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OPERATING COSTS FOR MECHANICAL
UNLOADERS IN TOWER SILOS
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INTRODUCTION

Not all farmers climb their tower silos every day to throw down silage. A number are using electrical power and mechanical equipment to do this job. The first mechanical unloaders were introduced on New York farms shortly after World War II. They are now gaining somewhat wider acceptance and application as their mechanical performance has improved.

How practical are mechanical unloaders in tower silos? How much will it cost to operate such unloaders in different sizes and types of silos? To provide help in answering these questions, information was obtained on the costs of installing and operating 31 different unloaders from 26 New York dairymen in 1955 as part of a larger study on alternative methods of storing silage and their costs. ^{1/} Because it was difficult to determine which farmers in the state were using unloaders a method of randomly choosing farmers was not used. Instead a quota was established and records were obtained wherever unloaders were found in the areas in which methods of storing silage were studied. The representativeness of these unloaders might be questioned although it is doubtful if the experience of these farmers differs greatly from most owners of mechanical unloaders. The farms, on which unloaders were studied, were located in 11 different counties in central and western New York.

INSTALLATION AND OPERATING COSTS

Original Cost

Most unloaders range in price from \$900 to \$1350 including the cost of installation. Of the 31 unloaders studied only one had cost a farmer more than \$1350. On the other hand there were three farmers who had obtained unloaders for less than \$900 by making special arrangements with a local dealer. Three different makes were found in use and included in the study: - Clay, Jamesway or Leach, and Van Dale.

Unloaders were installed most commonly in 14 and 16 foot silos. Of the 31 unloaders 27 were of these two sizes. Most of the unloaders were permanently installed or used in only one silo. Seven of the 26 farmers, however, used their unloaders regularly in two or more silos during the winter feeding period.

Operating Costs

Annual costs resulting from the operation of mechanical silo unloaders largely consist of depreciation, interest, repairs, and electricity. These amounted to as little as \$100 and as much as \$250 per unloader each year.

^{1/} Results of this study are reported in A.E. 1043, Alternative Methods of Storing Silage and Their Costs, J. W. Wysong and B. F. Stanton, Department of Agricultural Economics, Cornell University, November 1956.

Fixed costs, depreciation and interest, made up from 70 to 90 percent of total operating costs in most cases. An annual depreciation charge was determined using the straight-line method. The original cost including charges for installation was divided by each farmer's estimate of the number of years the unloader might be used. Most commonly the length of life was estimated to be 10 years. General observation suggests that these estimates tend to be on the conservative side. Interest was charged at a rate of six percent on the depreciated value of each unloader in 1955. The six percent rate was chosen as reasonably representative of the cost of short term credit for similar equipment in New York.

Variable costs, consisting of repairs, maintenance, and electricity, make up a relatively small share of operating costs. Repairs and maintenance are highly variable from farm to farm and from year to year. To obtain estimates of annual charges for repairs and maintenance farmers were asked to indicate the cost of all repairs and maintenance since the unloaders were installed. This total was divided by the number of years the unloader had been in service. These annual charges ranged from nothing to \$75 and averaged \$11 per unloader.

Electricity provided the power necessary to unload silage. The size of the electric motors used on the unloaders varied with the diameter of the silo and the type of silage stored. There were nine five-horsepower motors, 18 three-horsepower motors and four two-horsepower motors. Electricity was charged at a standard rate of 2.0 cents per kilowatt hour used. The total charge for electricity varied depending on the size of silo and size of motor, and ranged between \$5 and \$40.

TABLE 1.
AVERAGE ANNUAL OPERATING COSTS
FOR 31 MECHANICAL UNLOADERS IN TOWER SILOS
(New York Dairy Farms, 1954-1955)

	Averages	Percent of total
Original investment.	\$1021	
Present value.	\$ 729	
Estimated years of life at time of purchase.	10	
Capacity of silo(s) from which silage was removed.	200	
Percent of total available capacity used	88	
<u>Annual Operating Costs</u>		
Depreciation	\$ 107	60
Interest	44	25
Repairs and maintenance.	11	6
Electricity.	15	9
TOTAL OPERATING COST	\$177	100

Average annual operating costs are shown in table 1. About half of the unloaders were operated annually at costs of \$150 - \$200, closely approximating the averages presented. The larger unloaders, which were used for 300 or more tons of silage, generally were operated at costs between \$200 and \$250. Those with costs below \$150 had the older or smaller unloaders.

Operating Costs per Ton of Silage Removed

In evaluating the use of mechanical unloaders in tower silos, study of operating costs per ton of silage removed helps in considering their feasibility. The average annual cost was \$1.00 per ton when counting each farmer's experience equally regardless of the number of tons of silage unloaded. However, half of the 31 men operated their unloaders at a cost of from \$0.50 to \$0.99 per ton (table 2).

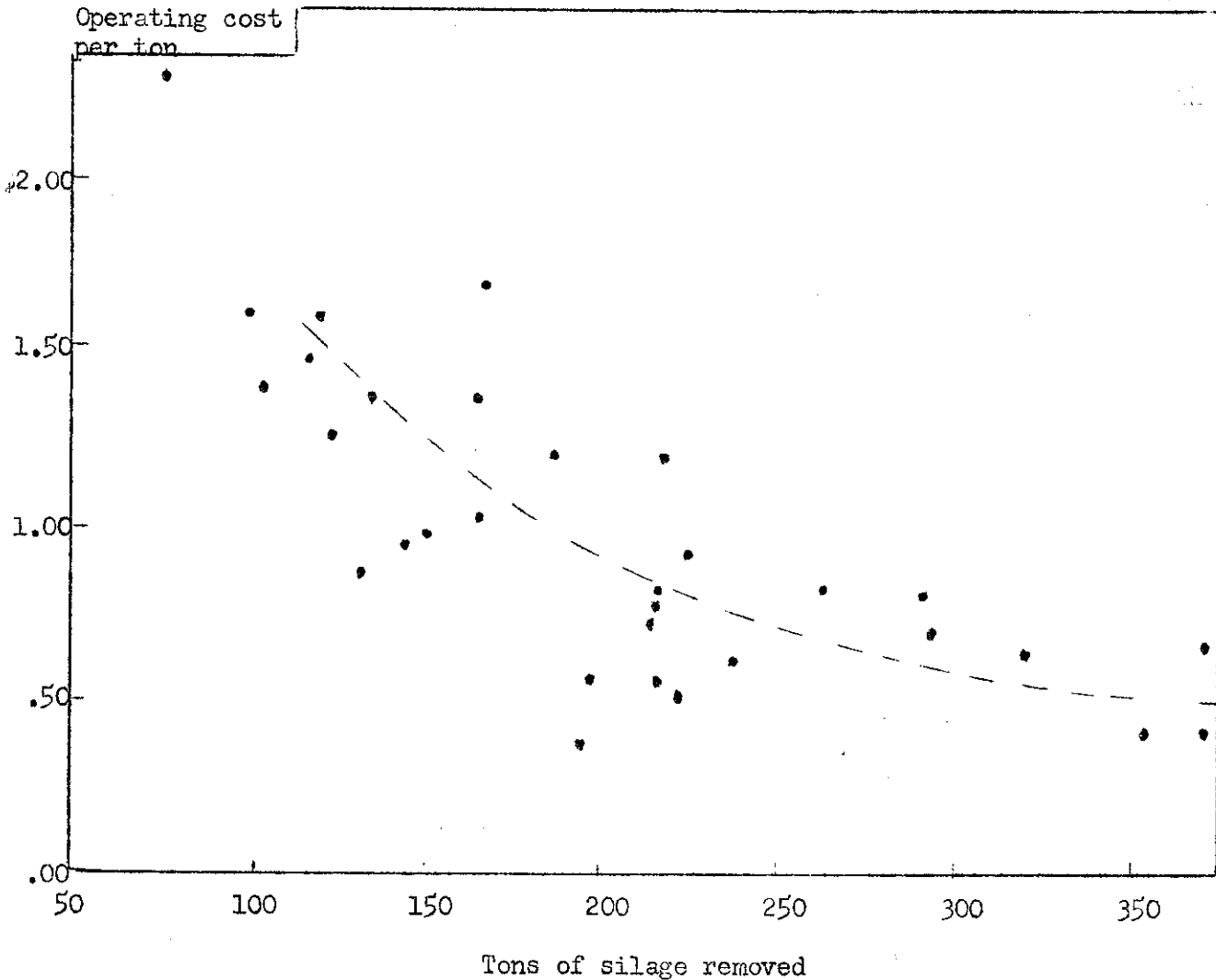
TABLE 2. DISTRIBUTION OF ANNUAL OPERATING COST PER TON OF SILAGE REMOVED FOR 31 MECHANICAL UNLOADERS (26 New York Farms, 1954-1955)

Cost per ton removed	Number of unloaders
Under \$0.50	3
\$0.50 - 0.99	16
1.00 - 1.49	7
1.50 - 1.99	4
2.00 - and over	1

The variability in operating costs per ton was not great compared with the variability in operating costs for many pieces of farm equipment. The one case in which costs exceeded \$2 per ton occurred because a small silo had been only partly filled and a total of 73 tons unloaded.

The most important factor determining the size of operating costs per ton was the number of tons of silage handled. All but one of the 15 unloaders removing more than 200 tons of silage annually had operating costs of \$1.00 per ton or less. The average operating cost per ton for this group was \$0.72. The seven men who used their unloaders in more than one silo were all included in this group. Nearly all of the men who unloaded less than 200 tons of silage had operating costs above \$1.00 per ton. The general relationship between tons of silage removed and operating costs per ton is shown in figure 1.

FIGURE 1. RELATIONSHIP BETWEEN TONS OF SILAGE REMOVED AND ANNUAL OPERATING COST PER TON FOR 31 MECHANICAL UNLOADERS (New York Farms 1955)



Use of Unloaders

Surface unloaders were used an average of 246 days annually or for about eight months. One unloader was used for only three months while three received year round use. Since operating costs per ton decrease with increased use farmers who feed silage throughout the year to relatively large herds can operate unloaders at relatively low costs per ton. The amount of daily use depended on the amount of silage fed daily. Most men used unloaders from 30 to 60 minutes per day. It took a little less than one hour to remove one ton of silage under average conditions. However, there was considerable variability from this figure ranging from 0.5 to over 2.0 hours per ton handled.

A considerable amount of time was required to move surface unloaders from one silo to another. Farmers also recognized the relatively high cost of using an unloader in small silos with a low tonnage capacity. Two farmers

were concerned with the danger of the unloader dropping on someone while hoisted in the top of the silo. Unloaders worked poorly during rainy periods in silos with no roof. Two farmers reported problems with frozen silage during cold weather although most of the farmers did not have this difficulty. Surface unloaders caused some waste of space at the top of the silo. One farmer reported that his electric wiring had been overloaded by the installation of a silo unloader. Only one farmer specifically stated that he considered surface unloaders too expensive for the average farmer to operate.

TABLE 3. AVERAGE AMOUNTS OF TIME USED IN UNLOADING SILAGE (26 New York Farms, 1954-1955)

Number of unloaders	31
Minutes of operation per day	47
Number of days operated	246
Total hours per year removing silage	189
Hours per ton removed	0.9

The amount of power consumed in operating a mechanical unloader is relatively small. The amount of electricity actually used per ton of silage unloaded is difficult to estimate. The size of motor and the degree to which it is loaded are important. In this study rough estimates were obtained from farm users based on the size of motor and amount of time it was in operation. These farm estimates were considerably larger than more accurately recorded consumption records based on experiments conducted by the Department of Agricultural Engineering at Cornell. Their evidence suggests that about 1.5 kilowatt hour is used per ton of corn silage and 2.5 kilowatt hours per ton for grass silage instead of the average of 3 kilowatt hours per ton reported as rough estimates by farmers. All this reinforces the point that electricity makes up a relatively small part of total operating costs.

Farmers' Reactions to Unloaders

Farmers who had operated their unloaders one or more years were asked to give their favorable and unfavorable experiences with them. Most reported the savings in time and physical labor as the primary advantage of mechanical unloaders. They were, in general, pleased with their unloaders when they operated without mechanical difficulties. The unloaders did a good job in mixing and removing frozen silage around the edges of the silo. They saved handling silage twice in wide silos and kept the surface layer of silage solid and level. When only small amounts of silage were removed daily this was of special importance in reducing top spoilage.

Some farmers had had unfavorable experiences and problems. Clogging was the most frequently mentioned. This resulted primarily from dropping the unloaders down on the silage too rapidly. Experience and a little care in handling the unloaders will reduce clogging materially. More problems arose in handling hay crop silage than with corn. Part of the difficulties resulted from using motors with inadequate horsepower. Belt tension was often overlooked as well. The frames on some unloaders were not adequate to handle heavy silage and repairs were generally heavy on these unloaders.

Conclusions

Surface unloaders will reduce the amount of physical effort required to get silage out of a tower silo. They can be used most efficiently in tall silos with large diameters from which silage is fed throughout the year. It is possible to move unloaders from one silo to another but this requires considerable effort and skill. However, this is one means of reducing operating costs on a unit basis.

On many farms the savings made in time required to throw down silage will not be great enough by itself to justify owning an unloader. Farmers use an average of about three-quarters of an hour per ton to unload silage by hand from conventional tower silos. ^{1/} The average cost of unloading 200 tons of silage with a surface unloader was about \$1.00 per ton. Since some time must be spent even with a mechanical unloader to put the machine in operation and be close at hand if any problems in unloading arise, no more than one-half hour per ton is saved in terms of man labor and probably less than this. Such a saving in labor must than be compared with the average cost of unloading per ton or an estimate of it for a particular farm. For example in cases where 250 or more tons of silage are handled annually, the saving in labor compared with operating costs per ton may justify owning an unloader.

A dairyman's main concern in getting silage out of his silo and then feeding it is not simply to minimize the amount of time spent doing these jobs or to do them at the lowest possible cost in all cases, although both are very important. In deciding whether to buy an unloader the following estimates may be helpful.

	<u>Example</u>	<u>Your farm</u>
Original cost of unloader installed	1200	_____
<u>Annual operating costs:</u>		
Depreciation, 10 years life	\$ 120	_____
Interest @ 6%	72	_____
Repairs and maintenance	10	_____
Electricity (250 tons x 1.5 kwh. per ton x 2.0¢ per kwh.)	8	_____
Total operating costs	210	\$ _____
Operating cost per ton ($\$222 \div 250$ tons)	\$0.84	\$ _____

Once estimates of operating costs have been made the following pertinent questions should also be answered before a final decision is made.

- (1) How effectively can I use the time and labor saved by an unloader?
- (2) Will the unloader help me to avert serious back trouble?

^{1/} Wysong and Stanton, Alternative Methods of Storing Silage and Their Costs, A.E. 1043, Department of Agricultural Economics, Cornell University, November 1956.

- (3) Will having an unloader help me to keep a good hired man from leaving?
- (4) Will the money invested in an unloader save more time and more backache than if invested in some other way in the business?
- (5) Would this money invested in cows or other equipment return me more income than I could save with the unloader?
- (6) Will my credit position be materially affected if I must borrow to obtain the unloader?