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LAYER MANURE: A VALUABLE PRODUCT

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In the preceding 20 years, there has been a worldwide awakening to the problem of pollution of the environment (air, water, soil) and its effects on human health and other forms of life.

Much of this concern has stemmed from the amount of manure produced by the increased number of animals in confinement.

This is certainly true in the poultry industry. The trend is away from small flocks and toward the concentration of poultry into houses containing more than 100,000 laying hens.

The economy of size has enabled producers to take advantage of labor-saving devices for feeding and watering, technological innovations for egg collection and processing, discounts associated with bulk feed purchases, and other production cost-saving practices.

However, one limitation is the utilization of manure from this large concentration of birds.

The public and environmentalists have voiced the following major concerns pertaining to pollution associated with farm animals excreta:

- Nitrates — natural processes break down manure and allow nitrates to disperse into surface and ground water.
- Inorganic elements — excessive application of manure to crop land tends to accumulate these elements (P, K, Ca, etc.) in the soil that can be toxic to plants and detrimental to soil structure.
- Oxygen demand — organic material (runoff) has a high oxygen demand that will decrease obtainable oxygen to fish and other aquatic life.
- Odors, dust and insects — farms located near centers of population are having a growing number of complaints filed against them because of these nuisances.

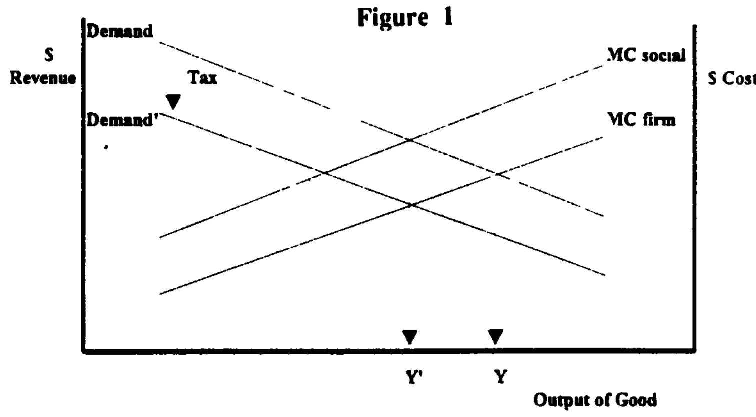
Economic Viewpoint

Economists classify these pollutants as externalities (an effect of one economic agent on another that is not taken into account by normal market behavior). In simple terms, the excess application of manure to land by farmers imposes a cost (the cleanup) on society.

Today, this cost is not normally determined as a production cost to the poultry producer. Thus, the input (pollution) is considered a free factor of production and thus its use is maximized. Therefore, the benefits accrue to the firm while the cost is passed to society.

One traditional solution to an externality is a governmental tax on the good generating the problem. This is illustrated conceptually in Figure 1.

Figure 1



The normal workings of the market will cause output "Y" to be produced. Taxing of the good (eggs) will reduce the demand curve facing the firm from "Demand" to "Demand'". This will shift the profit-maximizing level of egg output from "Y" to "Y'", which is also the level of output that is socially optimal.

By taxing eggs, the effective demand for the product has been reduced; individuals who use eggs are now forced to pay for the damage that egg production creates.

Two concerns with this solution are, first, calculating the precise tax to be imposed directly on the good. Second, the price elasticity of demand for eggs is -.23, which is inelastic (the quantity demanded changes relatively little compared to the change in price). Combined, these two factors make it difficult to obtain the exact desired effect of pollution abatement.

An alternative course is to internalize the externality. Instead of the cost of pollution cleanup being passed to society, the cost is internalized as a production cost to the egg producer. This will increase the price of the input manure disposal. The change in the input price will cause a shift in the firm's cost curves. In effect, the firm will now pay the full social marginal cost ("MC social") of egg production. In other words, the firm manger will now take the marginal cost curve for production to be MC social and would produce where marginal revenue ("Demand") = MC social, which is required for efficiency.

Solutions

There are numerous exotic techniques to utilize layer manure (ensiling for ruminant feed, incineration and methane digestion for electricity generation), although more realistic approaches to minimize the cost of manure utilization are:

1. Application to agriculture land as fertilizer at site of production
2. Export as fertilizer to agricultural land in neighboring areas.

Option 1: Application to agricultural land as fertilizer.

Most layer operations remove the manure regularly as a matter of animal health. After they move out a flock of hens, they clean the layer house. Other producers will remove the manure several times during the laying cycle. In either case, this results in an enormous pile of manure (around 1,600 tons of "as-is" manure/100,000 hens/year).

Most operations have solved the problem of disposal by spreading the manure on available land. As mentioned previously, excess manure applications can cause numerous pollution problems. In addition, because of the potential for environmental damage, some states limit the rate of manure application per acre of land.

For example, Pennsylvania House Bill Number 100 states that "concentrated animal operations" will be required to develop and maintain a nutrient management plan. Concentrated animal operations have an animal density of two or more animal units per acre on an annual basis. An animal unit is 1,000 pounds of live weight. The table below illustrates the outcome of this law on an average size flock of 100,000 hens.

AEU = Animal Equivalent Units
3.28 lb. mean weight x 100,000 = 328,000 lb. live at 2 AEU per acre = 164 acres required.
Manure and nutrient production from such a size flock would be:

AS IS*		LBS/ACRE (WITH 164 ACRES)
Manure	3,200,000 lbs (1600 tons)	19,512 (9.8 tons)***
total N	57,600 lb.	351***
P205	89,600 lb.	546***
K20	51,200 lb.	312***

* Based on 77 samples.
**This is above agronomist's recommendations of 7 tons/acre.
***These nutrient concentrations exceed values required for most crops.

For Example:
150 bushel corn silage requires
N = 200 lb/acre

Thus a location 50 miles from the source will cost:
$0x17 tons = $0.00
$0.50/ton to load 17 tons = $8.50
$1.30 x 100 miles = $130.00
Total Cost = $138.50/truck load or $8.15/ton

Therefore, the pollution dilemma still exists under these guidelines with this manure nutrient analysis. This suggests there is not only a manure quantity problem but also a quality consideration (nutrient concentration).

An additional issue is that the average farm with 100,000 layers may only have an average of 50 acres of tillable land. Therefore, another site must be located for disposal of poultry manure. If 50 acres are available and 164 acres are required, then an additional 114 acres must be obtained. Hence, the producer must decide whether to buy or rent land, sell the excess manure, or reduce production.

For simplicity sake, we will assume the most cost effective way is to sell the excess manure to another area (option 2).

Option 2: Export as fertilizer to agricultural land in neighboring areas.

Because of the bulkiness and the potentially high level of moisture (60 percent) of layer manure, the major cost for the buyer is transportation. However, there are custom applicators who will pick up, transport, and apply the manure. These custom applicators have spreader-type trucks that can haul and apply approximately 17 tons "as is" of layer manure per load. As one can surmise, as distance from the source increases, the total cost to the buyer increases (Figure 2).

"AS IS" 60.4% MOISTURE

Nutrient	price/ton %	lb./ton	cents	dollars
N	1.8	36	22.5	8.10
P205	2.8	56	23.0	12.88
K20	1.6	32	14.0	4.48
			Value	$25.46/ton

Total manure per 100,000 hens = 1600.00 ton annual x 25.46 value

For example, if the trucking distance is 50 miles, then the trucking cost is $8.15/ton and the value from the fertilizer is $25.46, resulting in a gain of $17.31/ton.

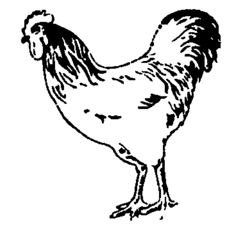
At distances greater than 163 miles, the trucking cost eliminates the benefits of using poultry manure fertilizer. Therefore, as shown by Figure 3, exporting manure for distances of 163 miles or less is profitable.

On the surface, exporting manure is an economically feasible solution with benefits to all (producer, applicator, buyer, society). Nevertheless, there are other concerns. For instance, is there a market for poultry manure? Are sufficient commercial applicators available? Also, what is the effect on the commercial fertilizer market? And, finally, would the increase in demand for custom application of poultry manure have a detrimental effect on the commercial fertilizer industry?

Summary

Nutrient management legislation has decreed that the benefits to society are greater than the cost imposed on firms for pollution control. The imposed cost is now incorporated as part of the firm's production function. The dual approach to cost minimization is for the firm to maximize output for a given expenditure of total cost.

One means to cost minimization is for efficient use of the resource. Layer manure, previously thought of as a "waste," must now be considered a resource. Taken one step farther, it can also be classified as a by-product that can have significant economic value as a plant nutrient.



Only two possible solutions have been addressed to the manure utilization issue. There are others as mentioned previously. One intriguing approach is, instead of treating the effect, why not examine the cause of the externality? Is it possible to modify the genetics of the bird to increase nutrient absorption? Can the nutrient makeup of the diet be altered to decrease the amount of nutrients in the feces? More research is needed to study other feasible and economical answers.

Trucking cost =
$cost/ton (table 1 x 17 ton/load.
Value "as is" =
$25.46/ton x 17 ton/load = $432.82.

Based on the current trucking cost and estimate of manure fertilizer value, it can be concluded that 163 miles is the maximum range for custom application (Figure 3).

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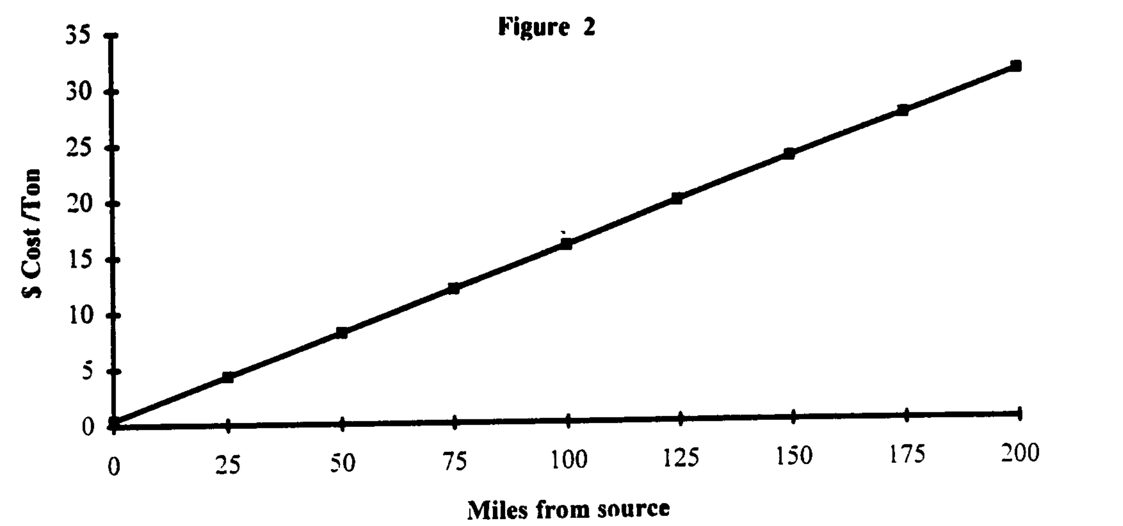
Figure 2



$0/ton purchase price of manure 17 tons/load$0.50/ton for producer to load truck $1.30/mile round trip.

Thus, a location 50 miles from the source will cost: 10C$0 x 17 tons = $0.00 10C$0.50/ton to load 17 tons = $8.50 9C$1.30 x 100 miles = $130.00 10CTotal Cost = $138.50/truck load or $8.15/ton

For correct analysis, a value, for the nutrient characteristics of layer manure as a fertilizer, must be determined. This is approximated by using commercial bulk fertilizer prices.