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Effect of Herd Size on Dairy Chore Labor

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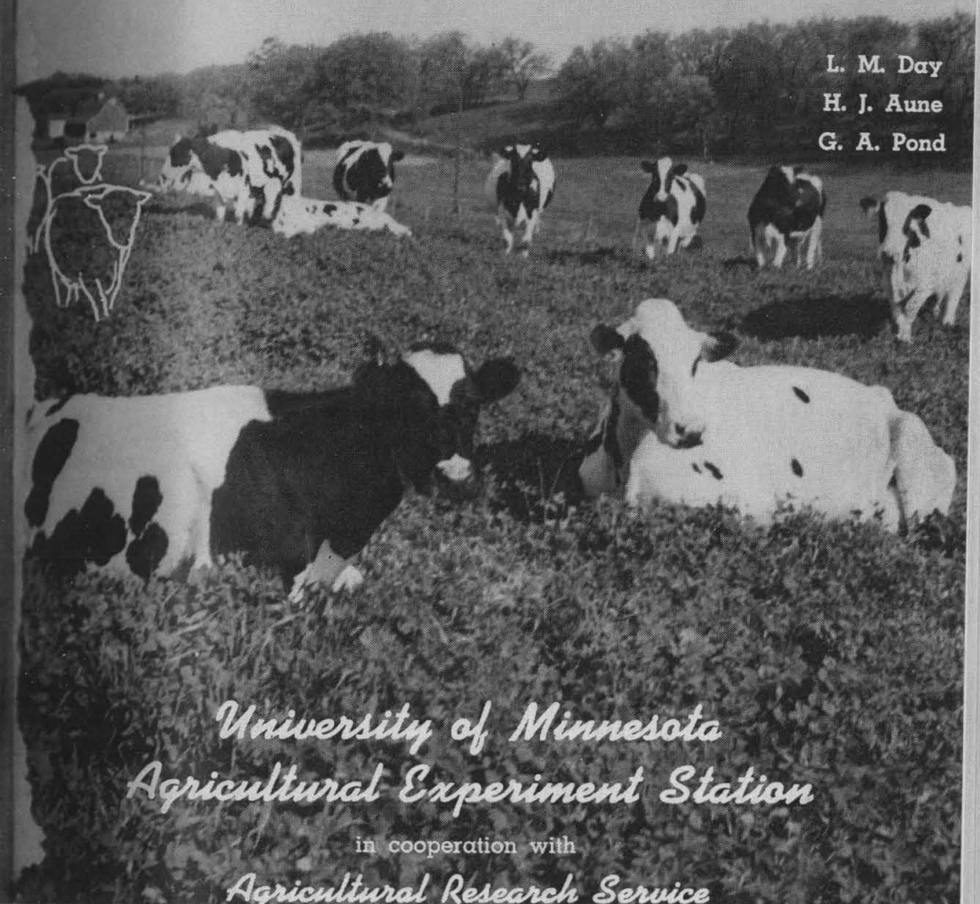

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Effect of Herd Size on Dairy Chore Labor

L. M. Day, H. J. Aune, and G. A. Pond[1]

RECENT YEARS have witnessed the introduction of a flood of new techniques in farming. Technological developments include mechanization and the increased use of mechanical power in both crop and livestock production. They also include revolutionary changes in breeding, feeding, disease control, and other contributions of the biological sciences. A striking effect of these new techniques has been to increase the productivity of human labor and thereby the size of unit a farmer can handle. With this has come increased size of farm units and greater specialization within the farm business. Farmers are concentrating on fewer enterprises in order to distribute the cost of expensive equipment involved in these new techniques over more units of business. This concentration on fewer crops or fewer classes of livestock enables farmers to keep up more effectively with the new techniques that are entering the picture.

Dairying, which is a major enterprise in Minnesota agriculture, has shared in this trend. From 1940 to 1954 the number of farmers who maintained dairy herds decreased nearly 30 percent, but the number of dairy cows decreased by only 21 percent and the average number of cows per dairy herd increased by 11 percent. Meanwhile, milk production per cow has increased by 20 percent. The trend is toward fewer but larger herds and increased production per cow. In the more intensive dairy areas, the trend toward larger herds is even more marked than in the state as a whole. In the 10 counties with the largest number of dairy cows per farm, the average size of the dairy herd increased 38 percent from 1940 to 1954.

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Source of Data Used in this Study

In view of this trend toward larger dairy herds, coupled with the new laborsaving techniques that are coming into the dairy picture, the Department of Agricultural Economics, Institute of Agriculture, University of Minnesota, in cooperation with the Farm Economics Research Division, Agricultural Research Service, U. S. Department of Agriculture, initiated a study of the effect of herd size on the labor required in dairy production. Field work was started in April 1956.

Data on labor used in caring for dairy cattle by operations were obtained from approximately 90 farmers in southern Minnesota. These farmers, who were members of the Southeastern and Southwestern Farm Management Associations, kept records of the labor they used on their dairy chores from April 1956 through April 1957. For such irregular chores as caring for sick cows and spraying flies, they recorded the information daily throughout each month. They recorded daily for one week of each month the labor used on each regular chore, such as grain feeding, hay feeding, silage feeding, and barn cleaning. Because the labor for each of these chores was recorded separately, the amount of labor used for milking could be estimated apart from the amount used in cleaning the milking utensils, feeding, and other dairy operations.

Previous investigations have shown that some savings in number of hours of labor used per cow are made as the size of the herd is increased.[2] To determine how much of the savings in labor was due to laborsaving equipment and procedures, each farm was classified according to its chore equipment and procedures. For example, a classification for the milking task was the use of two single units by one worker in a stanchion barn with rows arranged lengthwise. Within this classification, the effect of herd size on the labor used for milking was determined. In addition, comparisons were made between the time it took to milk with this equipment and the time needed using alternative equipment such as three single units operated by one worker. Similar comparisons were made for each of the major dairy chores.

Size of Herd and Systems of Management Affect Labor Economy

In recent years, Minnesota dairy farmers have shifted from the marketing of cream to the marketing of whole milk. For many farmers, this has meant large increases in fixed investments for such items as milk rooms, artificial refrigeration, and the like which are needed to insure a satisfactory quality of product. Farmers have tended to enlarge their herds in order to distribute the cost of this equipment over more units of production and thus reduce the cost per unit. However, since labor is scarce on many, if not most, farms any expansion of the dairy enterprise must be carefully planned. A major question

[2] Hasbargen, P. R. and Pond, G. A. "Planning Farms for Increased Profits," Minnesota Agricultural Experiment Station Bulletin 445, December 1957.

Table 1. Amount of labor used annually for chore work on dairy herds, by specified size of herd

Cows in herd	Labor used	
	Per cow	Per herd
	hours	
number		
10	131.9	1,319
15	106.4	1,596
20	94.3	1,886
25	86.4	2,161
30	81.5	2,444
35	77.9	2,727
40	75.2	3,009

the farmer must answer is, "How much extra labor is used as the size of the herd is expanded?" This bulletin will provide some information on the relationship between the size of the dairy herd and the amount of labor used.

A brief picture of some of the results of this study is shown in table 1, which gives the total number of hours of labor and the number of hours used per cow in caring for dairy herds of different sizes under specified conditions. For table 1 these conditions were: Production of manufacturing milk; milking with two single units by one worker in a barn with rows arranged lengthwise; milk cooled in a can cooler; grain fed once a day both summer and winter; baled hay fed once a day during both winter and summer; and silage fed during the winter only. A silage cart was used and silage was unloaded from the upright silo with a silo unloader. The barn was cleaned and manure was hauled to the field daily during the winter. Manure was removed from the barn with a litter carrier. Bedding was stored overhead.

Under these conditions, as shown in table 1, the average number of hours of labor used per cow decreases rather substantially as the size of the herd increases. With a 10-cow herd, about 132 hours of labor per cow were used. For a 20-cow herd, the number had dropped to 94 hours per cow, and for a 30-cow herd only 81 hours per cow were used. Although the average labor per cow decreases as the size of the herd increases, even though there is no change in equipment, the total amount of labor used in caring for the herd increases. However, doubling or tripling the herd size does not increase proportionately the amount of labor used. Table 1 shows that a 10-cow herd uses about 1,319 hours, a 20-cow herd uses about 1,886 hours, and a 30-cow herd uses about 2,444 hours. Thus, each additional 10 cows require another 563 hours or each additional cow would require another 56.3 hours.

When Is Labor Most Likely to be Scarce?

When making a decision about the size of the dairy herd and amount and arrangement of equipment to be used, remember that the amount of labor used annually to care for a dairy herd of a certain size may not be nearly so important as the amount of labor used at a particular time within the year. Certain peak load periods may occur, such as the haymaking season when the supply of labor is not adequate to handle the tasks that need attention. These periods may prove to be "bottlenecks" that will limit the size of the dairy herd. One of the first steps in planning for a dairy herd is to locate these bottlenecks. The data in table 2 are useful for this purpose.

The labor needed for the cropping system may be estimated from the data in table 2. For example, if a farm has 31 acres of corn, the total amount of

Table 2. Percentage distribution of labor used on specified crops per acre, by months

Item	Oats	Flax	Corn, grain	Soybeans	Alfalfa	Miscellaneous labor
			hours			
Total labor	5.0	4.7	6.4	4.5	6.1	*
Percentage distribution by months				percent		
January	.....	.....	.....	.....	.....	5.6
February	.....	.....	.....	.....	.....	5.3
March	.8	.....	.2	.....	.1	5.9
April	16.8	6.0	1.6	2.0	.2	6.6
May	10.0	16.2	25.3	24.2	.5	7.8
June	.6	8.1	15.5	20.9	36.4	11.4
July	16.4	5.1	7.8	12.4	30.8	10.3
August	41.6	28.7	3.1	2.0	14.4	11.2
September	6.2	26.1	12.7	9.1	16.9	12.3
October	3.2	6.2	27.3	23.6	.7	10.0
November	4.4	3.6	6.4	5.8	.....	7.3
December	.....	.....	.1	.....	.....	6.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

* Miscellaneous labor includes labor on farmstead upkeep, new building construction, building repair, machinery and equipment repair, tractor repair, truck and automobile repair, wood cutting, garden work, exchange work, and other jobs. Total labor required for these tasks amounted to 44 percent of the combined crop and livestock labor on farms with emphasis on beef and hogs. For dairy farms, it amounted to 29 percent of the combined crop and livestock labor. (This does not include time spent at farm meetings, off-the-farm employment, or public service work.)

Hasbargen, P. R. and Pond, G. A. "Planning Farms for Increased Profits," Minnesota Agricultural Experiment Station Bulletin 445, December 1957.

labor used on the crop would be 31 × 6.4 hours (see table 2), or a total of 198.4 hours. Of this amount 15.5 percent or 30.8 hours would be used in June. This figure, added to similar calculations for the acreages of oats and alfalfa raised on this farm, would indicate the total hours of crop labor to be used in June. To this is added the time spent in miscellaneous operations not directly involved in crop and livestock production. The sum of these items may then be deducted from the estimated total number of hours of labor available in June to determine how much is available for livestock production. An example for each month is shown in table 3.

Table 3. Monthly distribution of labor used on a farm, by specified acreages of crops and miscellaneous labor

Month	Crops and miscellaneous labor					Total labor available per month	Total labor available for livestock
	31 acres, corn	26 acres, oats	37 acres, alfalfa hay	800 hours, miscellaneous labor	Total		
				hours			
January	.....	.....	.....	44.8	44.8	300	255.2
February	.....	.....	.....	42.4	42.4	300	257.6
March	.4	1.0	.2	47.2	48.8	300	251.2
April	3.2	22.0	.5	52.8	78.5	300	221.5
May	50.4	13.1	1.1	62.4	127.0	300	173.0
June	30.8	.8	82.3	91.2	205.1	300	94.9
July	15.5	21.5	69.6	82.4	189.0	300	111.0
August	6.2	54.5	32.5	89.6	182.8	300	117.2
September	25.3	8.1	38.2	98.4	170.0	300	130.0
October	54.3	4.2	1.6	80.0	140.1	300	159.9
November	12.7	5.7	.....	58.4	76.8	300	223.2
December	.2	.....	.....	50.4	50.6	300	249.4

On the farm used as an example, summer and particularly the month of June is a critical period so far as labor is concerned. Thus, on this farm it is important to know the amount of labor used during the summer for the dairy enterprise so as to decide on the size of the dairy herd. In other instances, particularly those in which extra summer labor, either hired or family, is available, the winter months may be critical so far as labor is concerned.

Some Factors Affecting the Amount of Labor Used

Regardless of the month in which labor appears to be a limiting factor, the next step is to determine the relationship between herd size and the amount of labor used in the limiting month or season. The dairy chore load separates naturally into the winter barn-feeding season, which usually runs from late October to mid-May (29 weeks); and the summer season, which is usually 23 weeks under southern Minnesota conditions. From month to month, in either the winter or summer season, there is very little change in the amount of labor used per cow. However, there is a large difference in the amount of labor used in a summer month compared to the amount used in a winter month. In fact, the labor used in a summer month is about a third less than that used in winter. This results largely from the smaller number of tasks involved in caring for the dairy herd during the pasture season. For example, silage feeding and often hay feeding are eliminated during the summer. Also the number of animals fed grain often is reduced, and because the cows are in the barn for only a short time each day the barn-cleaning time is reduced substantially.

Besides season of the year, the composition of the herd and the system of management may affect the amount needed to care for the dairy herd. The amount of labor used in caring for a dairy herd in each season or month depends upon such things as the proportion of cows in the herd that are fed grain, the proportion fed silage, or the proportion milked. It depends also on the number of replacement stock that must be cared for. On some farms, all replacement animals are raised. On other farms, a substantial proportion of the replacement stock is purchased. Even on the same farm, the makeup of the dairy herd may vary considerably from season to season. For example, on some farms calving may be concentrated in September and October, with the result that about 95 percent of the cows in the herd are milked during the winter and only 75 percent of the cows are milked in July and August.

It often is necessary, however, to make estimates of labor used without specifically knowing the composition of the herd. In this case, an average composition may be of value. The chore routine and the composition of the average herd in the study are shown in table 4.

If a herd has about the same makeup as the average of those in this study, a 20-cow herd will have approximately 21.4 animals in the stanchions during the winter (107% of 20 = 21.4). All of them would be fed hay and bedded, and the manure from these animals would be hauled from the barn. Also,

Table 4. Chore routine and proportion of animals for which each task is performed for dairy herd, by feeding season

Item	Proportion of animals involved in each task expressed as percentage of cows in herd		
	Winter	Summer	Supplemental‡
	percent		
Animals in stanchions*			
Milking	89	84	.....
Hay feeding	107	98†	98†
Silage feeding	105	.....	.....
Grain feeding	103	95	.....
Manure disposal	107	98	.....
Bedding	107	98	.....
Miscellaneous	107	100	.....
Animals not in stanchions			
Summer			
Pens only	.....	52	.....
Pastured separately	.....	101	.....
Winter, all groups	92	.....	.....
Miscellaneous	92	100	.....
Other routine work	111	103	.....

* Where number of animals exceed 100 percent, animals other than cows in milk occupy stanchions.

† 98 percent of the cows in the herd were fed hay, if any hay was fed. The more usual case was that no hay was fed in summer.

‡ The supplemental season refers to the latter part of the summer, when pastures were supplemented with the feeding of hay.

about 21 animals would be fed silage (105% of 20 = 21). In addition to animals in the stanchions, about 20 others would be cared for during the winter (100% of 20 = 20). The figures for the summer in table 4 can be interpreted similarly, except that the summer hay-feeding season ran from mid-May to mid-September. From mid-September to late October—the supplemental hay-feeding season—pastures did not supply as much feed since earlier and larger quantities of hay were fed.

It should be emphasized that the data in table 4 represent an average herd belonging to the farmers who participated in the study. Dairy herds vary considerably as to composition. Nevertheless, a dairy herd of average composition may be used in making a rough estimate of the amount of labor used during a certain month, season, or year. Tables 5 and 6 are based on this average herd. Those who believe that the makeup of their herd differs from that of the average herd should use tables 10 and 11 instead of tables 5 and 6.

Fitting the Size of the Dairy Herd to the Labor Available in Summer

If labor is in shortest supply in some particular month and if the average composition of the dairy herd, as shown in table 4, adequately describes the situation, table 5 may be used to estimate approximately the amount of labor needed in a week to care for dairy herds ranging from 10 to 40 cows.

Before using tables 5 and 6, however, some general explanations are needed:

1) Milking—The labor needed for milking was divided into two parts, the actual milking and the cleaning and preparation of utensils. The latter includes the washing and rinsing of cans or bulk tank and milking units, as well as the assembly of the milking units.

2) Hay feeding—This includes only the labor involved in throwing hay down from the mow and in the actual feeding of the hay. It does not include the labor required to haul hay into the barn. Hay was stored overhead in the barn on all farms in the study.

3) Silage feeding—This includes the labor used to remove silage from the silo as well as the actual silage feeding. All silos on the farms studied were tower silos.

Table 5. Amount of labor used per week for care of dairy herds, by size of herd, 23-week summer pasture-feeding season

Task and method of performance	Number of cows in herd						
	10	15	20	25	30	35	40
	hours						
MILKING							
1. Two single units, barns with rows arranged lengthwise*	7.8	10.5	13.2	16.0	18.7	21.5	24.2
2. Three single units, one worker, barns with rows arranged lengthwise	.....	6.3	9.4	12.4	15.5	18.6	21.7
CLEANING AND PREPARATION OF UTENSILS							
3. Two single units, manufacturing milk, cans	3.7	3.7	3.7	3.7	3.7	3.7	3.7
4. Two single units, Grade A, can or bulk tank*	4.4	4.4	4.4	4.4	4.4	4.4	4.4
5. Three single units, manufacturing milk cans	4.3	4.3	4.3	4.3	4.3	4.3	4.3
6. Three single units, Grade A bulk tank	5.5	5.5	5.5	5.5	5.5	5.5	5.5
HAY FEEDING, SUMMER							
7. Baled hay, fed inside	1.4	1.4	1.4	1.4	1.4	1.4	1.4
8. Baled hay, fed outside	.9	.9	.9	.9	.9	.9	.9
HAY FEEDING, SUPPLEMENTAL SEASON							
9. Baled hay, fed outside	1.4	1.4	1.4	1.4	1.4	1.4	1.4
10. Baled hay, fed inside once a day	1.1	1.1	1.1	1.1	1.1	1.1	1.1
11. Baled hay, fed inside twice a day	2.6	2.6	2.6	2.6	2.6	2.6	2.6
GRAIN FEEDING							
12. Fed once a day	1.1	1.1	1.1	1.1	1.1	1.1	1.1
13. Fed twice a day*	1.7	1.7	1.7	1.7	1.7	1.7	1.7
MANURE HANDLING							
14. Gutter cleaner	1.6	1.6	1.6	1.6	1.6	1.6	1.6
15. Litter carrier or drive through, Grade A producers*	1.8	1.8	1.8	1.8	1.8	1.8	1.8
16. Litter carrier or drive through, manufacturing milk producers	1.1	1.1	1.1	1.1	1.1	1.1	1.1
BEDDING							
17. Baled and chopped*	.3	.6	.9	1.1	1.4	1.7	1.9
OTHER ROUTINE WORK*							
18.	2.8	2.8	2.8	2.8	2.8	2.8	2.8
CARE OF DAIRY CATTLE NOT IN STANCHIONS							
19. Pens only	1.8	2.7	3.7	4.6	5.6	6.5	7.5
20. Pastured separately only*	.8	1.0	1.2	1.4	1.5	1.7	1.9
MISCELLANEOUS LABOR							
21. Dairy cattle in stanchions*	.6	.6	.6	.6	.6	.6	.6
22. Dairy cattle not in stanchions*	.1	.1	.2	.2	.3	.3	.4
23. Daily rotational grazing*	1.5	1.5	1.5	1.5	1.5	1.5	1.5
24. Feed grinding*	.2	.3	.5	.6	.7	.8	.9
25. Total*	22.0	25.3	28.8	32.1	35.4	38.8	42.1

* Tasks and alternative methods chosen for an illustrative total.

4) Grain feeding—This is the actual grain-feeding time; it does not include the labor used in grinding feed.

5) Manure disposal — The figures shown in tables 5 and 7 include the time used to clean the barn and to haul manure to the field and spread it. In all instances, the manure was dumped directly into the spreader instead of being piled and hauled out later.

6) Other routine work—This category includes a number of jobs done each day but consists primarily of driving cows in and out of the barn.

7) Miscellaneous labor includes a number of nondaily jobs, such as caring for sick animals, spraying for flies, and repairing stanchions.

8) The labor used in caring for dairy cattle not in stanchions includes all tasks—feeding hay, silage, grain, milk, and cleaning pens.

9) For some tasks, the amount of labor used was found not to be significantly related to herd size. In these cases, the same figures are used in the 10-cow column as in the 40-cow column of tables 5 and 7.

The data in table 5 may be used in studying a situation in which labor is the limiting factor for a particular summer month. To estimate the amount of labor used in one week, mark the line which describes the way each task is done. Next, in the column which specifies the size of herd for which the estimate of labor used is desired, add the figures in the lines marked. For example, if milking is done with two units and one worker, mark line 1. If Grade A milk is produced, mark line 4. If no hay is fed in summer, this task may be ignored. If grain is fed twice a day, mark line 13. If manure disposal is with a litter carrier or drive-through arrangement and Grade A milk is produced, mark line 15. Similarly, indicate the other jobs to be included, such as bedding, other routine work, care of dairy cattle not in stanchions and pastured separately, miscellaneous labor, and daily rotational grazing.

An additional task included in chore labor was feed grinding. The labor used for grinding feed included (1) the removal of grain from the crib or granary, (2) the grinding time, and (3) the transfer of ground feed to the feed room. This amounted to 1.24 hours per ton. In order to put this on a per cow basis, something must be known about the level of grain feeding. If grain is fed at the rate of 39 pounds per cow per week in summer (23 weeks) and 52 pounds per cow per week in winter (29 weeks), the result would be 2,405 pounds of grain fed per cow per year. Only 19 cows (95 percent of a 20-cow herd as shown in table 4) were fed grain during the summer. Nineteen cows fed 39 pounds of grain per week would consume a total of 741 pounds of grain, or 0.37 ton per week. At 1.24 hours per ton, this would take 0.5 hours. Other figures in the feed-grinding row were computed similarly.

Once the procedures are specified, an addition of the marked lines in the 10-cow column gives the estimated total amount of labor per week needed to care for a 10-cow herd—22.0 hours. Similarly, the amount of labor used in caring for a 15-cow herd would be 25.3 hours a week. Increasing the herd size from 10 to 15 cows takes an extra 3.3 hours of labor per week, or $\frac{3.3}{5} = .7$ hour per additional cow. Thus the labor involved in caring for 11 cows would be 22.0 + .7, or 22.7 hours. With only about 95 hours a month available for livestock production, as in the case of the farm used as an example, an 11-cow herd would be the largest possible herd using these procedures. But it should be emphasized that with these procedures and equipment, each additional 5 cows take approximately only 3.3 hours per week, about 30 minutes a day, or less than 14 hours a month. By working less than one additional hour per day, a farmer could increase his herd from 11 to 21 cows. A similar effect could be achieved if other family labor were available to take care of the grain feeding and cleaning and preparation of milking utensils. Therefore, it would be realistic to plan the size of a dairy herd on the basis of some flexibility in the 95 hours of labor.

Since labor is scarce in certain months, procedures must be planned to overcome these bottlenecks if the herd size is to be expanded. In some instances, family labor or the operator working longer hours may take care of the labor shortage. In other instances, changes in equipment or procedures may be necessary. In summer, however, opportunities to save labor by this method are limited. For example, substituting a gutter cleaner for a litter carrier would save only about 0.2 hour per week (1.8 — 1.6 = 0.2 hour). Feeding grain only once a day rather than twice would save only 0.6 of an hour a week regardless of herd size. Substituting conventional grazing for daily rotational grazing would save only 1.5 hours a week. The only opportunity shown in table 5 to reduce substantially the labor needed to care for the dairy herd would be to change from two to three milking units. But this change would also involve some risk or difficulty in that the use of three single units by one worker commonly results in the milker being left on the cow beyond the normal milk-out period. This may result in some damage to the udder. For this reason, the practice is not generally recommended. Consequently, it is probable that on a dairy farm with a stanchion barn the best opportunity to reduce the labor load during the summer is with labor-saving machinery in fieldwork.

Nevertheless, if three units were to be used the labor involved could be estimated from table 5. For example, the milking of a 20-cow herd producing Grade A milk with two units used, along with the cleaning and preparation of utensils, would be 17.6 hours (13.2 + 4.4). With three units, the labor used for milking and cleaning would be 14.9 hours (9.4 + 5.5). The labor saved by substituting three units for two would be 2.7 hours per week. Subtracting 2.7 from the total of 28.8 hours per week for a 20-cow herd would leave about 26.1 hours per week to care for the herd. Similar calculations would provide estimates of labor saved with other herd sizes. But it should be recognized that the figures for milking with three units are based on fewer herds and hence may not be as representative as those covering herds for which two units were used. More specifically, stopwatch timing procedures indicate that the estimates of labor obtained in this study for small herds tend to be on the low side and on the high side for larger herds. Still, it appears that some savings in labor may be gained by switching to three single units.

The information in table 5 can also be used in estimating the amount of labor used for the entire summer as well as for any particular month. Suppose a southern Minnesota farmer with a 20-cow dairy herd wants to estimate the amount of labor used on his herd during the summer pasture-feeding season. Suppose also that the pasture-feeding season will run for 23 weeks with

Table 6. Estimated hours of chore labor needed for dairy herds, selected farm procedures, 23-week pasture-feeding season*

Cows in herd	Labor used	
	Total	Per cow
number	hours	
10	514.5	51.4
15	590.7	39.4
20	671.2	33.6
25	747.1	29.9
30	823.0	27.4
35	901.2	25.7
40	977.9	24.5

* Procedures are those marked in table 5.

ration-a-day grazing[3] used for the first 15 weeks. In the last 8 weeks of the season, ration-a-day grazing is replaced by continuous grazing and supplementary hay feeding twice a day inside the barn. Check off all the pertinent figures under "20-cow herd" in table 5. If those checked are the same as the previous example using table 5, 28.8 hours of labor per week are used during the ration-a-day grazing period. This is 432 hours for the 15 weeks. For each of the 8 weeks of supplementary hay feeding, subtract 1.5 hours for eliminating the ration-a-day grazing and add 2.6 hours hours for feeding hay inside twice a day. This adds up to 29.9 hours per week or 239.2 hours for the 8 weeks. Adding this to the time used for the other 15 weeks gives a total of 671.2 hours for the 23-week pasture season.

Calculations for other herd sizes would result in the figures shown in table 6. Similar estimates could be made for the use of different equipment or different work procedures.

Fitting the Size of the Dairy Herd to the Labor Available in Winter

On many farms, the hiring of custom work or the availability of additional family or hired labor effectively eliminates the scarcity of labor during the summer. As a result, the size of the farm business may be expanded to the point at which the availability of labor during the winter is a limiting factor. In this instance the use of table 7 will provide a means of estimating the labor used for various herd sizes and with differing equipment or work procedures.

As in table 5, the method of caring for the dairy herd is described in table 7 by marking the appropriate row for each task. For example, if the milking is done by one worker using two single units, the row with figures from 7.9 to 29.6 would be designated. Again, estimates must be made of the labor for feed grinding. Suppose a farmer wants to estimate the labor for a 20-cow herd. Other animals in the stanchions are often fed grain. According to table 4, on the average, the total number of animals fed grain is 103 percent of the number of cows in the herd. For a 20-cow herd, this means that in an average week 20.6 animals in the stanchions are fed grain. If each animal is fed at the rate of 52 pounds of grain per week, this would amount to 1,071 pounds, or 0.54 tons, of grain per week. With 1.24 hours needed to grind a ton of feed, it takes 0.7 hours to grind feed for a 20-cow herd.

After selecting the method of caring for the dairy herd by marking the appropriate rows in table 7 as was done for summer work using figures in table 5, the total labor for herds of various sizes may be estimated by adding the designated rows for each herd size. Thus, for the system of management illustrated in table 7, the chore labor for a 20-cow herd would be 44.0 hours per week. Five additional cows would take 6.3 more hours per week. Each extra cow would take only 1.2 hours ($6.3 \div 5 = 1.3$). Therefore, a 21-cow herd would take 45.3 hours (44.0 hours for the 20 cows and only 1.3 additional hours for the additional cow).

[3] Ration-a-day grazing is the name for a system of intensive management in which a new strip of pasture is opened for grazing each day. This system, also known as strip grazing and daily rotational grazing, provides enough forage for the daily ration.

Table 7. Labor used per week, for chore work on dairy herds, by specified size of herd, 29-week winter barn-feeding season

Task and method of performance	Number of cows in herd						
	10	15	20	25	30	35	40
	hours						
MILKING							
1. Two single units, worker, barns with rows arranged lengthwise*	7.9	11.5	15.1	18.7	22.3	25.9	29.6
2. Three single units, 1 worker, barns with rows arranged lengthwise	....	7.7	10.9	14.1	17.4	21.6	23.8
CLEANING AND PREPARATION OF UTENSILS							
3. Two single units, manufacturing milk, cans	3.6	3.6	3.6	3.6	3.6	3.6	3.6
4. Two single units, Grade A milk, cans or bulk tank*	5.1	5.1	5.1	5.1	5.1	5.1	5.1
5. Three single units, manufacturing milk, cans	4.4	4.4	4.4	4.4	4.4	4.4	4.4
6. Three single units, Grade A milk, bulk tank	6.0	6.0	6.0	6.0	6.0	6.0	6.0
HAY FEEDING							
7. Baled hay, fed once a day	1.3	1.5	1.6	1.8	2.0	2.2	2.4
8. Baled hay, fed twice a day*	1.9	2.0	2.2	2.4	2.6	2.8	3.0
SILAGE FEEDING							
9. Mechanical unloader with cart	1.4	1.7	2.1	2.4	2.7	3.0	3.4
10. Manually unloaded with cart*	2.1	2.4	2.7	3.0	3.3	3.7	4.0
GRAIN FEEDING							
11. Fed once a day	.8	1.0	1.2	1.4	1.6	1.8	2.0
12. Fed twice a day*	1.4	1.6	1.8	2.0	2.2	2.4	2.6
MANURE HANDLING							
13. Gutter cleaner	2.9	3.3	3.6	3.9	4.3	4.6	5.0
14. Litter carrier or drive through*	4.1	4.8	5.5	6.1	6.8	7.4	8.1
BEDDING							
15. Baled and chopped (composite)*	1.4	1.5	1.7	1.9	2.0	2.2	2.3
OTHER ROUTINE WORK*							
16.	1.2	1.5	1.8	2.1	2.4	2.7	3.0
CARE OF DAIRY CATTLE NOT IN STANCHIONS*							
17.	4.5	5.3	6.2	7.0	7.8	8.7	9.5
MISCELLANEOUS LABOR							
18. Dairy cattle in stanchions*	1.0	1.0	1.0	1.0	1.0	1.0	1.0
19. Dairy cattle not in stanchions*	.2	.2	.2	.2	.2	.2	.2
20. Feed grinding*	.3	.5	.7	.8	1.0	1.2	1.3
21. Total*	31.1	37.4	44.0	50.3	56.7	63.3	69.7

* Tasks and alternative methods chosen for an illustrative total.

Table 8. Effect on chore labor of substituting a gutter cleaner for a litter carrier, by size of dairy herd, for a 29-week winter barn-feeding season

Item	Number of cows in herd						
	10	15	20	25	30	35	40
	hours						
Total chore labor with litter carrier	31.1	37.4	44.0	50.3	56.7	63.3	69.7
Less manure disposal with litter carrier	4.1	4.8	5.5	6.1	6.8	7.4	8.1
Total chore labor without manure disposal	27.0	32.6	38.5	44.2	49.9	55.9	61.6
Manure disposal with gutter cleaner	2.9	3.3	3.6	3.9	4.3	4.6	5.0
Total chore labor with gutter cleaner	29.9	35.9	42.1	48.1	54.2	60.5	66.6

Table 9. Estimated chore labor needed for dairy herds, by size of herd, winter and summer seasons, and total for the year

Cows in herd	Labor needed			Annual labor per cow	
	Barn-feeding season, 29 weeks	Pasture-feeding season, 23 weeks	Total annual	With equipment*	With equipment†
number			hours		
10	901.9	514.8	1,416.7	141.7	131.9
15	1,084.6	590.7	1,675.3	111.7	106.4
20	1,276.0	671.2	1,947.2	97.4	94.3
25	1,458.7	747.1	2,205.8	88.2	86.4
30	1,644.3	823.0	2,467.3	82.2	81.5
35	1,835.7	901.2	2,736.9	78.2	77.9
40	2,021.3	977.9	2,999.2	75.0	75.2

* Procedures and equipment are those marked in table 5 for the pasture-feeding season and table 7 for the barn-feeding season.

† Procedures and equipment for this column are the same as for table 1. Items 1, 3, 7, 12, 16, 17, 18, 19, 21, 22, 23, and 24 in table 5 are used for the summer season; items 1, 3, 7, 9, 11, 14, 15, 16, 17, 18, 19, and 20 in table 7 for the winter season.

A comparison of the total labor shown in tables 5 and 7 indicates a considerably higher labor load in caring for the dairy herd during the winter. However, there are also many opportunities to reduce the labor used during the winter months. Hay feeding can be reduced to once-a-day feeding, saving about 0.6 hour per cow per week. Feeding grain only once a day and using a silo unloader will also save small amounts of labor. A gutter cleaner instead of a litter carrier would save 1.2 to 3.1 hours a week during the winter barn-feeding season, depending on the size of the herd. The effect on total chore labor of substituting a gutter cleaner for a litter carrier is shown in table 8.

The amount of labor used for manure disposal with the litter carrier as shown in table 8 is replaced by estimates of the labor used with a gutter cleaner. This method of substitution can be used to develop estimates of total chore labor for several combinations of equipment and work procedures.

The data in table 7 can be used also to estimate total chore labor for the entire barn-feeding season. For example, with the equipment and procedures specified in table 7, the chore labor for a 20-cow herd during the 29-week barn-feeding season would be approximately 1,276 hours ($44 \times 29 = 1{,}276$).

The results of similar calculations for other herd sizes are shown in table 9, column 2. When combined with those in table 6 for the summer pasture-feeding season these figures provide labor estimates on an annual basis (columns 4 and 5).

The data in column 5 of table 9, like those in table 1 (reproduced in the last column of table 9) for another set of equipment arrangements and procedures, indicate rather substantial savings in labor per cow as the size of the dairy herd is increased. As indicated in column 5, a 15-cow herd took about 112 hours per cow, but each additional cow took only about 53 hours. If a farmer with a 15-cow herd using 112 hours per cow, as in column 5, used his average for a 15-cow herd to predict the amount of labor for a 20-cow herd, the estimated chore labor would be 2,240 hours (112 hours per cow $\times$ 20 cows = 2,240 hours). When this is compared with 1,947 hours in column 4, it indicates that the use of a constant average per cow would overestimate the amount of labor used by approximately 300 hours.

Even though the additional labor for expanding a dairy herd is relatively small, 53 hours per year for each extra cow as shown in table 9, this does not mean that labor is an unimportant factor to consider when expanding the size of a dairy herd.[4] Labor bottlenecks, or periods of labor scarcity, sometimes make an extra hour or two of labor valuable. For example, suppose that the hay, grain, and building space would allow an expansion in the dairy herd but that in November labor is particularly scarce. As indicated in table 7, an extra 5 cows take about 6.3 hours of labor, or an extra cow takes about 1.3 hours of labor per week. Each extra cow would then take about 5.4 additional hours during the month. If during the year each additional cow produced 10,000 pounds of milk and this milk sold for 3.25/cwt., this would mean an additional gross income of $325.00 per year. This could easily mean an extra net cash income of approximately $250. Clearly, in this instance, an extra hour of labor during the month in which labor is more limiting could increase net cash income by as much as $50. Therefore, in some instances, the return of an extra hour of labor worked or the value of extra labor replaced by investment in labor-saving equipment may be quite high.

A striking fact brought out in these tables is the slight difference in amounts of labor used for alternative equipments or procedures. For example, when compared with the litter carrier, the gutter cleaner, one of the biggest labor savers, saved only about 2.8 hours a week on a 35-cow herd. But when due consideration is given to bottlenecks, or scarce periods of labor, this may be a significant saving. In fact, during the winter months 2.8 hours of labor per week with the equipment specified in table 7 are more than enough to care for two additional cows. In some instances, the additional net cash income from these two extra cows can readily pay for a gutter cleaner. However, the traditional laborsaving devices in a stanchion barn—a gutter cleaner and silo unloader—save labor primarily in winter. In winter, labor ordinarily is not a limiting factor, unless the size of the farm business has been expanded to use labor that is available only in summer. Therefore, only the farms that use hired labor or additional family labor in the summer are likely to have labor shortages in the winter. On these farms, there is a considerable possibility that laborsaving devices can be installed profitably.

On other farms, these laborsaving devices may be justified, not on the basis of the time saved, but on the basis of ease of work. For example, it is possible that in some instances the dairy herd would need either to be elimi-

[4] 30 additional cows take 1,582.5 extra hours per year ($2{,}992 - 1{,}416.7 = 1{,}582.5$ hours) or about 53.0 extra hours per cow ($1{,}582.5 \div 30 = 52.8$ hours).

nated or drastically reduced if silage had to be removed from the silo by hand. Thus, some pieces of laborsaving equipment may be economically justified even if the labor saved has no alternative use.

In other instances, laborsaving devices may be justified not as a productive resource but as an article of consumption. Obviously, the study reported provided no information on ease of work with various equipments or procedures. Nor was chore equipment studied as an article of consumption. Yet both these aspects of laborsaving equipment may be important considerations in decisions that involve the purchase of such equipment.

For those interested in timesaving changes in procedures or equipment, the data in tables 5 and 7 can be combined in a number of ways to give estimates of labor used for a variety of equipment and work procedures. But in using these tables, several factors must be considered. Some of them tend to increase the usefulness of the information, and some tend to limit the range of its use:

1) The herd sizes in the study reported ranged from 10 to 40 cows. These data should not be used beyond this range.

2) The results of the study did not indicate any significant difference between the time used to perform each task in rows arranged lengthwise and rows arranged crosswise of the barn. Therefore, the figures in tables 5 and 7 can be used for either barn arrangement.

3) In milking, the use of additional men per unit, either two men per three units or some extra help per two units, meant more man-hours of labor per cow milked. However, the data derived from the study were inadequate to provide reliable estimates of how much more labor would be used.

4) The feeding of chopped hay required more labor than baled hay. However, the data derived from the study did not provide as reliable estimates of the additional labor used as might be desired.

5) Although the data derived from the study did not provide reliable estimates of the amount of labor saved by a silage cart, there was evidence that silage carts did save some labor.

6) Although in grain feeding the amount of labor used with a feed cart did not differ significantly from that when no feed cart was used, a higher proportion of those farmers with large herds tended to use a feed cart.

7) For manure disposal, there was no significant difference between the amount of labor used with a litter carrier and with a drive-through arrangement. Also, during the summer Grade A producers used more labor than other producers because they cleaned the barn daily.

Estimating Labor Used on Herds with Other Than Average Composition

An important factor that affects the chore labor for a dairy herd is the structure or makeup of the herd. The data presented earlier in this bulletin were based on the structure of an "average herd." Because such things as the distribution of calving throughout the year vary from farm to farm,

Table 10. Number of hours of labor per week used to perform specified tasks for the dairy herd, by size of herd, summer pasture-feeding season

Task and description of method	Number of animals involved in the task							Labor per extra animal
	10	15	20	25	30	35	40	
	hours							
MILKING								
1. Two single units, barns with rows arranged lengthwise	8.8	12.1	15.3	18.6	21.8	25.1	28.4	0.65
2. Three single units, 1 worker, barns with rows arranged lengthwise	4.4	8.0	11.7	15.4	19.1	22.7	26.4	0.74
CLEANING AND PREPARATION OF UTENSILS								
3. Two single units, manufacturing milk, cans	3.7	3.7	3.7	3.7	3.7	3.7	3.7	.....
4. Two single units, Grade A, cans or bulk tank	4.4	4.4	4.4	4.4	4.4	4.4	4.4	.....
5. Three single units, manufacturing milk, cans	4.3	4.3	4.3	4.3	4.3	4.3	4.3	.....
6. Three single units, Grade A bulk tank	5.5	5.5	5.5	5.5	5.5	5.5	5.5	.....
HAY FEEDING, SUMMER								
7. Baled hay, fed inside	1.4	1.4	1.4	1.4	1.4	1.4	1.4	.....
8. Baled hay, fed outside	.9	.9	.9	.9	.9	.9	.9	.....
HAY FEEDING, SUPPLEMENTAL SEASON								
9. Baled hay, fed outside	1.4	1.4	1.4	1.4	1.4	1.4	1.4	.....
10. Baled hay, fed inside once a day	1.1	1.1	1.1	1.1	1.1	1.1	1.1	.....
11. Baled hay, fed inside twice a day	2.6	2.6	2.6	2.6	2.6	2.6	2.6	.....
GRAIN FEEDING								
12. Fed once a day	1.1	1.1	1.1	1.1	1.1	1.1	1.1	.....
13. Fed twice a day	1.7	1.7	1.7	1.7	1.7	1.7	1.7	.....
MANURE HANDLING								
14. Gutter cleaner	1.6	1.6	1.6	1.6	1.6	1.6	1.6	.....
15. Litter carrier or drive through, Grade A producers	1.8	1.8	1.8	1.8	1.8	1.8	1.8	.....
16. Litter carrier or drive through, manufacturing milk producers	1.1	1.1	1.1	1.1	1.1	1.1	1.1	.....
BEDDING								
17.	.3	.6	.8	1.1	1.3	1.6	1.8	0.05
OTHER ROUTINE WORK*								
18.	2.8	2.8	2.8	2.8	2.8	2.8	2.8	.....
CARE OF DAIRY CATTLE NOT IN STANCHIONS								
19. Pens only	3.5	5.4	7.2	9.0	10.9	12.7	14.5	0.37
20. Pastured separately only	1.2	1.5	1.8	2.2	2.5	2.8	3.2	0.07
MISCELLANEOUS LABOR								
21. Dairy cattle in stanchions	.6	.6	.6	.6	.6	.6	.6	.....
22. Dairy cattle not in stanchions	.1	.1	.2	.2	.3	.3	.4	0.01
23. Daily rotational grazing (only one sort)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	.....
24. Feed grinding (at 1.24 hours per ton)	.2	.4	.5	.6	.7	.9	1.0	.024

and because these changes in structure of the herd affect the distribution of labor, the following tables are presented. These tables are not on a per cow-in-the-herd basis. Instead, they are based on the number of animals involved in each task. For example, in table 10, if two single units are used by one man to milk ten cows, he would be expected to use about 8.8 hours a week in doing the task. The last column is used in estimating the labor used for animal numbers between those shown in the table. For example, if 12 cows are milked, the estimated time would be:

	Hours per week
10 cows	8.8
2 additional cows (.65 × 2)	1.3
Total 12 cows	10.1

Similarly, if 20 calves were cared for in pens, it would be expected to take 7.2 hours per week and 21 calves would take 7.6 hours (7.2 + .37 = 7.6). (See line 19, table 10.) Whatever combination of cows milked, animals in stanchions fed grain, hay, and silage, and calves and young stock cared for, tables 10 and 11 can be used. However, one does need to know the number of animals involved in each task for which there is a relationship to the number of animals involved.

To illustrate the use of these tables, suppose we want to estimate the chore labor for the following situation: (1) winter labor is scarce (therefore, we use table 11); (2) about 20 cows are milked in winter; (3) the 25-stanchion barn is filled by keeping five dry cows and heifers in the stanchions; (4) all animals in the stanchions are fed grain and hay, but only those cows in milk are fed silage; (5) 15 head of calves and young stock are cared for.

By designating a figure in row 1 of table 11, we specify milking by one worker with two single units. By selecting a figure in the 20 column, we specify that 20 cows were milked. Similarly, the method of doing the other tasks and the number of animals involved are specified as shown in table 11. Then by adding the designated figures, it is estimated that 42.8 hours of chore labor per week would be used for a herd of this kind during the winter season.

Tables 10 and 11 allow considerable flexibility in making estimates of labor use. If, for example, four of the dry cows in this illustration calved in January, this could be reflected easily in the labor estimates for the rest of the winter season.

	Hours per week
Total labor per week before January	42.8
4 additional cows milked at 0.81 hour per cow	3.2
4 additional cows fed silage at 0.06 hour per cow	.2
4 additional calves at .18 hour per calf	.7
Total labor per week in January	46.9

In addition, these tables, like tables 5 and 7, can be used for different climatic conditions by adjusting the number of weeks in the winter and summer seasons to fit local conditions.

Any dairy farmer may choose from tables 4, 5, and 7 or from tables 10 and 11 a situation or setup that most nearly approximates his own. From these tables he can estimate the labor that would be needed to care for his dairy herd in this situation or setup. He can also use these tables in estimating the labor that would be used with any other types of equipment, procedures, size of herd, and even composition of herd that he is considering in an effort to maximize his returns from dairying.

Table 11. Number of hours of labor per week used to perform specified tasks for the dairy herd, by size of herd, winter barn-feeding season

Task and description of method	Number of animals involved in the task							Labor per extra animal
	10	15	20	25	30	35	40	
	hours							
MILKING								
1. Two single units, one worker, barns with rows arranged lengthwise	8.8	12.8	16.9*	21.0	25.0	29.1	33.1	0.81
2. Three single units, one worker, barns with rows arranged lengthwise	5.3	8.9	12.5	16.1	19.8	23.4	27.0	0.72
CLEANING AND PREPARATION OF UTENSILS								
3. Two single units, manufacturing milk, cans	3.6	3.6	3.6*	3.6	3.6	3.6	3.6	.....
4. Two single units, Grade A milk, cans or bulk tank	5.1	5.1	5.1	5.1	5.1	5.1	5.1	.....
5. Three single units, manufacturing milk, cans	4.4	4.4	4.4	4.4	4.4	4.4	4.4	.....
6. Three single units, Grade A milk, bulk tank	6.0	6.0	6.0	6.0	6.0	6.0	6.0	.....
HAY FEEDING								
7. Baled hay, fed once a day	1.2	1.4	1.6	1.8*	1.9	2.1	2.3	0.04
8. Baled hay, fed twice a day	1.8	2.0	2.2	2.4	2.5	2.7	2.9	0.04
SILAGE FEEDING								
9. Mechanical unloader with cart	1.4	1.7	2.0*	2.3	2.6	2.9	3.2	0.06
10. Manually unloaded with cart	2.0	2.3	2.6	2.9	3.3	3.6	3.9	0.06
GRAIN FEEDING								
11. Fed once a day	.8	1.0	1.2	1.4*	1.6	1.8	2.0	0.04
12. Fed twice a day	1.4	1.6	1.8	2.0	2.2	2.3	2.5	0.04
MANURE HANDLING								
13. Gutter cleaner	2.9	3.2	3.5	3.8	4.2	4.5	4.8	0.06
14. Litter carrier or drive through	4.1	4.7	5.3	5.9*	6.5	7.1	7.8	0.12
BEDDING								
15. Baled and chopped (composite)	1.4	1.5	1.7	1.8*	2.0	2.1	2.2	0.03
OTHER ROUTINE WORK*								
16.	1.1	1.4	1.7	1.9*	2.2	2.5	2.8	0.06
CARE OF DAIRY CATTLE NOT IN STANCHIONS								
17.	4.6	5.5*	6.4	7.3	8.2	9.1	10.1	0.18
MISCELLANEOUS LABOR								
18. Dairy cattle in stanchions	1.0	1.0	1.0	1.0*	1.0	1.0	1.0	.....
19. Dairy cattle not in stanchions	.2	.2*	.2	.2	.2	.2	.2	.....
20. Feed grinding (at 1.24 hours per ton)	.3	.5	.6	.8*	1.0	1.1	1.3	.03

* Tasks and alternative methods chosen for an illustrative total.

Summary

Recent trends in dairying in Minnesota have been toward fewer but larger dairy herds and increased production per cow.

The many new techniques introduced into dairy production may involve increased capital investment but may reduce labor requirements.

Since labor is a limiting factor on most farms, the study reported was designed to determine potential labor economies resulting from increased size of herd and adoption of new techniques of production.

Because dairy labor requirements are characterized by seasonal variations, labor inputs for the pasture- and barn-feeding seasons are shown separately.

The percentage distribution of labor utilization by crops and for miscellaneous operations in southern Minnesota is shown as a basis for locating periods of heavy or slack labor demand.

Illustrations are presented of how these data can be used effectively in selecting the operations and the size of herd that best fit any particular farm.

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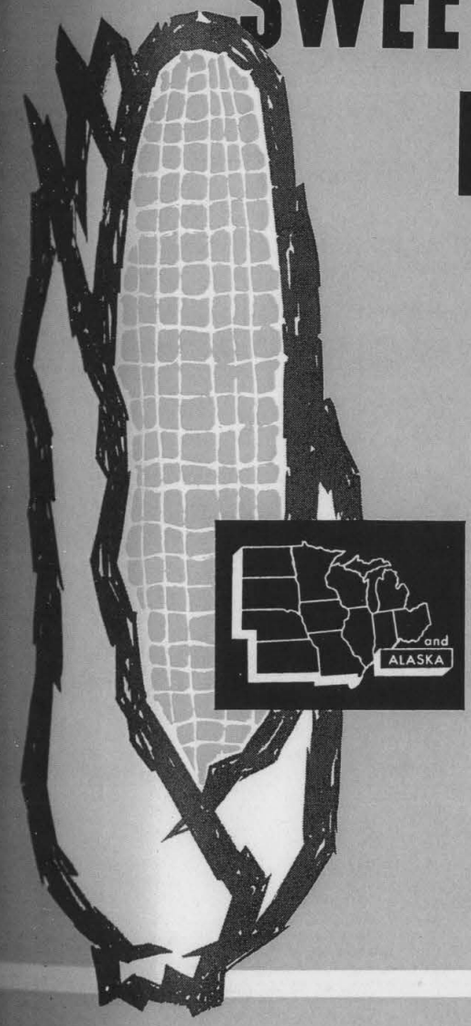

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