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UNIVERSITY OF MINNESOTA

Department of Agriculture

**LABOR REQUIREMENTS AND COSTS FOR
DIFFERENT METHODS OF HAY MAKING**

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LABOR REQUIREMENTS AND COSTS FOR DIFFERENT METHODS OF HAYMAKING

R.R. Beneke and S.A. Engene 1/

The war-induced labor shortage has sharpened farmers interest in labor-saving haying methods. Many have purchased new types of machines such as pickup balers and field choppers. Others are considering such purchases, but are not certain as to the advantages or disadvantages of these machines.

This problem has been studied to gather information helpful to farmers in evaluating some of the newer methods. Specifically the objectives were to determine:

1. The labor requirements for the different methods.
2. Costs for the different methods.
3. Farmers' evaluations of the advantages and disadvantages of the different methods.

The information was gathered largely by interviews with farmers. Fifty-eight farmers were visited in September, 1945 and 74 in September, 1946. They were questioned as to the size of their haying job, time spent, costs, experiences with different methods, and other relevant points. In addition 21 farmers were visited in June and July, 1945, while they were putting up hay. Detailed time observations were obtained on those farms.

Man hours per ton

The number of man hours used in putting up a ton of hay with five different methods are shown in Table I. The number of man hours is the time required to put up a ton multiplied by the number of men in the crew. For example, if a crew of 3 put up one ton an hour they use 3 man hours per ton. The time shown in Table I is for bringing the hay from the windrow to storage, including spreading the loose hay or piling the bales. Mowing and raking are not included since those jobs are the same for all of the methods shown.

1/ T.R. Nodland, G.E. Toben and V.E. Dose assisted in making field interviews in 1945. H.W. Ottoson assisted in 1946. E. Rauchenstein, Bureau of Agricultural Economics, U.S. D.A., assisted in gathering the data in 1945, as a part of a cooperative agreement. This study was financed in part by a grant of funds from the General Education Board for research in Farm Work Simplification.

Table I. Man Hours Per Ton Required to Bring One Ton of Hay From Windrow to Storage

Method	Number of Farms*	Man Hours Per Ton	Tods Hauled	Tons Per Acre
Hay loader	70	2.2	77	1.9
Sweep rake (tractor-mounted)	13	1.6	80	1.7
Hand-tying baler (pickup)	35	2.3	109	1.8
Self-tying baler (pickup)	6	1.7	68	1.5
Field chopper	39	1.2	90	1.8

*These numbers are not proportional to the total number of farms in the state using these methods.

Farmers with hand-tying balers used 2.3 man hours per ton. This was the highest for any of the methods studied. However, farmers using hay loaders spent almost as much time, 2.2 man hours per ton. Since only 6 of the farmers interviewed used self-tying balers the average for that method is less reliable than for the others. On the basis of these few records the man hours were 1.7 per ton. Time was saved in baling, but not in hauling and piling. Farmers using tractor-mounted sweep rakes spent 1.6 man hours per ton. This time has been adjusted to a length of haul equal to that for the other methods. Those using field choppers spent only 1.2 man hours per ton. This was the lowest for the methods studied. It was only slightly more than half as much as for hand-tying balers and loaders.

While the data reflect fairly accurately present differentials in labor expenditures among the methods these differences may not hold true for the future. Most of the farmers using balers and field choppers had had relatively little experience in their operation. They had not yet developed a high degree of skill nor worked out proper storage arrangements and time saving equipment. On the other hand, those using loaders were experienced in their use. Their barns were built to accommodate the loader method and the operators had developed a high degree of skill. In the future the labor requirements for hay loaders may remain fairly constant while there might be a considerable reduction in the man hours required for the newer methods.

Farmers are interested in reducing effort as well as time. Unfortunately it was not possible to measure the effort required by the various methods. However, some comparisons can be made by general observations. The use of the tractor-mounted sweep rake required less effort than the use of the loader. The use of the sweep rake eliminated the job of loading in front of the loader in the field, although more tractor driving was needed. Hay brought in by the sweep rake was fully as easy to spread in the mow as that brought in by wagon. Baling was a relatively light job, although tying the bales by hand was frequently dusty work. Loading the bales, placing them in the barn, and piling them was a heavy task. On some farms a part of this

effort was eliminated by letting the baler push the bales to a wagon pulled behind, and by use of slings, forks, or a bale elevator at the barn. Field chopping probably required the least effort. When wagons with automatic unloaders and blowers which distributed the hay in the barn were used very little of the hay was handled by hand. Most of the workers' time was used in operating the machines.

Size of Crew

The numbers of workers in the crews used on the farms studied are shown in Table 2. Farmers who pulled a wagon behind the baler, so that they baled and hauled at the same time, used the largest crews. Two men generally were used to operate the self-tying balers, and 3 or 4 were used with hand-tying baler. In addition, the operators of both types of balers used an average of 3.3 men for hauling. Farmers who dropped the bales on the ground and hauled them to the barn after the baling was completed, used fewer workers, but each one worked for a longer time. Men hauling to the barn with sweep rakes used the smallest crews. In a few cases one man worked alone. Men using sweep rakes and those using loaders generally did the work with the labor available on the farm or by exchanging with a neighbor. Many of the men using choppers exchanged work with neighbors in order to get a full crew. Balers were operated to a large extent with hired labor, although some farmers did exchange labor.

Table 2. Average Number of Workers in Crews

Method	Total	Able bodied men	Other workers
Loading with loader and hauling to barn	2.8	2.1	.7
Hauling to barn with sweep rake	2.4	1.9	.5
Baling with hand-tying baler	3.3	2.4	.9
Baling with self-tying baler	2.0	2.0	0
Hauling bales to barn	3.3	2.7	.6
Chopping in field and hauling to barn	3.1	2.8	.3

Most of the workers were able bodied; that is, physically sound men from 16 to 60 years of age. Partially disabled men, young boys, old men, or women were used for some jobs. These workers frequently were used to tie bales, drive the team in the field when using the loader, and driving the team or tractor on the hay rope at the barn. Most of the workers used for hauling bales were able bodied men, since that is a heavy job. Farmers chopping their hay also used mostly able bodied workers, even though that method involved the least hard labor.

Cost of Mechanization

Since costs play an important part in the selection of a hay making method an effort was made to arrive at an average cost for each of the ways being studied. Cost data were collected in this study in so far as possible.

This has been supplemented from other sources in order to obtain as complete information as possible.

The original investment and the estimated annual cost for the principal hay making machines are shown in Table 3. These represent average costs on the farms visited. The total annual costs will vary somewhat with the hours of use, although variations in use had surprisingly small effects on costs on these farms.

The farmers estimated the number of years each machine would last on their farms. The original cost was spread over these years of expected life in order to determine the annual depreciation. Repair costs included cash outlays and the value of the time the farmers spent in repairing. Interest was calculated on the basis of 5 per cent of half of the original investments.

Table 3. Investment in and Annual Cost for Haying Equipment

Item of Cost	Loader	Hand-Tying Field Baler	Field Chopper and Blower	Sweep rake
No. of machines	70	30	35	11
Original cost +	\$117	\$960	\$1033	\$225
Expected life (years)	21	13	12	17
Annual depreciation	\$5.60	\$73.90	\$86.17	\$13.20
Repairs	1.33	28.12	15.15	6.23
Interest on half of purchase price	2.94	24.02	25.84	5.62
Total annual cost	9.87	126.04	127.16	25.05
No. of tons put up	41	269	140*	73

*Also used to cut 375 tons of silage

+The original cost is the price paid for the machines on the farms studied. There was a wide variation in cost among the different makes of machines and according to the time at which they were purchased.

The balers and choppers were used on a larger tonnage of hay than were the loaders and sweep rakes. Since these machines were more expensive they were purchased primarily by groups of farmers, by operators of large farms, or by farmers who could do custom work for others. During the war period many dealers sold the few machines available only to farmers who would do work for neighbors as well as for themselves.

Table 4 presents estimates of the cost of putting up a ton of hay. These do not include the mowing or raking of the hay but cover only the moving of the hay from the windrow into the barn or storage place and the spreading of the loose hay or arranging of the bales. The operating costs of the machines were computed as in Table 3, except that the cost per ton was calculated for conditions requiring 50 tons, 100 tons and 200 tons of use. Since the typical farmer in Minnesota puts up about 50 tons of hay the first group represents the probable costs if one farmer owns the machine. The figures for 100 tons will apply if two average farmers own

the machine in partnership or if the operator of a large farm owns it. The figures for 200 tons will apply to very large farms, to groups of farms, or to custom operators. The power cost was obtained from cost accounting records adjusted to 1946 levels. Labor was valued at 50¢ per hour; this included both able bodied and other labor. No adjustments were made for variations in the yield of hay, distance from the barn and the size of the operation. While these do have an effect upon the cost, the variations between the methods should be slight.

Table 4. Cost of Bringing a Ton of Hay from Windrow to Storage

Item of Cost	50 ton total	100 ton total	200 ton total
<u>With loader</u>			
Cost of loader	\$.27	\$.16	\$.10
Labor (2.2 hr. at 50¢)	1.10	1.10	1.10
Power (.9 hr. at 50¢)	.47	.47	.47
Miscellaneous	.10	.08	.05
Total	<u>1.94</u>	<u>1.81</u>	<u>1.72</u>
<u>With hand-tying baler</u>			
Cost of baler	1.95	1.07	.67
Baling wire	.60	.60	.60
Labor (2.3 hr. at 50¢)	1.15	1.15	1.15
Power (7.5 hr. at 50¢)	.38	.38	.38
Bale elevator	.20	.12	.08
Total	<u>4.28</u>	<u>3.32</u>	<u>2.88</u>
<u>With field chopper</u>			
Cost of chopper & blower	1.79	1.11	.65
Labor (.95 hr. at 50¢)	.48	.48	.48
Power (.9 hr. at 50¢)	.45	.45	.45
Special wagons with mech. unloading device	1.04	.69	.35
Total	<u>3.76</u>	<u>2.73</u>	<u>1.93</u>
<u>With tractor-mounted sweeprake</u>			
Cost of sweeprake	.33	.16	.12
Labor (1.5 at 50¢)	.75	.75	.75
Power (1.2 at 50¢)	.60	.60	.60
Hay fork, rope, etc.	.10	.08	.05
Total	<u>1.78</u>	<u>1.59</u>	<u>1.52</u>

On the basis of the estimates in Table 4, costs per ton are lowest when tractor-mounted sweep rakes are used, and only slightly higher with loaders. Costs are highest for hand-tying balers.

Costs decrease slightly with increased use for loaders and sweep rakes. With these methods most of the costs are for labor and power, costs which increase in direct proportion with use. On the other hand, the machine cost is very large for balers and choppers. Since these costs do not rise materially with increased use, the cost per ton falls rapidly. The machine cost is \$1.79 a ton if a field chopper is used for only 50 tons a year; it is only \$.65 a ton if used for 200 tons a year. The total costs fall from \$3.76 to \$1.93.

The cost of bringing a ton of hay from the windrow to storage is twice as high with balers and choppers as with loaders and home-made sweep rakes if each of these are used to handle only 50 tons a year. Operators of average farms who use these machines only for their own hay may find the loader or sweep rake to be most economical. If each machine can be used for 200 tons a year the cost per ton is only slightly higher for field choppers than for loaders. These large expensive machines compare favorably with other methods when the volume of use is large. The average farmer can increase the use of choppers or balers by doing custom work for others, or by owning it in partnership with neighbors. The costs of choppers can also be spread by using them to cut corn silage or grass and legume silage. Both can be used to pick up straw when combines are used for small grains.

The comparisons of these methods vary somewhat with different rates for labor. In table 4, labor was valued at 50 cents per hour. This undoubtedly is a conservative estimate even in view of the fact that some of the labor used was not able bodied. Low cost labor would give an advantage to methods which use relatively large amounts of labor, particularly the use of balers or loaders. Table 5 shows the relationships when the charges for labor are 75¢ and \$1.00 per hour. When labor is valued at 75¢ the chopper becomes more economical at the 200 ton level than the loader. The same holds true when the cost of labor is \$1.00. With higher rates for labor the baler compares less favorably with the other methods due to the fact that it requires relatively large amounts of labor. The home-made sweep rake was the cheapest method even when labor was charged at \$1.00 per hour. Its advantage over the chopper was small, however, with high labor costs.

The cost of moving hay from windrow to storage does not give a complete comparison of the two methods. The higher cost for baled or chopped hay may be offset in part at least by lower costs of storage or shelter. Baled or chopped hay can be stored in approximately one half the space needed for loose hay. This may be an important factor for farmers with inadequate storage space.

Table 5. Cost of Putting Up Hay with Labor Valued at \$.50, \$.75 and \$1.00 per Hr

Annual Usage	Cost of Labor per hour		
	\$.50	\$.75	\$1.00
	<u>With Hay Loader</u>		
50 ton	\$1.94	\$2.49	\$3.04
100 "	1.81	2.36	2.92
200 "	1.72	2.27	2.82
	<u>With Hand Tying Baler</u>		
50 "	4.28	4.85	5.43
100 "	3.32	3.89	4.47
200 "	2.88	3.45	4.03
	<u>With Field Chopper</u>		
50 "	3.76	3.99	4.23
100 "	2.73	2.96	3.20
200 "	1.93	2.16	2.40
	<u>With Homemade Sweep rake</u>		
50 "	1.78	2.15	2.53
100 "	1.59	1.96	2.43
200 "	1.52	1.89	2.27

Hiring vs. Owning

Some farmers may prefer to employ custom operators to bale or chop their hay rather than own the machines. In order to provide information for this comparison some data concerning custom charges for baling were secured in the interviews. Thirteen cents a bale was the most common charge. With 80 pound bales this amounts to \$3.25 a ton. For this the owner of the baler supplied the baler, a tractor, the full crew needed for baling, fuel and wire or twine. The farmer supplied the equipment and crew for hauling the bales to the barn and piling them.

The costs to the farmer for doing this work if he owns the machine are shown in Table 6. Labor is priced at \$1.00 an hour in this comparison. If the machine is used for 100 tons a year the cost per ton would be about the same as the 1946 custom rates. The advantage of owning would be greater if labor was valued at less than \$1.00 an hour; the advantage would be smaller if labor was valued at more than \$1.00 an hour.

The decision to buy or own depends upon many factors other than the costs shown here. Farmers with limited capital may prefer to invest their money in livestock or other parts of their business. Men with limited mechanical ability may find that repair costs may be higher than the average. Hiring custom operators to do part of the work is one way to secure extra labor at haying time. Owning the machine, however, gives the farmer more complete control over the timing of his work; he is less dependent upon his neighbors.

Table 6. Cost of Baling Hay with Hand-Tying Balers*

Item of cost	50 tons per year	100 tons per year	200 tons per year	500 tons per year
Cost of baler, per ton	\$1.95	\$1.07	\$.67	\$.32
Wire, per ton	.60	.60	.60	.60
Labor (1.3 hrs. at \$1.00)	1.30	1.30	1.30	1.30
Power, per ton (.4 hrs. at .70)	.28	.28	.28	.28
Total per ton	4.13	3.25	2.85	2.50
Total per bale	.16	.13	.11	.10

*This does not include hauling the bales into storage.

On the basis of the data presented in Table 6, the cost of baling was less than 13 cents a bale when the volume baled was 100 ton a year or more. That does not necessarily mean that custom charges were too high. Custom operators incurred some extra costs in soliciting business and in making collections. They frequently found it necessary to pay higher rates for labor, and to pay that labor for short periods when laid up for bad weather or repairs. They also set their rates to cover the risks involved and to provide some profits.

Little information was available about custom rates for chopping hay. Only a few of the farmers interviewed did custom work for others, and most of them had not decided what was a reasonable charge. But by cost calculations similar to those presented in Table 6 it is possible to estimate the point at which it may be cheaper to own than to hire. The figures given here are averages, and may not apply exactly to any individual farm. They will give a general indication, and the farmer can adjust the data to fit more nearly his own circumstances.

Data on the cost of chopping are presented in Table 7. The charges are for the items usually supplied by the custom operator. These are the chopper and tractor, a man to operate the chopper, a blower, and possibly special wagons for hauling. The farmer would supply the crew for hauling and unloading, tractors for hauling, and a tractor for the blower. On the basis of these costs a farmer with only 50 ton of hay to chop would pay \$3.68 a ton, or \$7.36 an hour or more. With increasing volume of use these rates would fall. By using the chopper for silage as well as hay the volume of use could be increased.

As with balers custom rates for chopping will possibly run somewhat higher than shown here. If the margin over these costs is the same as for balers the charge would be \$2.25 a ton, or \$4.50 an hour. With choppers as with balers, many factors besides these costs enter into the decision as to whether a farmer shall buy or hire.

Variations within Methods

There were wide differences in man hours per ton among farmers using the same method. In fact, the variations within methods were wider than the variations between methods. The man hours per ton for the 25 per cent of the farmers using the least time per ton and the 25 per cent using the most are presented in Table 8. The average baler operators used more labor per ton than the average chopper operators. But the most efficient baler

operators used about the same time as the average chopper operator. In other words, the average baler operators could save as much time by increasing the efficiency of their operation as they could by changing to choppers without a change in relative efficiency. Similar comparisons can be made for other methods. The differences among farmers is even greater when individual cases are studied.

Table 7. Cost of Chopping Hay with Field Chopper*

Items of Cost	50 tons per year	100 tons per year	200 tons per year	500 tons per year
Cost of chopper, blower, special wagons, per ton	\$2.83	\$1.80	\$1.00	\$.48
Cost of operator of chopper, per ton (.5 hours at \$1.00)	.50	.50	.50	.50
Cost of tractor on chopper, per ton, (.5 hours at \$.70)	.35	.35	.35	.35
Total per ton	3.68	2.65	1.85	1.33
Total per hour	7.36	5.30	3.70	2.65

*Does not include cost of labor for hauling and unloading, tractors for hauling and a tractor for operating blower.

Many factors account for these differences within methods. One is differences in type of equipment. For example, nine of the farmers using field choppers used wagons with mechanical unloading devices. These consisted mostly of canvas aprons or endless chains which pulled the load to the back of the wagon. This group used 1.1 man hours per ton. Twenty three men used no special devices, but pushed the chopped hay into the blower by hand. They used 1.4 man hours per ton.

Table 8. Variations Within Methods in Man Hours Per Ton

Method	No. of Cases	All Farmers		
		Most Efficient 25%	Using Method	Least Efficient 25%
Choppers	32	.6	1.2	2.3
Balers	33	1.3	2.3	3.8
Loader	66	1.5	2.2	3.2
Sweep rakes	9	1.0	1.6	2.1

Differences in experience accounted for part of the variation within methods. Thirteen farmers who were using field choppers for the first year used 1.4 man hours per ton. Farmers who had used field choppers in past years averaged 1.1 man hours per ton. These farmers gained skill with each year of experience. They also were able to make changes in their storage facilities and in supplementary equipment that enabled them to take advantage of the potentialities of their machines.

Variations in yields, distances hauled, and care with which hay was spread in the barn or bales were piled accounted for a part of these differences. Some farmers who had ample storage space dropped the bales into the barn and left them as they fell; others piled them carefully.

There also was considerable difference in the abilities of the different workers.

Farmers using larger crews used more man hours per ton. These data are summarized in table 9. In every case the relationship was the same; the larger the crew the greater the labor requirement per ton. It should be pointed out, however, that in the case of the baler and the chopper the differences were probably too small to be significant.

Table 9. Man Hours Required to Move Hay from Windrow to Storage With Small and Large Crews

Method	No. of records	Small Crews		Large Crews		
		Size of crew	Man hrs. per ton	No. of records	Size of crew	Man hrs. per ton
Hayloader	24	2	1.9	38	3-7	2.5
Baling	18	2-5	2.3	13	6-9	2.4
Chopping	13	1-3	1.2	15	4-5	1.3
Bucking to Barn	2	1-2	.9	5	3-4	1.6

A number of factors apparently account for this higher labor requirement for larger crews. The most obvious reason is that the least efficient operators needed a greater amount of labor to completely utilize the equipment and to get the haying job completed in a timely fashion. Another factor is that the problems of coordinating a large crew so that no time is lost are more difficult. Workers are without work more often in large than in small crews. There also seems to be a tendency for farmers who have large amounts of labor available to use it all whether they employ it effectively or not.

Farmers Attitudes Towards Haymaking Methods

An attempt was made in interviewing these farmers to get their attitude toward the method which they were using and the other methods with which they were acquainted. In order to do this the farmers were asked what they regarded as the advantages and disadvantages of the various methods.

Most farmers who were using hay loaders disliked the amount of heavy and hard work involved. Another frequently mentioned criticism was the fact that putting up hay with the hayloader required too much time during a period when there were many other pressing jobs to be done on the farm. On the other hand, farmers liked the hayloader as a method because there was relatively little money invested in haying equipment. One frequently mentioned advantage was that they were already equipped with a good hay loader and the other necessary equipment, whereas changing to some other method would involve an additional investment.

The majority of farmers who were asked about stacking hay in the field were definitely opposed to it. They said it wasted too much hay and involved more labor than any other method when the time spent hauling in

the hay from the stack was considered. They disliked also having to haul hay in the winter time, often during bad weather. Those few farmers who did stack hay in the field did so because it saved labor during a period when labor was hard to get and because they lacked adequate storage facilities.

Farmers cited a wide variety of disadvantages for the hay baler. The most frequently mentioned one was that baling was too expensive and involved too much work. Many farmers said they disliked feeding baled hay because bales were heavy to handle and it took too much time to break up and scatter out the bales. There was wide disagreement on this point, however. Others didn't like to have the wire around the farm after feeding bales. Another frequently mentioned objection was the tendency for hay in bales to spoil more easily than loose hay. Here, too, many farmers disagreed. Some farmers also brought up the point that baling hay itself was a dirty and dusty operation and that they would rather haul hay with a loader than work around a baler.

When asked what they considered were the advantages of baling hay over other possible methods a number of farmers mentioned the fact that baling took less time. There was disagreement among farmers on this point also. The most frequently mentioned advantages of baling were that it saved storage space and that bales were the best form in which to market hay. A number of farmers brought out the point that while baling did not require any less labor, hiring a custom baler offered an opportunity for them to hire labor which was difficult to obtain in any other way.

Most farmers who owned choppers believed the chopper possessed definite advantages over other methods of making hay. They were as a group well satisfied with hay chopping. Most of the criticism advanced against the chopper came from farmers who had had no experience with the machine. Owners of choppers thought they saved a lot of time in addition to making their work easier. These were the two most frequently mentioned advantages. They also liked the chopper because it saved storage space. A number commented on the fact that they could also use the chopper for picking up straw behind the combine and added that they thought chopping the straw improved it as a bedding material. Many of the chopper operators also pointed out that the chopper could be used for filling silo.

There was considerable disagreement as to whether the hay had to be drier to be put in with a chopper. Some farmers contended that they chopped their hay as soon after cutting as they could have put it up with a hay loader. Many farmers who did not use choppers thought that getting the hay dry enough to chop was a major problem. Most farmers who used choppers, however, did not regard this as a serious disadvantage to chopping, although the majority of them agreed that the hay should be somewhat drier for chopping. A number of farmers indicated that they thought chopped hay was more difficult to feed than loose hay and others objected to the amount of dust that accompanied chopped hay while it was being put up and fed.

The major objection to both the balers and choppers was that they required large investments. Many farmers who had loaders felt that they could hire considerable extra help during the haying season with the money they would have tied up in a baler or chopper.

Few of the farmers interviewed had ideas concerning the sweep rake as a method of making hay. Most of them had never seen a sweep rake used. Those who did use them were for the most part enthusiastic although they emphasized considerable skill was required in their operation. They also recognized that the sweep rake has limitations as a method for putting in hay. The haul must be relatively short and the road fairly level. None of the operators of sweep rakes, however, planned to go back to the hay loader; all of them thought it saved both time and effort.

The majority of farmers interviewed indicated they expected to continue with their present system. This does not mean that there is not considerable interest in new methods or that there will not be many changes made. As present equipment wears out and new must be purchased many farmers will make changes. Probably, the change being considered by more farmers than any other is a shift to chopping of hay. In many cases they will change their haying and silo filling methods at the same time. They will thus use the field chopper, blower and wagons for both silo filling and haying. Many who already have choppers are planning to equip their wagons with mechanical unloading devices. This development seems to be gaining rapid headway. All of the unloading attachments observed in the interviews were home made but most of them seemed to be practical and highly successful. As commercial equipment of this nature appears on the market there will undoubtedly be a wide adoption of it. Most farmers using field choppers for hay and silage were interested in getting away from the heavy work involved in unloading. The fact that the chopper on many farms can be used for three jobs - haying, picking up straw after combining, and filling silo, tends to spread the investment in equipment over a number of enterprises. This does away in part with the objection of too much money invested in haying equipment which many farmers had to the chopper.

There was considerable interest being shown in the self-tying balers. A self-tying baler cuts down on the large amount of labor involved in baling. Nevertheless, a much larger number of farmers indicated an interest in purchasing a hay chopper than a baler. The future of baling as a method of putting up hay will probably be dependent on the practicability of the self-tying balers. A number of farmers indicated that they liked to hire some custom baling done and would hire more if the cost was less. This was particularly true of farmers who were short on storage space or who wished to sell part of the hay crop. Thus the baler may find its greatest use as a custom operated machine.

Using Field Choppers for Silage

As has been mentioned previously in this report, field choppers also can be used for corn silage. This helps to spread the machinery cost over a larger volume. By purchasing a corn silage attachment and using the chopper for both hay and corn silage the machinery investment per farm will not be materially increased. The field chopper will replace the loader,

the corn binder, and the stationary silage cutter. The hay carrier and track, ropes and slings can be eliminated.

In order to evaluate more fully the possibilities for using field choppers for silage, information concerning that use was obtained in the interviews made in 1946. The average size of crews and the man and power hours per ton for stationary cutters and field choppers are shown in Table 10. The crews and time for stationary cutters includes cutting the standing corn. In calculating power hours a team used for hauling was considered equivalent to a tractor.

Table 10. Man and Power Requirements with Stationary and Field Choppers for Silage

Machine	No. of machines	Average size crew	Man hours per ton	Power hours per ton
Stationary cutter	7	6.8	.90	.47
Field chopper	9	3.4	.54	.46

The field chopper saved considerable man time compared with the stationary cutter. To fill a 14 foot silo with 30 feet of settled silage or with 90 tons would require 81 man hours; to fill the same silo with a field chopper would take 49 man hours. At 50 cents an hour this is a saving of \$16; at \$1.00 an hour it is a saving of \$32.00 for labor. Adequate unloading devices can further reduce the time used with field choppers. Four men using wagons with mechanical unloading equipment used .46 man hours per ton; the five men who unloaded by hand used .60 man hours per ton.

The crews were twice as large with the stationary cutters as with the field choppers. It is usually necessary to exchange work with 3 or 4 neighbors in order to assemble a crew of 6 or 7 men. Two or three farmers can supply the 3 or 4 men needed to operate a field chopper. The larger crews with the stationary cutter were able to fill a silo in less elapsed time than the smaller crews with the field chopper, but the difference was small. The rates were 7.6 tons per hour for the entire crew with stationary cutters and 6.3 tons per hour with field choppers.

Seven of the chopper operators interviewed in 1946 did some custom silo filling. Six of these charged by the foot. The average charge for a 14 foot silo was \$2.00 per foot. At 3 tons of silage per foot this is \$.67 per ton or \$4.25 an hour. Those who furnished special wagons generally charged more than \$2.00 or made a separate charge for them. One operator charged \$6.50 per hour. Another charged by the foot, but had a minimum rate of \$6.00 per acre of corn cut.