lichtenberg, Parker and Lynch; Parker; Pelletier, Pease and Kenyon). Nutrient content at the time of excretion varies according to the type of bird and feed type used. Post-excretion nutrient content also varies with

how well litter is managed (Dou et al.). Nutrient losses can occur due to leaching and/or runoff; in the case of nitrogen, volatilization losses are also a possibility.

As suggested by Parker, litter's value to agriculture as a crop fertilizer could be measured as the value of the marginal product that can be obtained from using litter as a soil amendment or as the savings that could be obtained from substituting commercial fertilizer for litter. Under this assumption the value of poultry litter would be closely related to the crop onto which litter is applied (Lichtenberg et al.). If a market exists, the price of the product such as poultry litter can be determined through the interaction of supply and demand. But the market for litter is nearly nonexistent and as such it is difficult to elicit its price. At this point, you might ask, "Why would anyone care to know the price of poultry litter if its demand does not even trigger the development of a market?" There are at least four possible reasons 1) poultry litter should be viewed as a resource because of its nutrient content, organic matter, enzymes, etc.(Risse et al.); 2) the cost of commercial fertilizers, especially nitrogenous fertilizers, has increased recently and poultry litter can be considered a close substitute of fertilizer (ibid.); 3) at a time when natural gas prices are historically high, using poultry litter as fertilizer could reduce the demand for natural gas, a key ingredient in the production of nitrogenous fertilizers; and 4) developing a market for litter could reduce environmental stress in locations with concentrated poultry production. The first reason has to do with changing the perception one has of animal manure and to do that one must know what the current perception is so that facts can be separated from fiction. The second and third reasons are closely related and are revalidated given the oil prices hikes of the second half of 2005. The fourth reason deserves some additional comments.

Continuous animal production could contribute to water quality problems (Dou et al.) such as eutrophication problems caused by excess phosphorus or nitrogen (Lynch and Tjaden).

Many people may think of poultry litter as a pollutant and as such believe that its management costs are the responsibility of the polluter, that is, the poultry grower. However, growers do not have the means to incur these additional costs; historically poultry litter was an added income source for growers. One year's poultry litter production from Benton and Washington counties is valued at approximately $16 million in terms of N-P-K, using July 2005 commercial fertilizer prices (Goodwin and Carreira). For the average Washington County grower, assuming they can obtain $15/ton for poultry litter, we can expect their net farm income to be nearly $7,500 after accounting for operating and fixed expenses. If litter has no value, then the net farm income is reduced to less than $2,100. The current tournament-contract structure pervasive in the U.S. poultry industry is the result of over forty years of vertical integration, specialization, and geographical concentration. The ultimate result of this process has benefited the American consumer through lower poultry prices and greater product variety and quality (Goodwin).

In general terms, the industry is composed of integrators who provide chicks, feed, and medication, and contractors who provide labor, housing, and operating inputs. The broiler industry, the main component of the American poultry industry and worth over $20.4 billion (NASS/USDA), faces two major threats: foreign competition and environmental concerns regarding poultry litter management (FSA/USDA, 2004). Brazil is the number one exporter of poultry in the world, a lead that traditionally had been held by the U.S. Brazil's comparative advantage lies in lower production costs in areas such as labor and feed (ibid.). According to the FSA/USDA (2005), preliminary results indicate that Brazil exported 2.840 billion metric tons while the U.S. exported 2.46 billion metric tons.

Gollehon et al. assert that producing too much manure (meaning that manure availability exceeds manure use capacity in nearby land) does not necessarily lead to water quality problems;

it does mean that excess manure needs to be transported off-farm to locations where it can be effectively used. Incentives may be needed to make off-farm transport a feasible option but the size of such incentive is unclear. One thing to consider is that according to Risse et al. many studies have shown that crop yields using poultry litter can be equitable or superior to those attained with inorganic fertilizer, so finding alternative markets hinges on finding locations that are nutrient deficient where the nutrients can be fully utilized.

Poultry litter is readily available in Benton and Washington counties, which jointly account for 20% of the sales of broilers and other chicken meat in Arkansas; the state ranks second in the U.S. in production, after Georgia (NASS/USDA). If the litter problem is not solved in a manner that is at least neutral, if not advantageous, to the region, it is not farfetched to imagine a relocation of much of the Northwest Arkansas poultry industry, possibly abroad, considering that the U.S. poultry industry has been losing cost competitiveness to the Brazilian industry. Transporting poultry litter to alternative locations where it can be applied to crops with better nutrient removal rates could be a solution to the problem (Gollehon et al), but litter adoption by crop farmers is not widespread not only because of litter's bad reputation but also due to costs of transporting litter to nutrient-deficient areas. Although poultry litter can be considered a close substitute of commercial fertilizers, there is great uncertainty regarding how crop producers value the litter resource. Until we know more about the willingness to pay for poultry litter, we cannot successfully address the issue of excess poultry litter in Northwest Arkansas and we may continue to waste a valuable resource.

The purpose of this paper is to inquire about the worth of poultry litter to crop farmers in select counties in Arkansas. The main objectives are to discover the current perceptions of crop

farmers regarding poultry litter, what conditions need to be met to develop a market for poultry litter and how much potential users would be willing to pay for litter under different scenarios.

Data and Methods

We conducted a survey of 65 crop producers (41 in Arkansas, 12 in Oklahoma and 12 in Missouri) who are potential users of poultry litter. In June, 2005, we mailed a two-page survey with an introduction letter informing recipients of our goals for the survey, the confidentiality of the data collected, and the date (approximately one week later) when we would be calling to collect the answers,. We collected responses from 34 individuals but discarded four that were from non-farmers and therefore out of sample. Of the valid respondents, 16 were from Arkansas, six were from Missouri and eight were from Oklahoma.

The survey instrument contained nine questions, the format of which ranged from open-ended, closed form and Likert-scale questions. The first two questions collected information on the farm's location, acreage that was rented, acreage that was owned and total acreage. In question 3, we inquired how often the farmer had used poultry litter over the last ten years; if he had never used it, we asked if he had an interest in using it. Questions 4 to 6 asked about price of litter from their last experience of using litter, the crop onto which litter was applied, and the availability and nature of a storage facility for litter (dimensions, length of time litter could be stored, closeness of facility to field where litter was to be applied). In question 7, we asked about the willingness to purchase litter at different price levels (ranging between $15/ton and $35/ton or higher, with $5 increments) under two different interacting scenarios: type of land where litter was to be used (cut land, also referred to as laser-leveled land, and non-cut land) and whether or not the litter could be applied at the farmer's convenience—this means whether the farmer would

arrange for litter application much like one would arrange for chemical fertilizer application or whether the litter was delivered to the farmer, who would have to store the litter and arrange for its application. Question 8 was a five-level Likert scale question (strongly disagree, disagree, agree, strongly agree and no opinion) that respondents used to express their agreement with the statements regarding litter availability, experience with litter, specialized equipment, litter use being time-consuming, nutrient value of litter versus fertilizer, litter nutrient content uncertainty, litter price, and environmental concerns over using litter. The order of the statements tried to minimize bias as much as possible. The last question asked for comments from the respondents.

Results

Despite having 30 completed surveys, not all respondents answered all the questions (Table 1). When applicable, standard deviations are reported in parenthesis. On average the respondents farmed 2,702 (2,781) acres. The average number of acres owned was 1,120 (1,022) and 1,628 (2,340) acres were rented. Over the last ten years, two farmers land-applied litter once, six applied it 2 or 3 times, seven applied it 4 or 5 times, and five applied it 6 or more times. Two respondents indicated they had never used litter and had no intentions of doing so ever, while eight farmers indicated that they had never used litter but had plans to do so in the future. Eighteen farmers reported having purchased broiler litter; they paid on average $26/ton (10.70) with a minimum of $7/ton and a maximum of $50/ton. Only one farmer reported having purchased layer litter and the price paid was $40/ton. Two farmers reported having purchased turkey litter at $24/ton and $50/ton. Some of the farmers purchased more than one type of litter. None of the farmers surveyed had purchased litter pellets.

As reported in Table 2, rice was the crop that received the most litter followed by corn and soybeans. Twelve farmers reported having applied litter to rice at an average rate of 1.18 (0.32) tons/acre and an average acreage of 64,417 (1,409). Seven farmers applied litter to corn at an average rate of 1.83 tons/acre to an average of 234 (256.61) acres. Wheat and cotton also received some litter; two farmers indicated that they applied litter to other crops such as grass, pasture and sunflowers. None of the farmers reported applying litter to silage or sorghum. Some of the farmers reported applying litter to more than one crop.

Twenty-three farmers said that they did not have a facility where litter could be stored and 4 farmers said they had such a facility although only one farmer specified its measurements. Two of the farmers said their facility was right next to one of the fields that received litter and an average of 13.5 miles from the farthest field that received litter. One of the farmers said litter could be stored in his facility for a period of seven months (Table 3).

Table 4 contains the results for the scenario in which litter would be delivered to the farm and land-applied to cut land at the convenience of the farmer. On average farmers would purchase between 586 (721) and 63 (188) tons. The total demand for litter at any price level is higher for non-cut land than for cut land. This can be explained by two facts: 1) cut land acreage is limited—Young, Goodwin and Wailes estimated cut land in eastern Arkansas to be around 20% of crop land—and 2) cut land is land that is poor in soil organic matter, which can be supplied with poultry litter but not with commercial fertilizer. The total demand for poultry litter for cut land application varied between 1,000 tons when the price was $35/ton or higher and 9,960 tons when the price was less than $20/ton; in the case of litter to be applied to non-cut land, total demand varied between 1,450 tons when the price was $35/ton or higher and 20,400 tons when the price was less than $20/ton.

Table 5 reports the results for the scenario in which litter would be delivered to the farmer who would need to store it and arrange for its application. As in the previous scenario, less litter is demanded for application to cut land than to non-cut land and on average less litter would be land-applied. If the price was less than $20/ton, almost 5,000 tons would be demanded to be applied to cut land and 16,750 tons would be demanded for non-cut land. Contrasting tables 4 and 5 we can see that, as litter price increases, crop farmers become more sensitive to whether litter is provided to them and land-applied at their convenience or not. Thus, if litter costs less than $20/ton, supplying litter in such a way that the farmer must store it and arrange for its application instead of supplying it at his convenience, contracts quantity demanded for litter application to cut land by half from 9,960 to 4,990. If the price of litter is between $20/ton and $25/ton then demand is cut by more than tenfold. In the case of non-cut land, three farmers indicated that at some price levels they would purchase more litter if they had to store and arrange for its application than if the litter was conveniently delivered to them. Thus more litter is demanded for price levels between $20/ton and $30/ton if farmers must arrange for litter storage and application than if farmers conveniently receive the litter. One explanation for this counter-intuitive result is that past experiences of farmers, or hearsay information from other farmers, has biased recipients against the promise of “on-time” delivery; the risk premium of not having litter to apply during the narrow time window is too great, resulting in a higher price paid for litter that is on hand. One other possibility is that the farmers may have misunderstood the question’s instructions or may have been tired or distracted.

In the last question (before the comments area) we inquired about how strongly farmers agreed/disagreed with statements associated with litter use (Table 6). Over half of the respondents agreed (ten) or strongly agreed (six) that litter is not available when needed,

reinforcing the last observations above regarding Table 5, two people had no opinion, nine people disagreed, and three people strongly disagreed. Nearly two-thirds of the respondents (18) indicated that they did not have much experience with poultry litter; only three strongly disagreed and eight disagreed. Twenty-three out of the 29 respondents indicated that they did not have adequate equipment to use poultry litter. Seventeen respondents indicated that using poultry litter was very time-consuming. Over two-thirds of the respondents disagreed or strongly disagreed that litter has less nutrient value that fertilizer but the respondents were equally split in terms of nutrient uncertainty of litter—13 respondents agreed with this statement and another 13 disagreed, one respondent strongly agreed while another strongly disagreed, three respondents had no opinion. Over half of the respondents agreed or strongly agreed that litter was too expensive, eight disagreed and two strongly disagreed, the other four respondents had no opinion. Fourteen respondents disagreed that they had concerns over the environment, four had no opinion, eight agreed, and three strongly agreed.

Some of the respondents' comments indicated that they would use more litter if the price was right; some specifically mentioned that if the price of litter was comparatively equal to or lower than the price of commercial fertilizer, they would opt for litter. A few respondents indicated that they would use litter if they could conveniently arrange for its delivery and application. Another issue of concern to farmers was the nutrient value of litter reinforcing the results of the latter question. For the most part, the comments provided reiterated concerns that were focused on the previous question. In the few original comments, one showed concern for the actions of the Oklahoma Attorney General, some thought litter should be shipped to eastern Arkansas, one farmer was skeptic about processed poultry litter (litter pellets and baled litter)

and another farmer would pay to have litter spread if someone else provided funding for the transport of the litter to his farm.

Conclusion

The results of the survey indicate that crop farmers are interested in using poultry litter and many of them are already using it or have used it in the past. Based on farmers' past experience, rice and corn are crops that could be good markets for poultry litter. In eastern Arkansas rice is cultivated sometimes in cut land and the organic matter in litter is a good asset for this type of land. Corn is a nutrient intensive crop and could use many of the nutrients available in litter. Farmers' main concerns for adopting poultry litter are the need for specialized equipment if they had to do it themselves, the amount of time needed for litter application, and the price of litter and its availability. Although there is some poultry litter use, the market is not fully developed and potential users still lack familiarity with and access to the product. Because poultry litter is a renewable resource and nitrogenous commercial fertilizers consume non-renewable resources (natural gas), there should be some public intervention to develop the market for renewable crop nutrient sources, in particular poultry litter.

Current unpublished research by the authors pertaining to the feasibility of implementing a Poultry Litter Bank indicates that if the price paid for litter is in accordance with its intrinsic value of approximately $51/ton, a subsidy would be required to ship raw litter to Mississippi County, one of the Arkansas counties that is farthest from the northwest of the state. The cost of this subsidy would need to be at least $7/ton or $0.11/ton per mile. It is important to establish a sustainable price at least equal to the cost of processing and shipping litter to its market destinations. Subsidy levels necessary to sustain operation of a litter bank most likely would not

be politically sustainable over the long run, pointing to the real need to create a sustainable marketing system for poultry litter in nutrient-deficient areas that may reasonably receive poultry litter as a soil amendment.

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Tables

Table 1. Last Price Paid for Raw Litter (Broiler, Layer, and Turkey) and Processed Litter (Pellets)

Litter Type	Mean	Std. Dev.	Min.	Max.	N
Broiler	25.67	10.70	7	50	18
Layer	40.00	0.00	40	40	1
Turkey	37.00	18.38	24	50	2
Pellets	0.00	0.00	0	0	0

Table 2. Summary of Poultry Litter Use of Respondents' Last Experience with Poultry Litter over Last 10-Year Period

Crop	Acreage Mean	Acreage Std. Dev.	Acreage N	Tons/Acre Mean	Tons/Acre Std. Dev.	Tons/Acre N
Corn	234.14	256.61	7	1.83	0.41	6
Silage	0.00	0.00	0	0.00	0.00	0
Soybean	194.13	200.99	8	1.36	0.48	7
Sorghum	0.00	0.00	0	0.00	0.00	0
Rice	644.17	1409.00	12	1.18	0.32	12
Wheat	45.00	0.00	1	2.00	0.00	1
Cotton	200.00	0.00	1	1.00	0.00	1
Other	324.50	352.85	2	2.00	0.00	2
Total			31			29

Table 3. Availability of Storage Facility for Litter, Dimensions, Storage Time, and Distance of Facility from Field where Litter Was Applied During Respondents' Last Experience with Poultry Litter over Last 10-Year Period

	Mean	Std. Dev.	N
Number of farmers with storage facility			4
Number of farmers without storage facility			23
Dimension 1 (feet)	70.00	0.00	1
Dimension 2 (feet)	25.00	0.00	1
Length of time litter could be stored (months)	7.00	0.00	1
Distance from closest field (miles)	0.00	0.00	2
Distance from farthest field (miles)	13.50	9.19	2
Total number of respondents			27

Table 4. Amount of Poultry Litter (Tons) Farmers Were Willing to Purchase at Different Prices ($/Ton) Assuming Litter is Land-Applied at Farmer's Convenience

Price	Cut (Laser-Leveled) Land				Non-Cut Land			
$/Ton	Mean tons	Std. Dev.	N	Total Tons	Mean tons	Std. Dev.	N	Total Tons
15-19	585.88	720.66	17	9,960	2,040.00	3554.17	10	20,400
20-24	420.88	632.38	17	7,155	1,179.55	1587.17	11	12,975
25-29	318.75	657.35	16	5,100	954.55	1625.80	11	10,500
30-34	77.56	187.68	16	1,241	131.82	293.49	11	1,450
>=35	62.50	188.41	16	1,000	131.82	293.49	11	1,450

Table 5. Amount of Poultry Litter (Tons) Farmers Were Willing to Purchase at Different Prices ($/Ton) Assuming Litter is Delivered and Farmer Must Arrange for Storage and Application

Price	Cut (Laser-Leveled) Land				Non-Cut Land			
$/Ton	Mean tons	Std Dev	N	Total Tons	Mean tons	Std Dev	N	Total Tons
15-19	332.73	672.76	15	4990	1861.11	3866.02	9	16750
20-24	43.33	94.24	15	650	1350	3771	10	13500
25-29	10	38.73	15	150	1350	3771	10	13500
30-34	10	38.73	15	150	70	221.36	10	700
>=35	10	38.73	15	150	70	221.36	10	700

Table 6. Summary of Farmers' Perceptions of Litter Use (Number of Farmer Responses to each Statement)

Statement\Level of Agreement	SD	D	NO	A	SA	Total
Litter is not available when needed.	3	9	2	10	6	30
I don't have much experience with poultry litter.	3	8	0	14	4	29
I don't have proper equipment to use litter.	2	4	0	17	6	29
Litter application is very time consuming.	3	4	5	12	5	29
I think litter has less nutrient value than fertilizer.	5	15	2	7	0	29
Litter nutrient content is uncertain.	1	12	3	12	1	29
Litter is too expensive.	2	8	4	14	1	29
I have concerns over the environment.	0	14	4	8	3	29

Note: SD is strongly disagree, D is disagree, NO is no opinion, A is agree, SA is strongly agree