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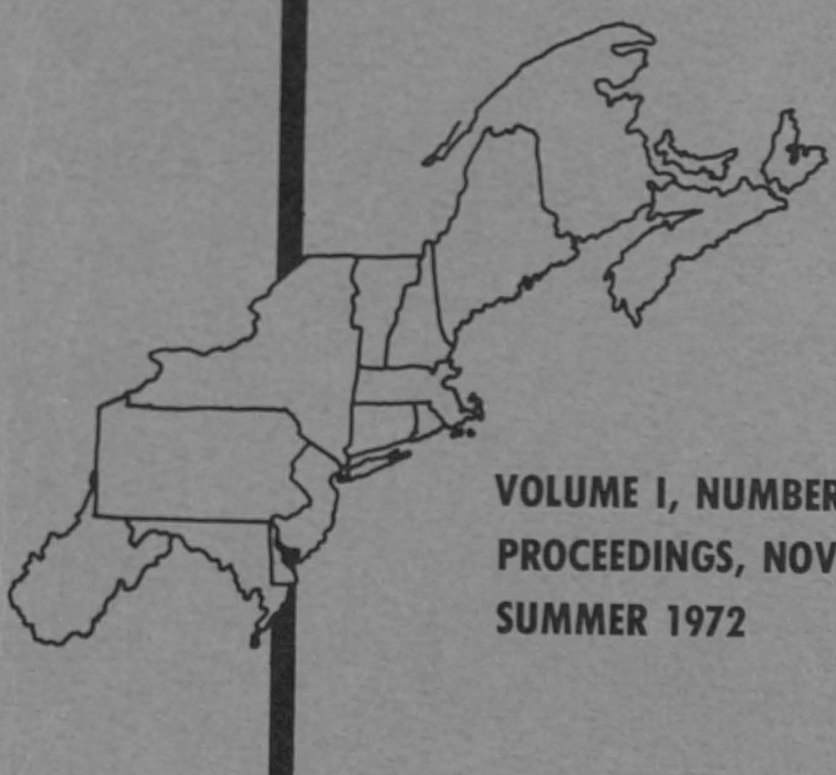

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AN ECONOMIC EVALUATION OF SELECTED MANURE DISPOSAL SYSTEMS

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Manure Disposal and Pollution

Environmental pollution is defined as "the unfavorable alteration of our surroundings through direct or indirect effects on the chemical, physical, and biological characteristics of our air, land, and water influenced primarily by man's actions [2]. Some of the major variables, elements of the problem, and problems related to farm animal waste management can be found in Table 1 [2,52].

Table 1.
Major Variables, Elements of the Potential Problem and Types of Problems Related to Farm Animal Wastes

Major Variables	Elements of the Potential Problem	Problems
Population density	Air	Odors
Farm animal density	Animal waste	Offensive sights
Geology	Land	Loss of nutrients from the soil
Soil	Surface water	Excessive enrichment of surface water, especially lakes
Landforms	Groundwater	Buildup of nitrate concentration in groundwater
Surface runoff	People	Organic pollution of surface waters
Groundwater		
Land use		
Wind		

Nutrient pollution of waters attributable to dairy and livestock farms can be held to a minimum by the adoption of good management practices. It has been common for farmers to spread manure daily in winter months on frozen and snow covered fields. Similarly, manure is often stored in an unprotected pile near the barn. Either practice leads to leaching of nutrients into surface runoff during the rainy periods of late winter and early spring.

Presently there is no profitable method of manure utilization and it is unlikely that one will be developed in the near future [14, 108].1/ Therefore, the farm operator is concerned with finding the least cost method of disposal, which is dependent on many variables. For instance, the net disposal cost is dependent upon the value of manure as a commercial fertilizer substitute and the costs of disposing or handling it. The manure disposal activity is also constrained by a set of actual or potential social and institutional (government) rules and regulations.

The following points should be considered in selecting a livestock waste management system [10, 3]:

(1) The amount of manure produced.
(2) The nutrient content and value of farm manure as a replacement for commercial fertilizer.
(3) The cost of alternative systems of disposal.
(4) The availability of cropland on which to spread manure.

Another study described the ideal manure disposal system as follows [7, 150]:

(1) One that results in least cost from source to ultimate disposal.
(2) One that has zero odor during collection, handling, and spreading.
(3) A convenient operation that fits farm labor allocation schedules or one that is completely mechanized.
(4) One that creates zero pollution of surface or subsurface water.

It is easily recognized that there may be a conflict in the simultaneous achievement of these ideals. For instance, the least cost method may not be odor free or have zero pollution potential of surface or subsurface water. Dr. L. W. Weinberger has been quoted as saying: "Unfortunately we have confused our technical ability in solving a problem with the costs associated with solving the problem, and who should be paying the costs of pollutional control" [8, 3].

1/ Excepting, of course, the occasional situation where a particular set of circumstances may create a profitable sales alternative for manure.

Given present legislative attitudes it is quite conceivable that livestock producers may be required to bear all of the costs associated with the qualitative damages of livestock manure to the environment. If controls were applied uniformly on an interregional basis, it then becomes likely that the pollution abatement costs will eventually be passed on to the consumer in the form of increased prices [6, 12].

Budgeted Costs for Manure Disposal in Free Stall Dairy Operations

Since dairy farm operations are an important segment of the livestock industry, managers need to know the costs associated with various manure disposal activities.

In order to facilitate the managerial decision making process, budgetary information was developed for three manure disposal alternatives for two representative dairy farms. The three manure disposal alternatives are:

(1) Daily spreading
(2) Stacking system for biannual spreading
(3) Liquid storage system for biannual spreading.

The two different sized farms budgeted were a 50 and a 100 cow free stall dairy operation. Therefore, this study derived six different manure disposal budgets (Table 2). These budgets are not intended to represent all different sizes and types of dairy operations or all of the manure disposal alternatives. We also recognize that, in an economic sense, many of the overhead and labor costs we have considered are costs attributable to "the business of being in business". Hence, to attribute them to one segment of an integrated operation may be somewhat questionable. However, it is hoped that this analysis may be of some assistance to many dairy farmers confronted with a need to estimate cost consequences of adopting alternative manure disposal systems in order to conform to pollution control regulations.

Implications

One study indicated that a 60 cow dairy farm in Massachusetts had average annual receipts of $827 per cow [15, 23]. The associated average annual expenses per cow were $594. The net cash income per cow is then estimated to be $233 per cow. If it is assumed that the typical dairy farmer in Massachusetts presently disposes manure by daily spreading, the average cost of manure disposal would range from $39 per cow for a 50 cow free stall system to about $26 per cow for a 100 cow system.

Table 2.
Alternative Annual Manure Handling Cost Budgets for
50 and 100 Cow Free Stall Dairy Systems

	FREE STALL HOUSING					
	50 Cows			100 Cows		
	Manure Handling System			Manure Handling System		
	Daily Spread	Stacking	Liquid Storage	Daily Spread	Stacking	Liquid Storage
Fixed Cost Items						
Spreader (105 bushel, $1,116)	301.17	--	--	--	--	--
Spreader (150 bushel, $1,305)	--	--	--	352.34	--	--
Spreader (300 bushel, $2,295)	--	619.66	--	--	619.66	--
Liquid Manure Spreader (1,500 gallon, $2,000)	--	--	510.00	--	--	510.00
Ramp ($500)	75.00	--	--	75.00	--	--
Scraping Blade (7 foot, $170)	84.72	84.72	84.72	84.72	84.72	84.72
Manure Platform ($2,000)	--	330.00	--	--	--	--
Manure Platform ($4,000)	--	--	--	--	660.00	--
Stacker ($1,900)	--	551.00	--	--	551.00	--
Manure Loader ($600)	--	93.00	--	--	93.00	--
Pump (high capacity with chopper impeller unit, $1,500)	--	--	457.50	--	--	457.50
Storage Tank (24,000 cubic feet, $.40/ cubic foot, $9,600)	--	--	1,152.00	--	--	--
Storage Tank (48,000 cubic feet, $.35/ cubic foot, $16,800)	--	--	--	--	--	2,016.00
Tractor (2-plow, used, gasoline, $1,000)	350.00	350.00	350.00	350.00	350.00	350.00
Tractor (4-plow, diesel, $8,874)	--	--	124.03	--	--	106.48
Total Fixed Costs	735.89	2,028.38	2,678.25	862.06	2,358.38	3,524.70

Table 2 (continued)

	FREE STALL HOUSING					
	50 Cows			100 Cows		
	Manure Handling System			Manure Handling System		
	Daily Spread	Stacking	Liquid Storage	Daily Spread	Stacking	Liquid Storage
Operating Cost Items						
Scraping Labor ($2.25/hour)	405.00	405.00	405.00	648.00	648.00	648.00
Hauling Labor ($2.25/hour)	540.00	157.50	135.00	756.00	252.00	216.00
Loading Labor ($2.25/hour)	--	157.50	--	--	252.00	--
Tractor (2-plow, used, gasoline, 3 gallons/hour, $.20/gallon)						
Scraping	108.00	108.00	108.00	172.80	172.80	172.80
Hauling	144.00	42.00	--	201.60	67.20	--
Loading	--	42.00	--	--	67.20	--
Pumping	--	--	36.00	--	--	76.80
Tractor (4-plow, diesel, 5 gallons/ hour, $.135/gallon)						
Hauling	--	--	40.50	--	--	64.80
Total Operating Costs	1,197.00	912.00	724.50	1,778,40	1,459.20	1,178.40
Total Fixed and Operating Costs	1,932.89	2,940.38	3,402.75	2,640.46	3,817.58	4,703.10

The cost of manure disposal for a 50 cow free stall system using a manure stacking system would be roughly $59 per cow, while a liquid manure handling system for the same sized herd would be $68. These average costs are respectively $20 and $29 per cow greater than the daily spreading method for the same sized operations.

For a 100 cow free stall dairy system the average cost per cow for a manure stacking system is about $38 and for a liquid storage system is $47 per cow. These two average cost figures are $12 and $21 greater per cow than the daily manure spreading alternative.

The net cash income per cow using a manure stacking system would fall from $233 to $213, about an 8.6 percent decrease. Using a liquid manure system would reduce net income per cow to $204, an approximate 12.4 percent decline. The respective reductions in net cash income for a 50 cow herd would be about $1,000 and $1,450.

Also, if the receipts per cow for a 60 cow herd are constant and are also representative for the budgeted 100 cow free stall system, then the net cash income will drop by $12 per cow for the farms utilizing the manure stacking system and by $21 per cow for the farms utiliting the liquid storage system. These two declines are respectively about 5.2 and 9 percent and in terms of net cash income amount to about $1,200 and $2,100 respectively for a 100 cow herd. If these costs were completely passed on in the price of milk, the price per hundredweight would increase. For the manure stacking system the price per hundredweight would increase roughly 2.5 percent from about $5.89 to $6.04, while the costs of the liquid storage system would increase the price of a hundredweight of milk by about 3.6 percent to $6.10.

The 100 cow free stall dairy system adopting a manure stacking or liquid storage system had increased average costs per cow by $12 and $21 respectively as compared to a daily spreading system. If all the increased associated costs were passed on in higher prices, the price per hundredweight of milk would be about 1.5 and 2.6 percent higher for each respective system. Therefore, the respective prices for a hundredweight of milk would be about $5.98 and $6.04.

In any case the increase in the cost of milk to consumers would be less than one cent per quart if these costs were passed on.

What the analysis has attempted to illustrate is that, with given technology, manure management systems designed to enhance environmental quality are more costly than the traditional daily spreading disposal technique. Assuming that environmental quality could be enhanced by changing manure disposal techniques, the increased costs will be borne by the producers, the buyers, or some combination of the two.

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