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B639: Alternative Systems for Feeding Maine Dairy Cows

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CONTENTS

SUMMARY

Information obtained from one-day-a-month timings of feeding chores by 39 dairymen over a period of 13 months permitted comparisons of labor used for various systems of feeding dairy animals

In feeding silage to cows in stanchions using a cart, the removal of the silage by tractor loader from a horizontal silo was the best alternative by a relatively narrow margin compared with hand removal or the use of a mechanical unloader in an upright silo.

In feeding silage to cows in loose housing barns using group mangers, the use of a tractor loader for removal and a self-unloading wagon for feeding was the best alternative compared with auger feeding or removal and feeding with a tractor loader alone. As the distance from silo to feed manger increased, the advantage of using the self-unloading wagon rather than the tractor loader also increased. The self-feeding wagon filled by hand was the most time consuming method of feeding studied.

The tractor loader was an economically feasible mechanical method of removing and feeding silage, when its use was based upon savings in labor when wages were $2.00 or more per hour. At $3.00 per hour the self-unloading wagon was an economically sound alternative method. The mechanical silo unloader used in upright silos was not a labor saver on farms in this study, therefore its use could not be justified for economic reasons.

ALTERNATIVE SYSTEMS FOR FEEDING MAINE DAIRY COWS

HOMER B. METZGER AND DEAN F. TUTHILL[1]

Introduction

The handling of feeds once they are stored on the farm has received relatively little attention. Much research has been conducted on hay and silage in field handling and storage operations. The improvement in efficiency of feed handling within the barn is just as essential if the ultimate goal of efficient dairying is to be achieved. Current upward pressures on wages paid to hired help, the scarcity of capable laborers and the farm operator's pressing need to expand the size of his enterprise all point to a need to achieve efficiency in all farm operations.

This study was undertaken as part of a northeast regional effort to ascertain the methods used in feeding forages and concentrates to dairy animals and to determine the relative amount of labor used under various systems. Special emphasis was given to methods of handling silages on Maine farms.

Procedure

During a 13-month period September 1963 through September 1964, a group of dairy farmers in Maine kept records of their feeding chore times for one day a month. In addition, they recorded non-regular time associated with feeding but not part of a daily chore on the one day a month. This non-regular time involved feed handling or feed handling equipment. For the month of January, farmers supplied information on occasional labor performed during the month associated with feeding. This occasional labor included time for transportation of feeds, moving and servicing equipment, installing and repairing equipment, grinding, mixing and buying feed and other time spent in feed management. In addition, farmers supplied information on their cropping system and yields, farm size and layout, volume and cost of feeds purchased, and an inventory of land, buildings and equipment.

The once-a-month daily timings were allocated to the type of feed (e.g. silage, hay, concentrate or green chop) and to the animal age group (cows, older heifers or younger heifers). The time spent on each feed was assigned to removal, transport or feeding time.

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The emphasis in the Maine study was on timings for different silage feeding methods. Dairy farmers were selected to provide coverage for the major silage feeding systems in Maine. Other states of the northeast participating in this feed handling study emphasized hay or concentrate feeding methods. Maine records do include hay and concentrate feeding times, although farms were not selected for variety or complete coverage of these feeding systems.

This report deals largely with the feeding chore time as summarized from the one-day a month records for the period of 13 months. Thirty-nine farmers contributed 401 monthly cards for the time summaries. The major feeding systems used by the farmers are presented. Some typical cases of feeding systems are put together and analyzed. These case studies are a composite of compatible feeding methods and do not represent any one individual or group of farms.

The final section of this report considers the investment and operating costs for different feeding systems. The reduction in labor time resulting from changes is usually accompanied by a capital investment (i.e., there is a substitution of capital for labor). The dollars and cents decision should be based on the decreased cost of labor versus the increased cost of capital. Individual factors will enter into the decision in any given situation.

DESCRIPTION OF FEEDING METHODS

Silage Feeding

Silage feeding methods used by farmers in this study differ generally by the way in which cows were housed. Feeding methods observed for stanchion housing largely involved forking silage into the manger from a cart. Methods of removal differed, however, from hand removal and silo unloaders for upright silos to tractor loaders for horizontal silos. In some cases a conveyor carried silage from a silo unloader into the individual manger, but as an operation this was classified the same as an auger or conveyer into a group manger. Occasionally, stanchion barns were associated with group manger feeding of silage.

Cows in loose housing arrangements generally were fed silage in group mangers which were filled directly by a tractor loader, or by an auger carrying silage from a silo unloader. Self-unloading wagons were also used to fill group mangers. They were loaded by silo unloaders or by hand from upright silos and by tractor unloader from horizontal silos. Self-feeding wagons were placed in pastures or dry lots, and were filled by hand or silo unloader. No farms in the sample had self-feeding wagons being filled by tractor loaders.

Several farmers combined silage feeding methods during the year, particularly as they stored silage in both upright and horizontal silos and moved from one to the other. Some changed methods during the year with new installations. A few farmers carried silage in wheel barrows or baskets, but the timings for these were so few that they were not listed as separate methods.

Fewer farmers feed silage to heifers, particularly to young heifers, than to cows. Even when other systems existed for cows, heifers were more frequently fed silage in individual mangers from carts with silage being removed by hand or a silo unloader from an upright silo. Frequently the old silo and barn were turned over to heifers as new loose housing arrangements were set up for the cows.

Hay Feeding

Methods of feeding hay were again separated largely by differences in housing. Hay fed in stanchion barns came from overhead or ground level storage and was fed directly, or carried by hand or some mechanical means such as cart or hand truck to the manger.

Group mangers, generally associated with loose housing, were commonly filled directly from ground level storage and occasionally directly from overhead storage. Group mangers were also filled by carrying hay from either overhead or ground storage by hand or mechanical means.

Older heifers more frequently than cows were fed hay in group mangers filled directly from overhead or ground level storage. Younger heifers were more generally fed in stanchion mangers from overhead storage.

Concentrate Feeding

Concentrates were fed in stanchion barns largely by cart, and occasionally by pail to individual mangers, and the grain was removed from bag or barrel storage by hand, or from bulk bin storage by gravity flow. Loose housing almost always involved grain feeding in a milking parlor by gravity flow from bulk storage. Occasionally wheel barrows were used for stanchion mangers, or for the group manger when feeding was done to supplement parlor feeding, but these timings were not included as a particular feeding method.

No heifers were fed in milking parlors except as they might have been handled with the cows just before freshening. Not all farmers fed grain to older heifers. When they were fed grain it was mainly as they neared freshening. Both older and younger heifers were fed far more frequently by pail than were cows and seldom was grain stored in overhead storage bins for them.

TIMINGS FOR SELECTED FEEDING METHODS

The timings sent in monthly by farmers were categorized by remove time, transport time and feed time for each of the different age groups, feeds, and methods of feeding. In summarizing the time for feeding chores, remove and feed time were combined; transport time was not included so that feeding systems would be comparable. Transport time was that used when feed was stored in another barn, or not stored in the normal reationship to the feeding area.

In order to organize the time data in a systematic form for presentation, certain combinations of feeding silage, hay and concentrate were organized into typical feeding "cases." These cases do not represent any particular farm, but are combinations which would be compatible and practical on a farm. The chore time of the selected feeding systems is listed in tables by the type of feed and age group of animal, then added to show total times per day for the herd. The only recorded time not used directly was that for concentrate feeding to older heifers. In this case, the time required per head was reduced by half since farmers' records indicated that only about half of the older heifers were fed grain. Basic data for the various feeding methods are shown in appendix tables 1 through 7.

Since the emphasis of this study was on silage feeding systems, seven cases of different silage feeding methods were assembled. A natural break by systems of feeding, and the major differences in the chore times, occurred on the basis of methods of housing. Thus three systems for feeding in stanchion barns and four systems for loose housing are presented separately. In either of the housing groups, only the silage feeding method is changed. The most common method of feeding both hay and concentrate in a stanchion barn was selected and kept constant; the same was done for loose housing.

No attempt was made to adjust the time used under the various feeding methods for the amount of feed fed. The quantity of silage fed was about 40 pounds per cow per day. The amount varied among feeding methods from 38 pounds to 62 pounds per cow per day. The quantity of hay fed was about 15 pounds per cow per day and the quantity of concentrates fed was about 12 pounds per cow per day. Basic data on quantity of feed fed under the various feeding methods are shown in appendix tables 10 through 16.

The average size of herd for all farmers in the study was 52 cows, 17 older heifers and 14 younger heifers. The average herd size was 51 and 54 cows for stanchion and loose housing, respectively, and the number of heifers was nearly identical for both systems. Thus, the herd size selected for total feeding time was the average size for all farmers.

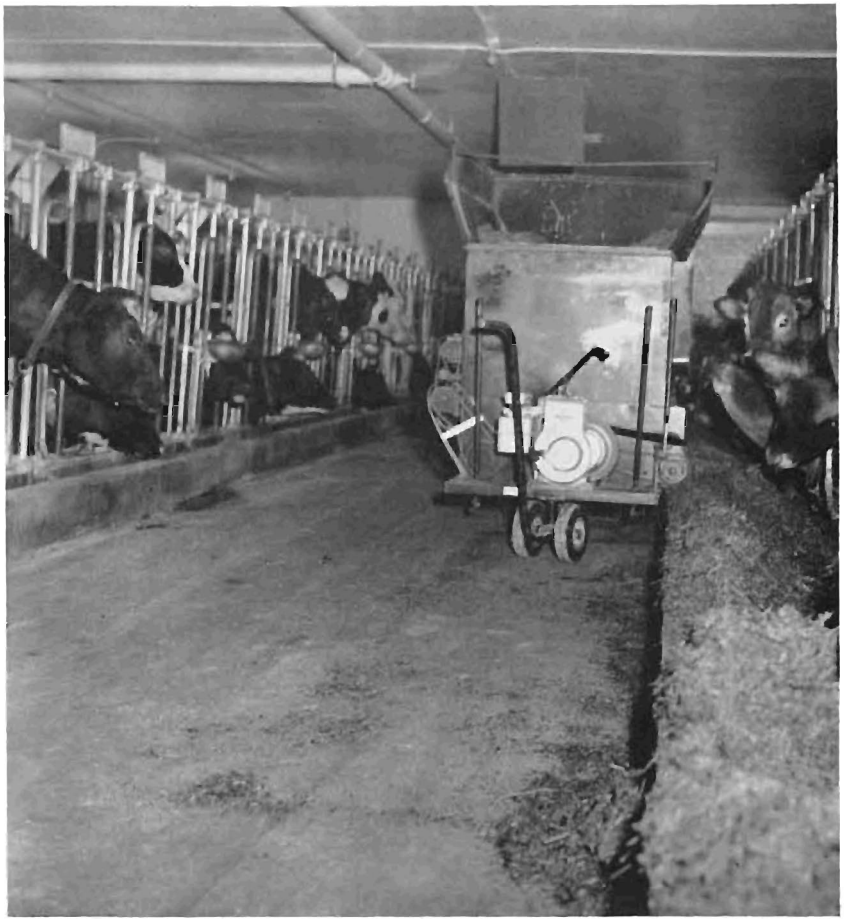

FIGURE 1. Self propelled, self unloading cart for mechanized silage feeding in stanchion barns.

Feeding Times in Stanchion Housing

Three different cases for feeding silage in stanchion barns were considered. Silage was fed to cows in stanchion mangers by cart and removed, (1) by hand from a vertical silo, (2) with a silo unloader from a vertical silo, and (3) by tractor loader from a horizontal silo. The older heifers were fed silage by the same method as the cows; the younger heifers were not fed silage. Hay feeding in each case was direct to the feed alley from overhead storage. Concentrate was fed to cows by cart which was filled from overhead storage by gravity. Heifers were fed by pail with the grain stored in bags or barrels.

Case 1: By Cart, Hand Remove—In case 1, the daily chore time

for silage fed by cart and removed from the silo by hand pitching was a minute and a half per cow, or 78 minutes for the 52 cows (table 1). Silage fed by the same method to older heifers took .8 of a minute per head, or 14 minutes for the 17 head. With no silage fed to the younger heifers, total time for feeding silage was 92 minutes per day for the herd.

Hay fed from overhead storage dropped into the feed alley took .7 of a minute per cow or 36 minutes daily for the 52 cows. Fed in the same way, both heifer groups required about .7 of a minute per head or 23 minutes in total for hay feeding. It took just under an hour to feed hay to the herd. Concentrates required .6 of a minute per cow, or about a half hour for the 52 head, when fed in individual mangers by cart from

TABLE 1

Time per Animal and per Herd for Feeding Chores in Stanchion Housing, Hay Fed Direct to Feed Alley From Overhead Storage, Concentrate Fed to Cows by Cart from Overhead Storage, to Heifers by Pail from Ground Level Storage

	Minutes Chore Time Per Day+			
Animals	Silage	Hay	Concentrate	Total
Case 1. Silage Fed by cart in stanchions removed by hand from a vertical silo for both cows and heifers.				
Cows, per head	1.5	.7	.6	2.8
For 52 head	78	36	31	145
Older heifers, per head	.8	.7	.2*	1.7
For 17 head	14	12	3	29
Younger heifers, per head	—	.8	.5	1.3
For 14 head	—	11	7	18
Total for the Herd	92	59	41	192
Case 2. Silage fed by cart in stanchions, removed by silo unloader from a vertical silo for both cows and heifers.				
Cows, per head	1.7	.7	.6	3.0
For 52 head	91	36	31	158
Older heifers, per head	.9	.7	.2*	1.8
For 17 head	16	12	3	31
Younger heifers, per head	—	.8	.5	1.3
For 14 head	—	11	7	18
Total for the Herd	107	59	41	207
Case 3. Silage fed by cart in stanchions, removed by tractor loader from a horizontal silo for both cows and heifers.				
Cows per head	1.4	.7	.6	2.7
for 52 head	76	36	31	143
Older heifers, per head	.5	.7	.2*	1.3
For 17 head	8	12	3	23
Younger heifers, per head	—	.8	.5	1.3
For 14 head	—	11	7	18
Total for the Herd	84	59	41	184

* Time reduced by onehalf from actual time per head for feeding older heifers since only half of them were fed grain.

+ Computations for the herd time were made from unrounded minutes per head.

overhead bin storage. The heifers were fed grain by pail from ground level storage and took .2 of a minute per head or 3 minutes for the older heifers (based on one-half of the older heifers being fed), and one half a minute per head, or about 7 minutes for the 14 younger heifers. The total grain feeding time was 41 minutes for the herd. The total time for feeding silage, hay and grain to the entire herd amounted to 192 minutes.

Case 2: By Cart, Silo Unloader—When silage was fed by cart but removed by a silo unloader from a vertical silo in case 2 (table 1), the total time for feeding silage was increased by 15 minutes over case 1 to 107 minutes daily for the herd. Silage feeding for the cows required 1.7 minutes per cow or about an hour and a half for the 52 head. The older heifers used 16 minutes for the 17 head. Hay and concentrate feeding was done by the same method and timing as in case 1. The total time for all feeding was 207 minutes, or 15 minutes more in total than case 1.

It was not quite logical that the silo unloader would require more

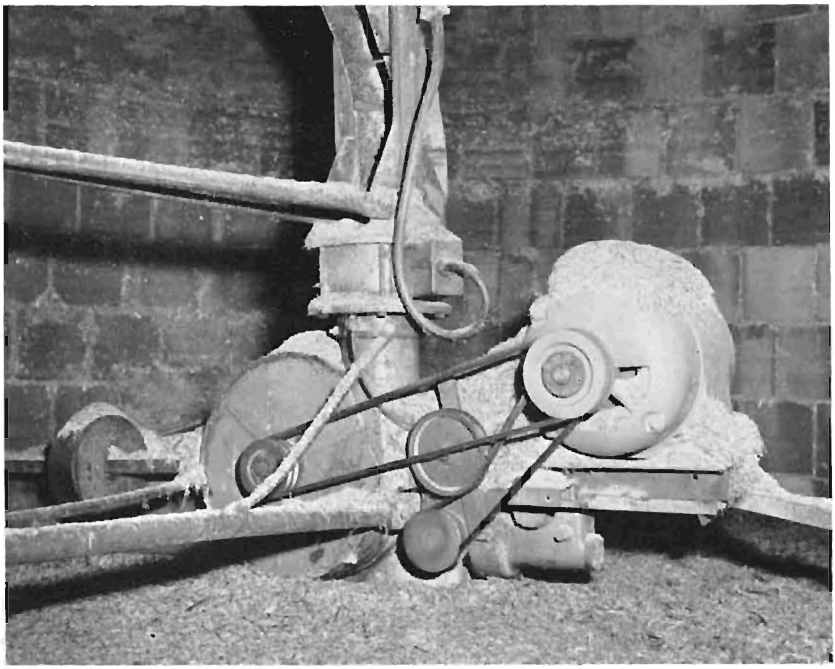

FIGURE 2. Mechanized silage removal from upright silo by top unloader. When used with hand methods of feeding such equipment did not save time but did eliminate the hard work. When teamed with an auger or conveyor for complete mechanization it reduces both time and work of feeding.

time than hand pitching of silage for the vertical silo. In the year of the study, some silo unloaders were newly installed and were not working properly or fitted efficiently into the feeding system. An attempt was made to eliminate time waiting for the silage to unload, but all of this time could not be detected. One record, particularly, had a large amount of break-down and waiting time, which illustrates the problems encountered with the use of mechanical unloaders. In time, more efficient use might be made of the silo unloaders. The greater ease of unloading over hand pitching may make this an attractive alternative even if time is not saved.

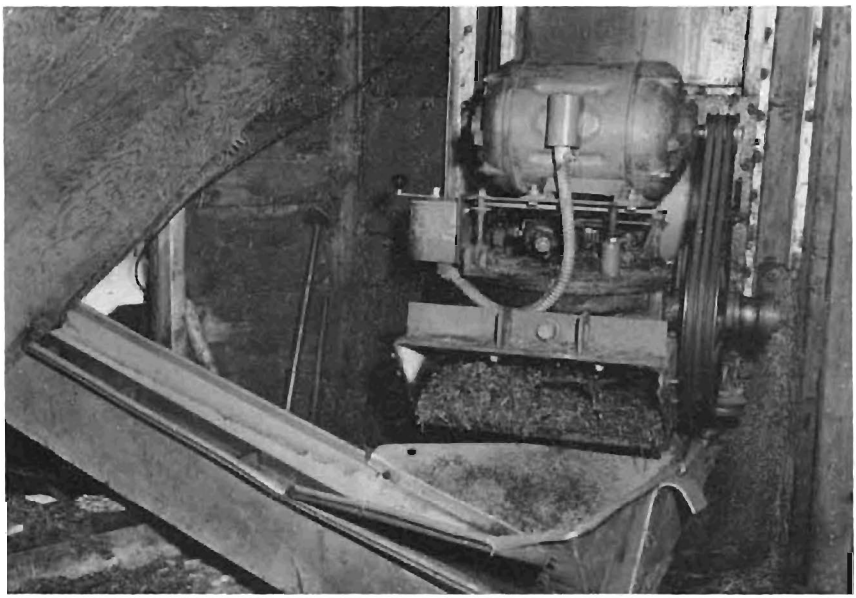

FIGURE 3. Merchanized haylage removal from upright silo with bottom unloader. Haylage is being unloaded into an elevator for transfer to an auger.

Case 3: By Cart, Tractor Loader—In case 3, cows and heifers were fed silage by cart in stanchions, but the silage was removed by a tractor loader from a horizontal silo. This method reduced silage feeding to 1.4 minutes per cow and .5 minute per heifer for a total time for the herd of 84 minutes per day. Again, the hay and grain were fed in the same way as in cases 1 and 2. The total time of 184 minutes per day was the least time of the three feeding situations, being 23 minutes less than case 2, and 8 minutes less than case 1.

Comparison of Stanchion Housing Cases

The feeding time was not greatly different among the silage feeding methods in cases 1, 2, and 3 (table 1). Individual differences among farmers using any of the methods would make no one case a clear-cut choice as the best or least time-consuming method. The savings or differences in time must be set against differences in investment and operating cost of mechanical equipment, however. It can be stated in general that the installation of a silo unloader cannot be justified by time savings alone.

These three cases also illustrate the importance of silage feeding in overall feeding time in stanchion barns. Silage feeding took nearly half of the feeding time as an average for all three cases, amounting to 48% for case 1, 52% for case 2 and 45% for case 3. The hay and concentrate feeding took about 30 and 20%, respectively of the total feeding time. Silage feeding is, therefore, an important component of the feeding time to consider when looking at the labor savings and additional investment and operating costs of alternative feeding methods.

In all three cases, table 1, the cows used around 75% of the total feeding time for silage, hay and concentrates, with about 25% allocated to the heifers. This would be logical because of the larger number of head and greater volume of feed, but it was exaggerated by

FIGURE 4. Hand Feeding with a silage cart. The most commonly used method of feeding silage to cows in stanchion barns.

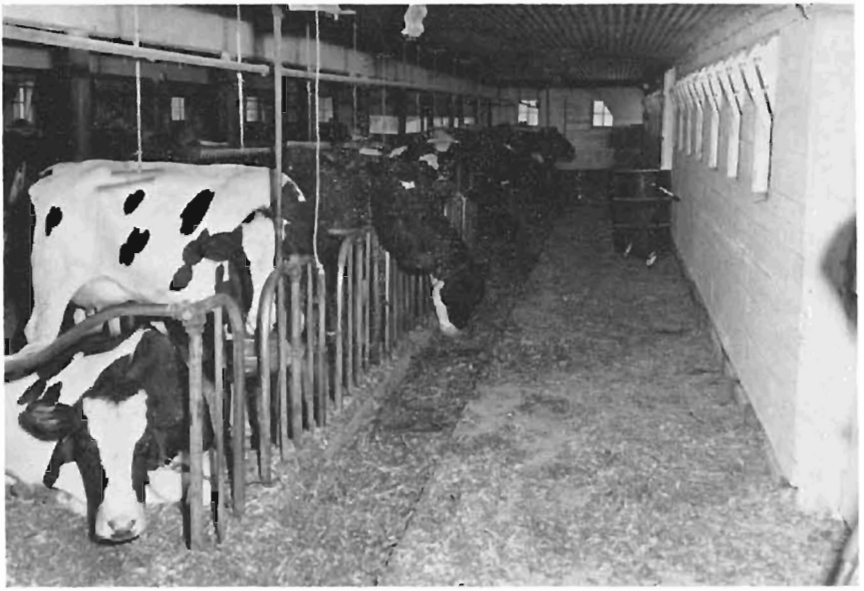

FIGURE 5. A conveyor installed in the "crib" or manger feeds silage to 50 cows in this stall barn in 15 minutes. Silage is mechanically unloaded from an upright silo onto an elevator which empties through the trap door in the ceiling of the tie up (see trap door above the second stall).

the nature of allocating time among the groups. In general, any combined time which was difficult to separate was charged to the cows. When silage was thrown down from a vertical silo for both cows and heifers, the time for removal would be charged to the cows, and only the direct feeding time to the heifers. Thus, the division of time recorded among the age groups could not be used for an accurate allocation of labor cost for the respective groups.

Feeding Times in Loose Housing

Four different cases for feeding silage were considered for loose housing arrangements. Silage was fed (1) by auger in a group manger, unloaded from the silo with a silo unloader, (2) into a group manger direct with a tractor loader from a horizontal silo, (3) into a group manger direct by a self-unloading wagon, with the wagon being filled by a tractor unloader, (4) in a self-feeding wagon, with the wagon being filled by hand. Both cows and older heifers were fed silage by the same method in cases 1 and 3. In cases 2 and 4, older heifers were assumed to be fed silage by cart in stanchion mangers, with the silage removed by hand from the silo. In feeding by a self-feeding

FIGURE 6. Auger feeding of haylage. Note the elevator in the background which brings haylage onto the auger from a bottom unloaded silo.

FIGURE 7. Auger feeding of silage. Silage is removed by an unloader in the top of the silo and moved by gravity directly to auger. Note the silage chute in the background.

TABLE 2

Time per Animal and per Herd for Feeding Chores in Loose Housing, Hay Fed Direct to a Group Manger From Ground Level Storage, Concentrates to Cows by Gravity Flow in a Milking Parlor and to Heifers by Pail from Ground Level Storage

Animals	Minutes Chore Time Per Day+			
	Silage	Hay	Concentrate	Total
Case 1. Silage fed by auger into a group manger, removed by silo unloader from a vertical silo for both cows and heifers.				
Cows, per head	.5	.4	[1]	.9
For 52 head	26	21	1	48
Older heifers, per head	.8	.4	.2*	1.4
For 17 head	16	6	3	25
Younger heifers, per head	—	.5	.5	1.0
For 14 head	—	7	7	14
Total for the Herd	42	34	11	87
Case 2. Silage fed in a group manger direct by a tractor loader from a horizontal silo for cows. Heifers fed by cart in stanchin manger, silage removed by hand.				
Cows, per head	.5	.4	[1]	.9
For 52 head	26	21	1	48
Older heifers, per head	1.2	.4	.2*	1.8
For 17 head	22	6	3	31
Younger heifers, per head	—	.5	.5	1.0
For 14 head	—	7	7	14
Total for the Herd	48	34	11	93
Case 3. Silage fed in a group manger by self-unloading wagon, removed by a tractor loader from a horizontal silo for both cows and heifs.				
Cows, per head	.4	.4	[1]	.9
For 52 head	23	21	1	45
Older heifers, per head	.1	.4	.2*	.7
For 17 head	2	7	3	12
Younger heifers, per head	—	.5	.5	1.0
For 14 head	—	7	7	14
Total for the Herd	25	35	11	71
Case 4. Silage fed in a group manger from a self-feeding wagon, removed by hand from a vertical silo for cows. Heifers fed by cart in stanchion manger, silage removed by hand.				
Cows, per head	1.8	.4	[1]	2.2
For 52 head	92	21	1	114
Older heifers, per head	1.2	.4	.2*	1.8
For 17 head	22	6	3	31
Younger heifers, per head	—	.5	.5	1.0
For 14 head	—	7	7	14
Total for the Herd	114	34	11	159

* Time reduced by one-half from actual time per head for feeding older heifers since only half of them were fed grain.

+ Computations for the herd time were made from unrounded minutes per head.

[1] Less than one-tenth minute.

wagon, none of the farmers in the study filled the wagon with a tractor loader, which would seem the more logical method. Timings were very limited for filling the self-feeding wagon by a silo unloader.

In all four silage feeding methods, all animals were fed hay in a group manger direct from ground level storage. Again, only the older heifers were fed silage, and the recorded time for feeding them concentrates was reduced by one-half. Concentrates were fed to the cows in all cases by gravity flow in a milking parlor, and both heifer groups were fed grain by pail from bag or barrel storage.

Case 1: By Auger, Silo Unloader—Silage fed by auger into a group manger and unloaded from a vertical silo by a silo unloader (case 1, table 2), took a half minute per cow or 26 minutes for the 52 cows. Silage fed to older heifers in the same way took .8 of a minute per head, or 16 minutes for 17 head, making a total time of 42 minutes for silage feeding. The higher amount of time per head for heifers compared to cows is explained by the inefficiency of feeding a smaller group of animals with this equipment. Hay fed directly to a group manger from ground level storage took .4 of a minute per cow, and per older heifer and slightly more (.5 minute per head) for the younger heifers. The total time to feed hay to the herd was 34 minutes.

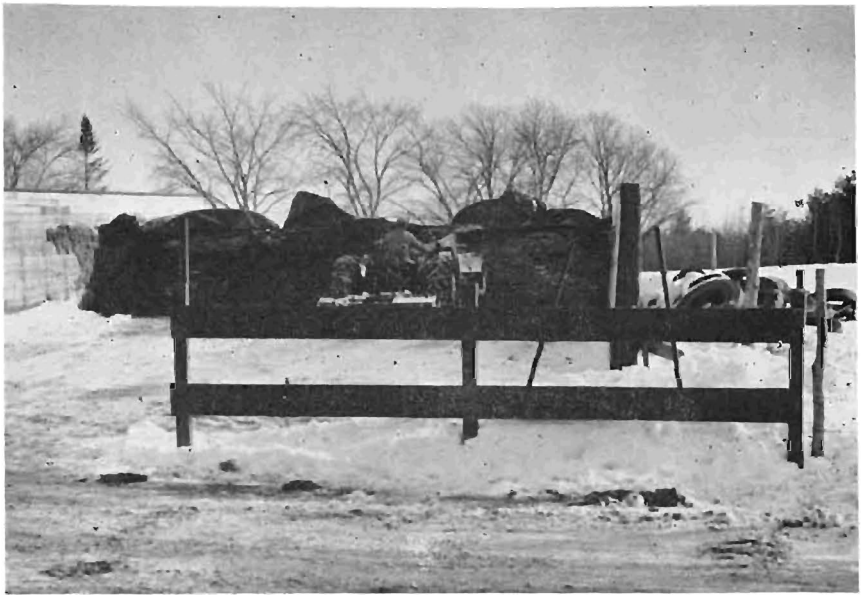

FIGURE 8. Unloading a horizontal silo (bunker type with concrete floor) with a tractor-bucket. This handling method was found to be a real time saver for feeding in stall barns or loose housing.

Concentrate feeding in a milking parlor took slightly over 1 second per cow, or 1 minute for all 52 cows. The heifers were fed grain by pail from ground level storage, and required less than .2 of a minute per head for older heifers (decreased by one-half) and a half minute per head for younger heifers. The total time for feeding the herd grain was 11 minutes. The total chore time for feeding the herd was just under an hour and a half per day.

Case 2: By Tractor Loader Direct—In case 2 with silage removed by tractor loader from a horizontal silo direct to a group manger, the silage feeding time was 15% greater than for case 1, or a total time of 48 minutes for feeding silage to the cows and heifers. The difference in time was due entirely to the method of feeding older heifers. In this case, the older heifers were fed silage by cart in a stanchion manger with the silage removed from a vertical silo by hand. This feeding arrangement resulted when the old stanchion barns continued to be used for young stock after new cow barns were constructed.

The hay and concentrate feeding methods in this case were the same as case 1, resulting in nearly equal total feeding time of 86 minutes for the herd. Because of the similarity in timings in cases 1 and 2, the advantage of one or the other would have to depend on factors other than the actual feeding time.

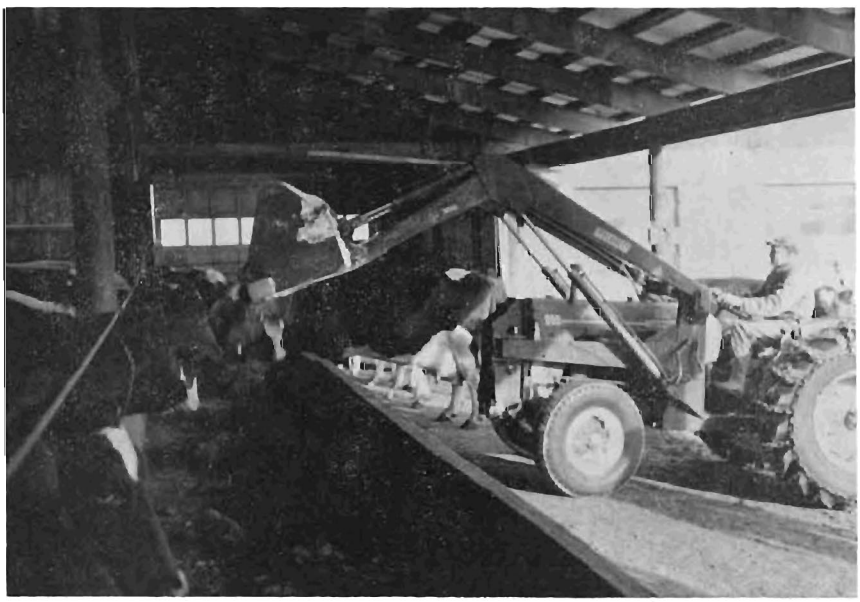

FIGURE 9. Feeding silage directly to bunks with a tractor-bucket. An excellent method when used with a horizontal silo located near the feeding area.

Case 3: By Self-Unloading Wagon, Tractor Loader—Case 3 required somewhat under a half a minute per cow for feeding silage from a self-unloading wagon into a group manger when removed from a horizontal silo by a tractor loader. The total silage feeding time for 52 cows was 23 minutes per day, or slightly less than cases 1 and 2, table 2. The older heifers fed by the same method as the cows used only .1 minute per head or 2 minutes daily in total. This timing in most cases, however, was just for unloading silage into the group manger. When cows and heifers were fed by the same method, removal time was generally charged to the cows. The combined feeding time for cows and heifers was 25 minutes. This is a substantial savings in total time to feed silage compared with cases 1 and 2.

FIGURE 10. Loading silage into a self unloading wagon from a horizontal silo by tractor-bucket. A method recommended when the silo is located some distance from the feeding area.

Since hay and concentrate feeding times were the same in case 3 as for case 1 and 2, the total feeding time per day for all feeds was 71 minutes. This was the lowest figure for these three cases. This saving in labor time would have to be balanced against the investment in a self-unloading wagon compared to equipment requirements of the other methods.

Case 4: By Self-Feeding Wagon, Hand Remove—Where silage was fed from a self-feeding wagon filled by hand from a vertical silo, a

total of 159 minutes was used for all feeding chores for the herd. The silage feeding time for cows was 1.8 minutes per head, or over three times as long as any of the prior three cases. Most of this time was needed for filling the wagon by hand. This time was based on observations on two farms for a total of eight daily records. Also contributing to the high amount of time used was the method of feeding the older heifers by cart from a vertical silo, as in case 2. The hay and concentrates were fed the same as in the other cases. On the farms studied, the self-feeding wagon method was not developed into a major, efficient system of silage feeding.

FIGURE 11. Feeding with a self unloading wagon into bunk. This was the least time consuming of the methods studied for feeding a 52 cow herd.

Comparison of Loose Housing Cases

The first two cases, table 2, are comparable in timings, thus the choice of system, timewise, depends largely on the individual farm arrangement and farmer preference. Case 1 required a silo unloader and auger compared to a tractor loader and trench silo in case 2. Case 3, using a self-unloading wagon and tractor loader showed an important saving in time over the other systems.

In the first three cases, table 2, cows required 55, 56 and 63%, respectively, of the total feeding time, the rest being used for heifers. This compares to about 75% of feeding time for cows in the stanchion

housing, table 1. This illustrates that the efficiency of feeding cows was improved more than that for heifers, mainly because heifers often remained in stanchion barns with greater relative feeding time for all feeds compared to cows in loose housing. Only case 4, table 2, had a distribution of labor among the animal groups comparable to the stanchion farm, with cows requiring 75% of total chore time.

The feeding methods used under loose housing in cases 1, 2, and 3, table 2, on the average decreased only slightly the proportion of the feeding time for silage. The percentage of total time for silage feeding was 47, 47 and 36%, respectively, for cases 1, 2 and 3 compared to about 50% for stanchion housing. Only in case 3, with the self-unloading wagon, did the proportion of time for silage decrease considerably. With milking parlor feeding of grain the proportion of time in grain feeding decreased to about 15% of the total feeding time compared to 20% for the stanchion barn. On the average, in loose housing, the proportion of time in hay feeding was nearly equal to that for silage feeding. Further improvement in both silage and hay feeding times would be necessary for increased feeding efficiency in loose housing.

Comparison of Feeding Time for Stanchion and Loose Housing

In all four cases of loose housing, and particularly the first three, the time required for the daily feeding chores for a 52 cow herd was considerably less than required for feeding in a stanchion barn. Loose housing, cases 1, 2, and 3, which involved feeding both silage and hay in group mangers and grain feeding by gravity flow for cows in a milking parlor, resulted in time savings in feeding of all three feeds. In total daily time to feed the herd, 30 minutes was saved in concentrate feeding and 25 minutes in hay feeding for loose versus stanchion housing. Time saved in silage feeding varied by method, but in cases 1 and 2 (auger feed and tractor loader direct) with times of 41 minutes and 48 minutes, respectively, 46 to 53 minutes were saved compared to the average for the three methods of feeding silage in a stanchion barn (94 minutes). Feeding silage by a self-unloading wagon in a group manger saved an hour and nine minutes per day over the average of stanchion feeding. The self-feeding wagon when hand loaded took 20 minutes more than the average stanchion feeding time.

In summary, it can be said that there is little difference among silage feeding methods in stanchion barns as long as all silage is fed in the individual stanchion, and hay and grain feeding are comparable.

The tractor loader with a horizontal silo has an edge; the silo unloader would have to be considered carefully for its adjustment to and compatability with the overall system of feeding, and then it may have to be justified on other than labor cost savings. The overall system of feeding in loose housing saves considerable time compared to systems in stanchion housing. The most time saving in loose housing was when the self-unloading wagon was used.

Farmers with stanchion barns, may, of course, use some of the feeding methods of the loose housing system, such as group manger feeding of silage and hay, or a milking parlor where grain would be fed. On the other hand, some farmers with milking parlors were concerned about the quantity of grain fed, and supplemented the parlor feeding with group manger or stanchion feeding. Many combinations and variations of the rather pure feeding systems here presented are being and can be used depending on the farm situation and the farmer's preference.

Comparison of Labor and Equipment Costs in Feeding Silage

The economic feasibility of mechanized methods of feeding silage were determined by computing the operating costs for 180 days of use and the fixed or ownership costs for the year for each system of feeding. The bases of these cost computations were operating times for power equipment reported by the dairymen on a monthly basis, plus investment values given by the dairymen at the beginning of the study. Standard rates for depreciation, interest, taxes, repairs, and for operating costs were assumed. The details of the fixed and ownership costs are given in appendix tables 10 and 11. To these costs were added a charge for labor used in 180 days of feeding at rates of $1.00, $2.00 and $3.00 per hour. Hours of labor were based upon the time used in feeding cows as shown in tables 1 and 2.

The results of this analysis indicate that with labor at $1.00 per hour it would not pay to mechanize silage feeding. The removal of silage by hand and feeding with cart would cost $244. All other systems would cost more, ranging from $260 for removal and feeding by tractor loader to $515 for removal by silo unloader and feeding with cart, table 3.

With labor at $2.00 per hour it would pay to mechanize provided it was limited to the removal and feeding with a tractor loader for which equipment and labor would cost $338. All other systems would be more expensive ranging from $478 for removal by hand and feeding with a cart to $788 for removal by silo unloader and feeding with a cart. At a cost of $542 annually the removal by tractor loader and feeding by

self-unloading wagon becomes nearly as attractive an alternative as feeding by hand. At $3.00 per hour for labor this system is definitely a feasible alternative. Only the removal and feeding of silage by a tractor loader is less expensive at this wage.[2]

At wages of $3.00 per hour hand removal and feeding by cart, among the alternatives studied, is the most economical method for feeding silage in stanchion barns. Removal by tractor loader and feeding directly to cows was the most economical method of feeding silage in loose housing barns.

In determining the ultimate economic feasibility of a silage handling system several additional factors may need to be considered, including the cost in filling the silo, the spoilage losses incurred in storage, and the cost of the silo itself.

It is apparent that mechanization of silage feeding may be desirable for reasons other than economic ones—such as making the work

TABLE 3

Total Equipment and Labor Costs in Feeding Silage to Cows with Various Silage Handling Systems, Maine Dairy Farms 1963

System of Feeding	Equipment Costs[1] Operating (180 days)	Fixed (annual)	Total	Labor Used (180 days)	Total Equipment & Labor Cost[2]		
				(hours)	$1/hr.	$2/hr.	$3/hr.
Stanchion housing							
Removed by hand fed by cart	$ 0	$ 10	$ 10	234	244	478	712
Removed by silo unloader fed by cart	16	226	242	273	515	788	1,061
Removed by tractor loader fed by cart	32	141	173	228	401	629	857
Loose housing							
Removed by silo unloader fed by auger	31	364	395	78	473	551	629
Removed by tractor loader fed directly	52	130	182	78	260	338	416
Removed by tractor loader fed by self-unloading wagon	34	370	404	69	473	542	611
Removed by hand fed by self-feeding wagon	95	40	135	276	411	687	963

[1] See appendix tables 8 and 9 for details of cost computation.

[2] Labor cost computed at $1.00, $2.00 and $3.00 per hour. Other labor rates would change not only the level but the relative costs of the feeding systems. A 52 cow hrd and 180 days of labor use are assumed. Greater or lesser use would change the level and relative costs.

[2] Where the farm operator is performing the chores the appropriate labor cost is that amount he could earn by devoting his time to other than feeding. It may be that 150 hours saved in feeding will permit adding two more cows to the herd which would mean $450 of added income.

more pleasant, holding capable hired labor, etc. Nevertheless if farm income is to be maintained, size of operation or other production inputs must be increased upon conversion to mechanized systems so that greater output is generated to pay for their cost.

APPENDIX TABLE 1

Time Used in Feeding Silage to Cows by Various Methods

Feeding method	Type housing	Number: Farms reporting	Number: Monthly timings	Number: Cows fed	Operation: Remove	Operation: Feed	Operation: Remove & Feed Total	Operation: Remove & Feed per cow
					— minutes — (all timings)			minutes per day
1. Auger fed, removed by silo unloader	5 Stall 1 Loose	6	28	1,336	158	519	677	.507
2. Fed from cart, removed by silo unloader	Stall	9	39	1,981	1,184	2,261	3,445	1.739
3. Fed from cart, removed by hand	Stall	11	51	2,867	1,785	2,473	4,258	1.488
4. Fed from cart, removed by tractor unloader	Stall	5	26	1,133	650	952	1,602	1.447
5. Fed from self-unloading wagon, removed by silo unloader	Stall	1	3	99	19	65	84	.849
6. Fed from self-unloading wagon, removed by hand	Loose	1	2	146	189	18	207	1.418
7. Fed from self-unloading wagon, removed by tractor loader	Loose	3	15	1,063	327	157	484	.451
8. Fed from self-feeding wagon, removed by silo unloader	1 Stall 1 Loose	2	4	153	42	85	127	.830
9. Fed from self-feeding wagon, removed by hand	Loose	2	10	345	564	49	613	1.777
10. Fed from self-feeding wagon, removed by tractor unloader	—	—	—	—	—	—	—	—
11. Fed directly with tractor unloader	1 Stall 2 Loose	3	13	1,032	0	519	519	.503
12. Other								

APPENDIX TABLE 2

Time Used in Feeding Silages to Older Heifers by Various Methods

Feeding method	Type housing[1]	Number: Farms reporting	Number: Monthly timings	Number: Heifers fed	Operation: Remove[2]	Operation: Feed	Operation: Remove & Feed Total	Operation: Remove & Feed per heifer
					— minutes — (all timings)			minutes per day
1. Auger fed, removed by silo unloader	Stall	3	5	57	15	36	51	.895
2. Fed from cart, removed by silo unloader	Stall	5	13	225	31	182	213	.947
3a. Fed from cart, removed by hand—fed separately	1 Stall 1 Loose	2	9	206	104	153	257	1.248
3b. Fed from cart, removed by hand—fed with cows	Stall	3	12	263	—	215	215	.817
4. Fed from cart, removed by tractor unloader	Stall	2	9	110	20	32	52	.473
5. Fed from self-unloading wagon, removed by silo unloader	Stall	1	2	50	—	10	10	.200
6. Fed from self-unloading wagon, removed by hand		—	—	—	—	—	—	—
7. Fed from self-unloading wagon, removed by tractor loader	1 Stall 1 Loose	2	8	215	—	38	38	.148
8. Fed from self-feeding wagon, removed by silo unloader	Stall	1	3	75	—	17	17	.227

[1] Type of housing is that for cows.

[2] When silage was removed for both cows and older heifers in one operation the removal time was charged to the cows.

APPENDIX TABLE 3

Time Used in Feeding Silages to Younger Heifers by Various Methods

Feeding method	Type housing[1]	Number: Farms reporting	Number: Monthly timings	Number: Heifers fed	Operation: Remove[2]	Operation: Feed	Operation: Remove & Feed Total	Operation: Remove & Feed per heifer
					— minutes — (all timings)			minutes per day
1. Auger fed, removed by silo unloader	Stall	1	1	20	0	7	7	.350
2. Fed from cart, removed by silo unloader	Stall	3	5	83	13	30	43	.518
3. Fed from cart, removed by hand	Stall	1	5	172	45	55	100	.581
4. Fed from cart, removed by tractor unloader	Stall	2	7	77	5	43	48	.623
5. Fed from self-unloading wagon, removed by silo unloader	Stall	1	1	25	0	2	2	.080
6. Fed from self-unloading wagon, removed by hand		—	—	—	—	—	—	—
7. Fed from self-unloading wagon, removed by tractor loader	Loose	1	4	90	3	9	12	.133
8. Fed from self-feeding wagon, removed by silo unloader	Stall	1	1	20	0	1	1	.05
9. Fed from self-feeding wagon, removed by hand	Loose	2	2	20	30	23	53	2.65

[1] Type of housing is that for cows.

[2] When silage was removed for both cows and older heifers in one operation the removal time charged to the cows.

APPENDIX TABLE 4

Time Used in Feeding Hay to Cows by Various Methods

Feeding method	Type housing	Number: Farms reporting	Number: Monthly timings	Number: Cows fed	Operation: Remove	Operation: Feed	Operation: Remove & Feed: Total	Operation: Remove & Feed: per cow
					— minutes — (all timings)			minutes per day
Manual drop from overhead storage to:								
1. Feed alley direct to stanchion manger	Stall	20	137	6,276	1,169	3,237	4,406	.702
2. Hand carry to stanchion manger	Stall	2	2	126	14	99	113	.897
3. Mechanical transport to stanchion manger	Stall	6	26	1,623	194	849	1,043	.643
4. Mechanical transport to group manger	Loose	1	2	70	82	18	100	1.429
5. Group manger direct	Loose	3	22	1,317	15	531	546	.414
Manual carry from ground level storage to:								
6. Stanchion	Stall	1	7	250	69	72	141	.564
7. Mechanical transport to stanchion manger	Stall	4	21	1,273	236	670	906	.699
8. Mechanical transport to group manger	Loose	2	2	105	22	35	57	.543
9. Group manger direct	2 Stall 10 Loose	12	71	3,896	371	1,233	1,604	.405

APPENDIX TABLE 5

Time Used in Feeding Hay to Older Heifers by Various Methods

Feeding method	Type housing[1]	Number: Farms reporting	Number: Monthly timings	Number: Heifers fed	Operation: Remove[2]	Operation: Feed	Operation: Remove & Feed Total	Operation: Remove & Feed per heifer
					— minutes — (all timings)			minutes per day
Manual drop from overhead storage to:								
1. Feed alley direct to stanchion manger	Stall	4	18	450	19	294	313	.695
2. Hand carry to stanchion manger	Stall	2	2	60	3	12	15	.250
3. Mechanical transport to stanchion manger	Stall	3	8	151	11	111	122	.808
4. Mechanical transport to group manger	Stall	7	27	433	28	288	316	.730
5. Group manger direct	Stall	8	44	820	90	661	751	.916
Manual carry from ground level storage to:								
6. Stanchion	2 Stall 1 Loose	3	16	297	56	284	340	1.145
7. Mechanical transport		—						
8. Mechanical transport to group manger	Loose	2	10	217	7	196	203	.935
9. Group manger direct	Loose	6	22	479	45	150	195	.407

[1] Type of housing is that for cows.

[2] When silage was removed for both cows and older heifers in one operation the removal time was charged to cows.

APPENDIX TABLE 6

Time Used in Feeding Hay to Younger Heifers by Various Methods

Feeding method	Type housing[1]	Number: Farms reporting	Number: Monthly timings	Number: Heifers fed	Operation: Remove[2]	Operation: Feed	Operation: Remove & Feed: Total	Operation: Remove & Feed: per heifer
					— minutes — (all timings)			minutes per day
Manual drop from overhead storage to:								
1. Feed alley direct to stanchion manger	10 Stall 1 Loose	11	67	764	50	548	598	.783
2. Hand carry to stanchion manger	Loose	1	8	56	10	36	46	.821
3. Mechanical transport to stanchion manger	4 Stall 1 Loose	5	20	267	18	203	221	.828
4. Mechanical transport to group manger	Stall	2	15	193	6	126	132	.684
5. Group manger direct	8 Stall 1 Loose	9	65	854	42	717	759	.889
Manual carry from ground level storage to:								
6. Stanchion	1 Stall 2 Loose	3	10	281	7	131	138	.491
7. Mechanical transport to stanchion manger	Stall	2	9	74	6	67	73	.986
8. Mechanical transport to group manger	Loose	3	7	145	31	98	129	.890
9. Group manger direct	1 Stall 6 Loose	7	37	551	61	222	283	.514

[1] Type of housing is that for cows.

[2] When silage was removed for both cows and younger heifers in one operation the removal time was charged to cows.

APPENDIX TABLE 7

Time Used in Feeding Concentrate to Cows, Older Heifers and Younger Heifers by Various Methods

Feeding method	Type housing	Number: Farms reporting	Number: Monthly timings	Number: Animals fed	Operation: Remove	Operation: Feed	Operation: Remove & Feed Total per animal	Operation: Remove & Feed Total per animal
					— minutes — (all timings)			minutes per day
			— Cows —					
1. Feed from pail, remove by hand	Stall	1	13	682	35	403	438	.642
2. Feed from cart, remove by hand	Stall	9	92	4,507	739	2,370	3,109	.690
3. Feed from cart, remove by gravity flow	Stall	11	117	5,745	400	3,019	3,491	.595
4. Gravity flow, parlor feed	1 Stall 12 Loose	13	108	5,682	40	52	92	.016
			— Older heifers —					
1. Feed from pail, remove by hand	3 Stall 4 Loose	7	23	360	2	148	150	.417
2. Feed from cart, remove by hand	Stall	7	37	583	14	181	195	.344
3. Feed from cart, remove by gravity flow	1 Stall 1 Loose	2	11	195	0	73	73	.374
			— Younger heifers —					
1. Feed from pail, remove by hand	6 Stall 9 Loose	14	93	1,166	16	601	617	.529
2. Feed from cart, remove by hand	8 Stall 2 Loose	10	85	1,095	49	659	708	.647
3. Feed from cart, remove by gravity flow	5 Stall 1 Loose	6	41	582	6	228	234	.402

APPENDIX TABLE 8

Comparison of Investments and Annual Ownership Costs for Power Equipment Used in Feeding Silage to Cows, Maine Dairy Farms, 1963

Equipment and system of feeding	Investment	Annual Costs			
		Depreciation[1]	Interest[2]	Repairs, Taxes Insurance[3]	Total
EQUIPMENT					
Silo Unloader	$1,438	$144	$43	$29	$216
Elevator, Auger	988	99	30	20	149
Self Unloading Wagon	1,600	160	48	32	240
Self Feeding Wagon	264	26	8	5	39
Regular Wagon	350	35	10	7	52
Tractor Bucket Loader	869	87	26	17	130
Cart	64	6	2	1	9
Fork	10	1	[4]	[4]	1
Silage Room	100	3	3	2	8
SYSTEMS OF FEEDING					
Silo Unloader and:					
Cart, Fork	1,512	151	45	30	226
Wagon, Cart, Fork	1,862	186	56	37	279
Elevator, Conveyor	2,710	271	81	54	406
Fork	1,448	145	43	29	217
Wagon, Fork	1,798	180	54	36	270
Elevator, Auger	2,426	243	73	48	364
Self Unloading Wagon	3,038	304	91	61	456
Tractor Bucket Loader and:					
Cart, Fork	943	94	28	19	141
Silage Room, Cart, Fork	1,043	104	31	20	155
Wagon, Cart, Fork	1,293	129	38	26	193
Self Unloading Wagon	2,469	247	74	49	370
Tractor Loader Only	869	87	26	17	130
Hand, Fork and:					
Cart, Fork	74	7	2	1	10
Wagon, Cart, Fork	424	42	13	8	63
Fork Only	10	1	[4]	[4]	1
Wagon, Fork	360	36	11	7	54
Self Unloading Wagon	1,600	160	48	32	240
Self Feeding Wagon	274	27	8	5	40

[1] Based on 10-year life, straight-line method, no salvage value.
[2] Based on 6% of one-half the original investment.
[3] Based on 2% of the original investment.
[4] Less than 50 cents.

APPENDIX TABLE 9

Comparison of Operating Time and Daily Cost
for Power Equipment Used in Feeding Silage to Cows
Maine Dairy Farms, Winter 1963-64

Feeding equipment	Type manger	Use Time		Variable Operating Cost		
		Electric motors	Tractor truck	Electric motors	Tractor truck[2]	Total
		- minutes per day -		— cents per day —		
Silo Unloader (5 hp motor) and:						
Cart, Fork	Individual	48		9		9
Truck, Wagon or Trailer and Cart, Fork	Individual	94	20	18	16	34
Elevator, Conveyor (6 hp motor)	Individual	35		14		14
Direct to Manger, Fork	Group	80		15		15
Truck, Wagon, or Trailer, Fork	Group	42	47	8	39	47
Elevator, Auger (6 hp motor)	Group	42		17		17
Self Unloading Wagon	Group	55	18	10	15	25
Tractor Bucket Loader and:						
Cart, Fork	Individual		22		18	18
Silage Room, Cart, Fork	Individual		31		25	25
Truck, Wagon or Trailer and Cart, Fork	Individual		40		34	34
Self Unloading Wagon or Truck	Group		23		19	19
Tractor Loader Only	Group		34		29	29
Hand, Fork and:						
Truck, Wagon, or Trailer and Cart, Fork	Individual		42		35	35
Truck, Wagon or Trailer & Fork	Group		42		35	35
Self Unloading Wagon	Group		15		13	13
Self Feeding Wagon	Group		63		53	53

[1] Cost based on rate of three cents per kilowatt hour; one horsepower hour equals 0.746 kilowatt hour.

[2] Variable costs computed at the rate of fifty cents per hour of tractor or truck use.

APPENDIX TABLE 10

Amounts of Silage Fed to Cows by Various Methods

Feeding Method	Number				Amount Fed	
	Type Housing	Farms Reporting	Monthly Timings	Cows Fed	All Cows (lbs/day)	Per Cow (lbs/day)
1. Auger fed, remove by silo unloader	5 Stall 1 Loose	6	28	1336	50,920	38.1
2. Fed from cart, remove by silo unloader	Stall	9	39	1981	84,430	42.6
3. Fed from cart, remove by hand	Stall	11	51	2867	114,410	39.9
4. Fed from cart, remove by tractor loader	Stall	5	26	1133	59,580	52.7
5. Fed from self-unloading wagon, remove by silo unloader	Stall	1	3	99	2,330	23.5
6. Fed from self-unloading wagon, remove by hand	Loose	1	2	146	4,300	29.5
7. Fed from self-unloading wagon, remove by tractor loader	Loose	3	15	1063	51,130	48.1
8. Fed from self-feeding wagon, remove by silo unloader	1 Stall 1 Loose	2	4	153	5,170	33.8
9. Fed from self-feeding wagon, remove by hand	Loose	2	10	345	21,480	62.3
10. Fed from self-feeding wagon, remove by tractor loader	—	—	—	—	—	—
11. Fed directly with tractor loader	1 Stall 2 Loose	3	13	1032	58,000	56.2

APPENDIX TABLE 11

Amounts of Silage Fed to Older Heifers by Various Methods

Feeding Method	Number				Amount Fed	
	Type Housing	Farms Reporting	Monthly Timings	Heifers Fed	All Cows (lbs/day)	Per Heifer (lbs/day)
1. Auger fed, remove by silo unloader	Stall	3	5	57	2,920	51.2
2. Fed from cart, remove by silo unloader	Stall	5	13	225	8,890	39.5
3. Fed from cart, remove by hand (Heifers fed separately)	1 Loose 1 Stall	2	9	206	491	23.8
(Heifers fed with cows)	Stall	3	12	262	755	28.8
4. Fed from cart, remove by tractor loader	Stall	2	9	110	5,090	46.3
5. Fed from self-unloading wagon, remove by silo unloader	Stall	1	2	50	4,100	82.0
6. Fed from self-unloading wagon, remove by hand	—	—	—	—	—	—
7. Fed from self-unloading wagon, remove by tractor loader	1 Stall 1 Loose	2	8	215	11,350	52.8
8. Fed from self-feeding wagon, remove by silo unloader	Stall	1	3	75	7,880	105.1

APPENDIX TABLE 12

Amounts of Silage Fed to Younger Heifers by Various Methods

Feeding Method	Number				Amount Fed	
	Type Housing	Farms Reporting	Monthly Timings	Heifers Fed	All Cows (lbs/day)	Per Heifer (lbs/day)
1. Auger fed, remove by silo unloader	Stall	1	1	20	1,320	66.0
2. Fed from cart, remove by silo unloader	Stall	3	5	83	1,240	14.4
3. Fed from cart, remove by hand	Stall	1	5	172	2,190	12.7
4. Fed from cart, remove by tractor loader	Stall	2	7	77	5,060	65.7
5. Fed from self-unloading wagon, remove by silo unloader	Stall	1	1	25	1,100	44.0
6. Fed from self-unloading wagon, remove by hand	—	—	—	—	—	—
7. Fed from self-unloading wagon, remove by tractor loader	Loose	1	4	90	4,820	53.6
8. Fed from self-feeding wagon, remove by silo unloader	Stall	1	1	20	1,080	54.0
9. Fed from self-feeding wagon, remove by hand	Loose	2	2	20	880	44.0

APPENDIX TABLE 13

Amounts of Hay Fed to Cows by Various Methods

Feeding Method	Number				Amount Fed	
	Type Housing	Farms Reporting	Monthly Timings	Cows Fed	All Cows (lbs/day)	Per Cow (lbs/day)
Manual drop from overhead storage:						
1. Feed alley direct to stanchion manger	Stall	20	137	6,276	98,780	15.7
2. Hand carry to stanchion manger	Stall	2	2	126	1,660	13.2
3. Mechanical transport to stanchion manger	Stall	6	26	1,623	20,610	12.7
4. Mechanical transport to group manger	Stall	1	2	70	1,850	26.4
5. Group manger direct	Loose	3	22	1,317	17,650	13.4
Manual carry from ground level to:						
6. Stanchion direct	Stall	1	7	250	3,720	14.9
7. Mechanical transport to stanchion manger	Stall	4	21	1,273	13,920	10.9
8. Mechanical transport to group manger	Loose	2	2	105	2,490	23.7
9. Group manger direct	2 Stall 10 Loose	12	71	3,896	58,220	14.9

APPENDIX TABLE 14

Amounts of Hay Fed to Older Heifers by Various Methods

Feeding Method	Number				Amount Fed	
	Type Housing	Farms Reporting	Monthly Timings	Heifers Fed	All Cows (lbs/day)	Per Heifer (lbs/day)
Manual drop from overhead storage:						
1. Feed alley direct to stanchion manger	Stall	4	18	450	7,830	17.4
2. Hand carry to stanchion manger	Stall	2	2	60	70	11.7
3. Mechanical transport to stanchion manger	Stall	2	8	151	3,800	25.3
4. Mechanical transport to group manger	Stall	7	27	433	7,030	16.2
5. Group manger direct	Stall	8	44	820	12,570	15.3
Manual carry from ground level to:						
6. Stanchion direct	2 Stall 1 Loose	3	16	297	4,560	15.3
7. Mechanical transport to stanchion manger	—	—	—	—	—	—
8. Mechanical transport to group manger	Loose	2	10	217	4,770	22.0
9. Group manger direct	Loose	6	22	479	7,490	15.6

APPENDIX TABLE 15
Amounts of Hay Fed to Younger Heifers by Various Methods

Feeding Method	Number				Amount Fed	
	Type Housing	Farms Reporting	Monthly Timings	Heifers Fed	All Cows (lbs/day)	Per Heifer (lbs/day)
Manual drop from overhead storage:						
1. Feed alley direct to stanchion manger	10 Stall 1 Loose	11	67	764	10,790	14.2
2. Hand carry to stanchion manger	Loose	1	8	56	580	10.3
3. Mechanical transport to stanchion manger	4 Stall 1 Loose	5	20	267	3,290	12.3
4. Mechanical transport to group manger	8 Stall 1 Loose	2	15	193	2,610	13.5
5. Group manger direct	Loose	9	65	854	11,530	13.5
Manual carry from ground level to:						
6. Stanchion manger direct	1 Stall 2 Loose	3	10	281	2,840	10.1
7. Mechanical transport to stanchion manger	Stall	2	9	74	850	11.5
8. Mechanical transport to group manger	Loose	3	7	145	2,400	16.6
9. Group manger direct	1 Stall 6 Loose	7	37	551	5,560	10.1

APPENDIX TABLE 16

Amounts of Concentrates Fed to Cows, Older Heifers and Younger Heifers by Various Methods

Feeding Method	Number				Amount Fed	
	Type Housing	Farms Reporting	Monthly Timings	Animals Fed	All Animals (lbs/day)	Per Animal (lbs/day)
			— Cows —			
1. Fed from pail, remove by hand	Stall	1	13	682	6,920	10.2
2. Fed from cart, remove by hand	Stall	9	92	4,507	56,580	12.3
3. Fed from cart, remove by gravity flow	Stall	11	117	5,745	67,160	11.7
4. Gravity flow, parlor fed (auger)	1 Stall 12 Loose	13	108	5,682	63,740	11.2
			— Older Heifers —			
1. Fed from pail, remove by hand	3 Stall 4 Loose	7	23	360	1,130	3.2
2. Fed from cart, remove by hand	Stall	7	37	583	2,980	5.1
3. Fed from cart, remove by gravity flow	1 Stall 1 Loose	2	11	195	430	2.2
4. Gravity flow, parlor fed (auger)	—	—	—	—	—	—
			— Younger Heifers —			
1. Fed from pail, remove by hand	6 Stall 8 Loose	14	81	1,166	3,260	2.8
2. Fed from cart, remove by hand	8 Stall 2 Loose	10	85	1,095	5,200	4.7
3. Fed from cart, remove by gravity flow	5 Stall 1 Loose	6	41	582	1,680	2.9
4. Gravity flow, parlor fed (auger)	—	—	—	—	—	—