ditures on the National School Lunch and Special Milk Programs are included, the total cost of demand expansion efforts is about $825 million. The combination of expanded operation of the two nutrition programs and a 10-percent decline in the price of meats (the least expensive price reduction proposed) gives an increase in total resource use of 3.1 percent at a cost of about $1,000 million. When current expenditures on the two nutrition programs are included, total costs are about $1,175 million.

Summary

Demand expansion programs could partially eliminate surplus agricultural production and improve human nutrition. However, total food consumption is highly unresponsive to changes in price and income. Large variations are needed to achieve a small change in total food consumption. Reasonable levels of expenditure on proposals to: (1) subsidize food consumption of low income groups, (2) lower food prices, or (3) provide better nutrition could reduce annual agricultural surpluses by approximately one-fourth or possibly one-third.

Proposals for subsidizing food consumption of low income groups would increase total food consumption and attack nutritional shortages. Estimates regarding a specific income subsidy program—a Food Allotment Program—indicate that even at low levels of operation it would cost about $550 million to get a 1-percent increase in food consumption.

Lowering retail food prices without reducing farm incomes is an even less effective approach to elimination of surpluses. Even if all retail food prices declined 20 percent, consumption would increase only 4.6 percent. And, such price programs are administratively complex and expensive. Moreover, such a program contains no direct attack on nutritional shortages.

Proposals emphasizing good nutrition for everyone **could** result in **decreases** in total food consumption. However, such results are very improbable. Two current programs for better nutrition, the National School Lunch and Special Milk Programs, could be expanded. They directly attack the problem of nutritional shortages and, moreover, operate with the group that can benefit most—the Nation's elementary and secondary schoolchildren. However, expansion of these programs would not greatly increase total food consumption.

The people of the United States, in general, are well fed. Improving consumer diets through increasing food consumption will not result in even moderate increases in total food consumption. However, welfare considerations may be of equal or greater importance than elimination of surpluses. Demand expansion proposals simultaneously attack both problem areas. Therefore, the extent to which demand expansion efforts can reduce the agricultural surplus mainly depends on how seriously the public views the problem of nutritional shortages and the amount it is willing to spend to remedy this problem.

A complete discussion of the research procedures and results summarized in this bulletin is contained in: *Policies for Expanding the Demand for Farm Food Products in the United States: Part I. History and Potentials* and *Part II. Programs and Results*, Univ. of Minn. Tech. Bul. 231 and 238, respectively.

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Alternative Dairy Chore Systems in Loose Housing

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Agricultural Experiment Station
in cooperation with
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CONTENTS

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FOREWORD

The authors examine 10 dairy chore systems in this bulletin: a typical Minnesota stanchion barn system, a mechanized stanchion modification, and eight loose housing alternatives. Changes in work procedures are emphasized.

These systems are compared as **alternatives for expanding herd size.** The results show that loose housing either with switch milking or with a low-cost, level-floor parlor is a favorable investment alternative for farms with ample labor for expansion. The capital required to expand a 20-cow typical stanchion barn system to a 30-cow switch system or a low-cost, level-floor parlor system can be repaid in about 2 to 2½ years. This is a shorter repayment period than for any other system.

If extra labor for expansion must be charged against the added income, then low-cost, level-floor parlor systems are still favorable, while the switch milking system no longer shows up as well. When labor is charged, the new investment for changing to a switch milking system and expanding to 30 cows pays for itself in about 6 years. However, less than 4 years are required with the level-floor parlor systems.

The comparative analysis suggests that the more expensive, improved forage feeding and herringbone parlor systems do not appear favorable unless the herd is expanded from 20 up to 40 or even 60 cows, despite the fact that these systems require relatively less labor per cow added to the herd. A farmer handling a 20-cow herd in a typical stanchion barn system can hardly expect these more expensive systems to pay for themselves in less than 8 to 9½ years if he changed to one of them and expanded his herd to 30 cows. This length of repayment period is based on the assumption that change in chore system is accompanied by a shift from the sale of grade B milk to grade A; without this shift even more time would be required. However, a changeover to one of these more expensive systems and an expansion of herd size from 20 to 40 cows reduces the time for the investment to pay off to 6 or 7 years. Increases in production per cow or per forage acre should make the investments in these more expensive systems pay for themselves more quickly, but were not taken into account.

The chore systems are also compared on the basis of labor requirements for a given herd size. This comparison suggests that the mechanized stanchion barn chore system makes relatively efficient use of labor. However, the level-floor parlor arrangements show up even better in most comparisons—without considering the added flexibility of these arrangements.

With the typical stanchion barn system and a 40-cow herd as a base for comparison, the capital required to mechanize can be repaid in about 11 years from the value of the labor saved. However, the value of the labor saved in a 40-cow herd by changing over to a level-floor parlor system can pay off the new investment in 8 years. But as many as 13 to 18 years are required before the value of the labor saved pays off the relatively high investments incurred when changing over to the improved forage feeding and herringbone chore systems.

These findings suggest that with a fixed investment in a typical stanchion barn system, sizable increases in herd size along with premium payments for milk are usually necessary to make investments in alternative high-capital-using chore systems appear favorable.

Alternative Dairy Chore Systems In Loose Housing

E. I. Fuller and H. R. Jensen[1]

CHANGE is a never-ending process. Hence, the farm manager must stay alert and keep himself constantly informed about the new alternatives opening up for him. He needs information to help him adjust to changing conditions and to help him decide which changes will improve his farming operations. Adjusting the dairy farm business to change often calls for reorganization of farm enterprises or substitution in farming practices. In these adjustments, labor requirements are, in most instances, modified.

This bulletin provides labor and equipment data and illustrates how these data can be used for evaluating alternative labor and equipment systems, especially in loose housing dairying. The systems outlined represent some of the major dairy enterprise adjustment alternatives considered by Minnesota dairymen.

Nine adjustment alternatives are discussed with the base from which these adjustments are measured—a typical stanchion barn setup with a 20-cow herd producing grade B milk.

The alternative systems are compared with the base system and evaluated in terms of changes in labor, capital costs, and returns. These evaluations are made for two situations commonly experienced by dairymen: (1) the operator wants to increase his herd size, is willing to provide more capital and labor for this adjustment, and therefore is interested in analyzing alternative systems, and (2) the dairyman wants to reduce the amount of labor annually used for dairy chores so that he can divert some of this chore labor to other uses. For this reason he is interested in an analysis of alternative systems. Comparisons of alternatives are made to suggest how other chore systems not specifically mentioned here also can be evaluated.

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The Intended Use, Source, And Analysis Of The Data

While labor data form the basic information upon which this study is based, they are only part of the data needed for planning and budgeting changes in farm organization and operation. Information on prices, amounts, and kinds of equipment used with or instead of labor is also needed.

To help assure that the data in this bulletin are put to practical use we have presented on pages 7-10 an example of how the labor data in this study were put together to form estimates of total chore labor for a system. The data are in tables 1 to 5 in Appendix B.[2]

From July 1958 to June 1959, 108 Minnesota dairymen with loose housing systems[3] cooperated with the Department of Agricultural Economics and the Agricultural Research Service, USDA, by recording the time required to do dairy chores on their farms. During 1 week of each month over this period the dairymen recorded the time used for regular chore tasks such as milking and feeding. This information was recorded on specifically designed forms. The dairymen also recorded on a separate form the time used for irregular chore tasks such as hauling manure and opening silos.

Each month the dairymen sent their records to the Department of Agricultural Economics. These records were checked immediately by the research supervisor and any questions were answered through correspondence or through visits.

These records were classified by work procedures, building arrangements, and equipment setups used by the dairymen and by types and forms of feeds, bedding, and other items handled by them.

Herds in the sample ranged from 20 to 80 milk cows. The average was 44.

Most of the dairymen had used loose housing for fewer than 5 or 6 years. They are progressive dairymen, intent on objectively evaluating the farm management alternatives open to them. Their farms are in most of the major dairy areas: from Winona County west to Ottertail, from Waseca County north to Pine, and in the southwestern corner of the state.

This study was designed to show the effect of herd size on chore labor in loose housing. A previous study, reported in Station Bulletin 449, was designed to show how herd size influences chore labor in stanchion barns.

Source of Capital Information

The analysis in this bulletin also required the figuring of some capital costs. These calculations should be considered illustrative in nature even though they do reflect the costs on particular farms.

The cost calculations are based on the following conditions: (1) that the sizes

[2] The labor data presented here not only are of use in evaluating total dairy chore systems but can be used for making chore-by-chore comparisons. These comparisons should help answer the following:
(a) How much labor is needed in various milking parlors?
(b) Which of the several summer feeding methods require the least labor?
(c) How much extra labor is required to expand herd size?
(d) Can changes be made that will save labor with little increase in other costs?
(e) How can changes be made to provide flexibility for future adjustments?
(f) In what phases of chore work do work study and materials-handling principles offer most opportunities for saving work?

[3] A special note of appreciation is extended to the dairymen cooperators.

and capacities of the facilities for which investments are made are adequate to handle the size of herd (20 to 40 cows) being discussed, (2) that the dairyman will provide the farm labor to construct minor changes in facilities; major changes will require hiring some construction labor, (3) that the facilities are used at capacity: in this way, the costs of alternative investments can be compared uniformly or on a like basis, and (4) that these costs illustrate the major but not all of the facility costs that a dairyman needs to account for in evaluating alternative chore systems.[4]

Method of Analyzing Labor Data

In this study, data were obtained on time required for each separate task or chore in loose housing, such as hay feeding, silage feeding, milking, and grain grinding. Regular chores such as the first three were reported for 1 week of each month for a year. Irregular work like grain grinding and health care were reported in total each month.

The data were prepared by weekly totals of time needed for each task in (1) the winter (barn or yard) feeding season and (2) the pasture season. For some purposes it was necessary to divide the pasture season into two parts: (a) pasture with supplemental feeding and (b) pasture without supplemental feeding.

Reporting data in this fashion facilitates their use in planning labor needs during critical demand periods for labor. Dividing weekly totals by seven provides estimates of daily chore time for regular tasks. Multiplying the weekly totals by number of weeks produces seasonal estimates.

For analysis purposes, the labor data for each task were classified according to those work procedures and equipment setups considered to influence significantly the amount of labor used. Tables 1 to 5, Appendix B, classify and summarize these data. As expected, individual farmer observations on labor use varied above and below the particular values reported. The reported values are "best estimates" for each classification. For planning purposes, the values reported should be useful and good predictors of what to expect.[5] For those work procedures or chores where individual farmer observations were insufficient, these observations have been supplemented with data from other sources. The supplementary information, however, is considered comparable to that obtained directly in the study.

The study shows, as did the companion study of stanchion herds, that analysis of most chore labor needs can be handled most meaningfully by dividing time requirements into two parts. The first, called **fixed time**, is the part that does not change as herd size increases. For example, when silage is fed from an upright silo by hand methods, fixed time corresponds roughly to the time needed to climb up and down the silo. Such time is not particularly affected by the number of head nor the amount fed.

On the other hand, the number of animals fed does affect the time required to throw down and to distribute silage. This part is called the **variable time or added time** per head fed.

The data were analyzed with the foregoing classification of time requirements.

[4] The capital investments for facilities are emphasized in the analysis. The annual costs (depreciation, interest, repair, insurance, and taxes) of these investments are not included nor is the cost of adding the extra cows themselves. See table 4 for a breakdown of the cost of items considered.

[5] The relationships between herd size and the time required for each task were specified by statistical regression procedure.

In general, the analysis shows fixed time to be a high proportion of total time in dairying, particularly in loose housing with moderately sized herds. Hence, the additional time needed to care for a few more head in the same herd represents a relatively small addition to total time, but does vary with how chores are done.

Classifying labor into its fixed and variable components is a much needed refinement in farm planning and analysis. Farm planning with this breakdown in labor describes much more realistically actual farm labor use than do average labor requirements. Use of average labor requirements in farm planning often has placed dairying at a disadvantage relative to other enterprises because of its relatively high labor needs.

As herd size increases, total time increases for most tasks, but average time per head decreases as the fixed time is spread over more head. Thus, for most tasks there is economy in (average) labor use as the herd gets larger. For some tasks the variable, or additional time, was so minute that the time reported is all considered as fixed time; total time for any herd is then estimated as the time for the average size herd studied.

How Estimates Of Total Time Per Week, Per Season, And Per Year Were Developed

As already mentioned, the labor data were obtained for each chore task. The time requirements for all the dairy chore tasks (feeding, milking, etc.) then were added together to obtain the total time required per week for each system. Tables 1 and 2 (abstracted versions of tables 1 and 2 in Appendix B) illustrate how the time requirements for individual chore tasks can be added together to obtain the total time required per week for a chore system. They show exactly how the estimates of time for the original system, "A typical Minnesota stanchion barn chore system" or "System I" were made. The left column "Task and description of methods" describes the tasks actually done in System I, e.g., milking, cleaning, and preparation of utensils. Below the tasks are task numbers followed by a brief explanations of how each task is done.

The next column, "Fixed time required per week," lists the fixed time for each task. The total of this column in table 1 is 16.51 hours of fixed time per winter week for this dairy chore system. Similarly, the total of the second column in table 2 is 12.26 hours or the total amount of fixed time per summer week for the same system.

The third column in tables 1 and 2 presents the time per week to add (in addition to the fixed time) for each head handled. But the number of head handled varies with tasks. Therefore, the values in the fourth column, "Animals handled as a percentage of cows in the herd," are multiplied by "Hours per week to add for each animal handled" to produce the figures in the last column in tables 1 and 2.

The sum of the column, "Hours per week to add for each cow in the herd," (table 1) equals 1.357 hours per cow per winter week. The sum for the same column in table 2 is .908 or the hours to add per cow for each summer week.

Hours to add per cow here means the added labor for each cow and her associated young stock in the herd.

The total time per winter week for a 20-cow herd with this chore system then equals 16.51 hours plus (20 cows times 1.357 hours per cow) or 43.65 hours. The total time per summer week is derived in the same manner from table 2.

A third table could have been constructed to give hours per week for the supplemental season. However, it would be identical to table 2 except that one line (task 9 from table 2, Appendix B) would be added. Rather than construct another table, a line with this task has simply been added at the bottom of table 2. With the addition of this line, the fixed time per week for the supplemental season is then 12.26 hours + 1.41 hours or 13.67 hours. Since task 9 shows no added time per cow, the hours per week to add for each cow in the herd during the supplemental season remain at .908, the same as for the summer season.

These per week values can then be totaled by seasons and for the year. For System I, these totals are: 29 winter weeks × 16.51 hours + 15 summer weeks × 12.26 hours + 8 supplemental

Table 1. Labor used in 1 week of the winter barn feeding season—stanchion barns

No.	Task and description of methods	Fixed time required per week	Hours per week to add for each animal handled	Animals handled as a percentage of cows in herd	Hours per week to add for each cow in herd
		hours	hours	percent	hours
	Milking				
1	Two single units, 1 worker, barns with rows arranged lengthwise	0.65	.812	89	.723
	Cleaning and preparation of utensils				
3	Two single units, manufacturing milk, cans	3.62	.....	.....	—
	Hay feeding				
11	Stanchioned cattle, baled hay, fed twice a day	1.47	.036	107	.038
	Silage feeding				
13	Manually unloaded with cart	1.40	.062	105	.065
	Grain feeding				
15	Fed twice a day	.99	.038	103	.039
	Manure handling				
17	Conventional methods (composite)	2.81	.124	107	.132
	Bedding				
19	Baled and chopped (composite)	1.08	.029	107	.031
20	**Other routine work**	0.55	.055	111	.061
21	**Care of dairy cattle not in stanchions**	2.80	.183	92	.168
	Miscellaneous labor				
23	Dairy cattle in stanchions	.96	.....	.....	—
24	Dairy cattle not in stanchions	.18	.....	.....	—
46	Feed grinding (65.4 pounds per week per cow in herd)	.....	.100	100	.100
	System I. Totals for a winter week	16.51	.....	.....	1.357

Table 2. Labor used in a week of the summer pasture feeding season—stanchion barns

No.	Task and description of methods	Fixed time required per week	Hours per week to add for each animal handled	Animals handled as a percentage of cows in herd	Hours per week to add for each cow in herd
		hours	hours	percent	hours
	Milking				
1	Two single units, 1 worker, barns with rows arranged lengthwise	2.28	.652	84	.548
	Cleaning and preparation of utensils				
3	Two single units, manufacturing milk, cans	3.72	.....	.....	.....
	Grain feeding				
15	Fed twice a day	1.72	.....	.....	.....
	Manure handling				
18	Conventional methods—manufacturing milk producers	1.05	.....	.....	.....
19	**Bedding**	−0.19	.050	98	.049
20	**Other routine work**	2.82	.....	.....	.....
	Care of dairy cattle not in stanchions				
21	Pens only	−0.16	.367	52	.191
22	Pastured separately only	0.48	.067	101	.013
	Miscellaneous labor				
23	Dairy cattle in stanchions	0.62	.....	.....	.....
24	Dairy cattle not in stanchions	−0.08	.013	100	.013
46	Feed grinding (65.4 pounds per week per cow in herd)	.....	.....	.....	.040
	System I. Totals for a pasture season week	12.26	.....	.....	.908
	Hay feeding (supplemental season)				
9	Baled hay fed outside	1.41	.....	.....	.....
	System I. Totals for a supplemental season week*	13.67	.....	.....	.908

* To 12.26 add 1.41 which equals 13.67. Task 9 shows no added time per cow, hence the hours per week to add for each cow in the herd are the same for the supplementary season as for the summer season.

season weeks × 13.67 hours + 2.17 hours for opening a silo or 774.22 hours of fixed time per year.[6] The "added time per cow and associated young stock in the herd" sum the the same way: (29 × 1.357) + (15 × .908) + (8 × .908) = 60.24 hours per year. With 20 cows in the herd, total time per year is then: 774.22 hours + 20 cows × 60.24 hours or a total of 1,979 hours per year. The average labor requirement per cow for a 20-cow herd managed under this system is then 99 hours.

The labor estimates for the other systems discussed in this bulletin were developed in the same way. For instance,

[6] This 2.17 hours for opening the silo appears as task 45 in table 1, Appendix B. This task is done only once each year per silo and hence the time requirements for it simply represent an absolute or flat amount that must be included to arrive at the total chore time for the year. Similar additions are made in all systems.

the hours of fixed time per week and the hours per week to add for each animal handled may be found at the bottom of tables 1 and 2, Appendix B for System II, a mechanized stanchion barn system. These tables also show which lines must be totaled to get these values.

A farm manager or planner can compute labor requirements for loose housing chore systems other than those discussed in this bulletin. To do this he first needs to list and describe the various chore tasks that make up the chore system. He can then turn to the tables in Appendix B where various chore tasks are described and numbered and where the fixed and variable time for each task is listed. To compute the total time per week within each season, he simply sums the fixed time and the variable time for all the chore tasks in the system. Following the same procedure as outlined above, he then can arrive at the total chore time by seasons and for the year. If the length of the various seasons differs from those observed and used in this study, he can adjust them to correspond to his particular situation.

Some Alternative Dairy Chore Systems

Ten alternative dairy chore systems are described in this section. They are presented in a sequence that may mark the steps a dairyman moves through, partly or completely, in expanding and developing his dairy operation. To some dairymen, these systems may prove interesting primarily as alternatives through which herd size can be expanded. Others may view these systems primarily as alternatives for reducing total labor used in dairy chores.

Herds, of course, can be expanded without a change in system and on many farms dairy labor can be reduced by changing work procedures without basically altering the dairy chore systems. The tables in Appendix B summarize how these kinds of adjustments affect labor requirements for dairy chores. In addition these tables provide the data for the systems described as well as for other systems the reader may construct.

The Typical Stanchion Barn, System I

The herd on our typical farm is assumed to include 20 cows (producing 10,000 pounds of milk for sale per year) and 20 young stock, all kept in a stanchion barn with overhead hay mow. The pens in the barn can hold all the young cattle.

Hay is baled and fed twice a day during a winter barn feeding season of 29 weeks. When pastures are short in the fall, hay is fed once per day in an outside rack; this period is known as the 8-week supplemental feeding season. Silage is fed from an upright silo in the winter, thrown down by hand, and fed with the use of a cart. Milking is done by one man with two pail units. The herd is pastured for a total of 23 weeks in the year. During the summer, the younger cattle not pastured with the herd are also outdoors in lots where they must be watered by hand methods.

The barn is cleaned by driving the spreader through the center alley. In this system, as in all others, the grain is ground and mixed with the farmer's own hammer mill. The herd is bred artificially.

A Mechanized Stanchion Barn, System II

Husbandry practices here are similar to those in System I except for three changes. Another milker unit is added to bring the total to three. Silage and manure handling are mechanized by adding a silo unloader and a gutter cleaner.

A Stanchion-Loose Housing Switch System, System III[7]

This system differs from System I in these respects. Hay is fed once a day outdoors below openings to the mow. To institute this practice requires new feed bunks. Silage is fed once each day outdoors at the base of the silo. This practice, too, calls for new feed bunks. To facilitate outdoor feeding of hay and silage a concrete feeding floor is constructed in the yard. In addition, a loafing shed is built to house the cows. The remainder of the operation, including milking which is done with the cows in the existing stanchion facilities, continues for the most part as in System I. Some changes, however, do take place in manure handling.

A Minimum Cost Four-Stall Milking Parlor, System IV

The farmer who manages his herd in a typical stanchion barn such as System I moves into a milking parlor-loafing shed when he changes to System IV. System IV has the same hay and silage feeding facilities and the same loafing facilities as System III. But System IV substitutes a four-stall-level-abreast-walk-through milking parlor for stanchion milking. This parlor is built in one corner of the stanchion area, freeing the other three-fourths of the stable area for a milk room and/or young cattle. This parlor has a cow entrance from the rear, feed manger doors for cow exits, a work space for each milker unit between each pair of cows, and walls and ceiling covered with asbestos cement board backed with lumber for strength. Milking in this type of parlor rather than in stanchion stalls is then the essential difference between this system and III.

A Minimum Cost Six-Stall Parlor, System V

This system is similar to System IV except that it is built around a six-stall, three-pipeline unit, level-abreast-walk-through parlor. The construction, as in System IV, is mainly of simple carpentry with a minimum of concrete work if built in the old stanchion area. An adjoining milkhouse also is built. This, too, could be constructed in the old stanchion area if this location is considered the most desirable. The parlor and milkhouse are equipped with suitable drains, fans, heaters, lights, pipeline, and bulk tank.[8]

System V resembles III, the switch system, in these respects: (1) it has the loafing shed and (2) the cows are bunk-fed both silage and hay in an outdoor yard equipped with a concrete feeding floor. Also, as in III these feeds are fed

[7] The word "switch" as used here refers to a dairy husbandry system where the cattle are bedded in a loafing area but are milked in the original stanchion barn. There are usually more cows than stanchions and the groups of cows must be "switched" during milking.

The term "shift system" has been used to describe a system where one "shift" of cows are stanchioned during the day, but are replaced by the other "shift" at milking time. The process is reversed next morning.

[8] At this point, a word is in order about some milking systems not otherwise discussed, the two-worker systems. The study did not provide enough data to say just how many more hours a two-man milking system adds, but it is quite certain that two man-team systems do take more man hours, though less elapsed time to milk a herd. This makes them poor choices if:

(a) Both workers are completely capable milkers.

(b) Emergencies arise where one must milk alone.

(c) There is other productive work for one to do at milking time.

A doubled in size System IV parlor would probably function twice as fast as a one-man size, if the two men worked separately; in elapsed time cows would be milked faster than in a System V parlor, but would require more man hours.

once a day but in V hay is fed the year around whereas in III it was fed only during the winter and supplementary periods.

This plan requires a man to stoop and bend when milking.[9] If one can tolerate the stooping and bending it is a relatively efficient milking setup. But fatigue may become an important factor if the herd grows much larger than 35 or 40 cows.

The milking area, as the milking areas in all previous systems, is assumed not to be hosed out in cleaning.[10] Rather it is brushed and limed, a quicker method as table 3, Appendix B shows. Brushing and liming is not a common method, yet a feasible one, if the cows' udders are washed with cloths or sponges and sanitation requirements will permit it. It requires appreciably less cleanup time unless large quantities of water under very high pressure are available for hosing. Furthermore, the room will be much less damp.[11]

A Double Four Herringbone, System VI

System VI calls for husbandry practices identical with Systems IV and V, the level floor parlors. Only the milking chore differs. A double four herringbone with a pipeline and bulk tank are the core of this system. Such a milking plant would likely call for an investment of about $9,000 (including bulk tank and other milking equipment) particularly if it becomes necessary to hire skilled labor to install the system in a reasonable length of time.

An investment in a $9,000 milking plant should be planned carefully. Design and locate so as to:

(a) Use part of the concrete yard and feeding area as a holding area.
(b) Provide easy access for parlor milking of the maternity cow.
(c) Provide an exit pen for cows to be sorted out.
(d) Connect the exit pen to the calf pen area to reduce travel.
(e) Have smooth, easy-to-keep-clean walls, floors, and fixtures.
(f) Light, heat, and ventilate it well.

Perhaps most importantly, design and locate so as to provide an easy view of all other areas in the design: (1) the bedded area, to insure its proper condition, (2) the feeding area, to assure adequate feeding, (3) the calf area, to care for the calves easier and more satisfactorily, (4) the young cattle, to guard their health and insure breeding, (5) the yard, to note estros, health, and sanitation. Such a design and location become important in maintaining production per cow as herd size increases in loose housing, particularly if the dairyman must supervise and depend on hired help. These changes are basic in attaining the quality of husbandry necessary for making loose housing successful. In some situations a new building, constructed between the old barn and the new loafing shed, can fulfill most of these requirements, as well as enclose the yard in a protective and flexible recommended "L" shape. The old milkhouse frequently needs to be discarded. These suggestions on design are emphasized because of the relatively large investment required to change from System I to VI and hence the need for assuring that the investment is given the opportunity of being as productive as possible.

[9] One might consider building this parlor as a two-level design to avoid stooping. This would raise construction costs somewhat but is a practical alternative.

[10] Later systems will assume hosing, the more common procedure.

[11] For information on what is needed to produce high quality milk see *Economies in Farm Dairy Buildings and Equipment*, by C. J. Fenzau and R. N. Van Arsdall, Agricultural Information Bul. No. 150, USDA, May 1957.

Improved Pasture and Forage Feeding, System VII

This system is similar to VI except that it includes daily rotational grazing, stepped up silage feeding, additional silage space, and a silo unloader. These changes or additions are likely considerations on farms where fairly large herds are being increased further and where grade A milk is sold. Summer forage feeding is improved in VII through daily rotational grazing when compared with conventional grazing in the previous systems. Moreover, in VII silage is fed not only during the barn-feeding season as in the preceding systems but during 37 weeks of the year—fall, winter, and spring. System VII provides for an additional silo and an unloader for use in both silos.

Adding a silo unloader may be considered a means of reducing chore time. But silo unloaders are not foolproof. Many operators find it necessary to stand by to see that they operate properly. While doing so they often find it difficult to find other work to do. Thus, installing one may promote safety and reduce fatigue but the data in this study show that it is unlikely to reduce chore time significantly. (See tables 1 and 3, Appendix B.)

Green Chopping in the Summer, System VIII

Some dairymen cooperators reported severe trampling problems with daily rotational grazing when the herd was over 30 cows. Moreover, sometimes pasture locations, fencing, and crops leave little choice but to cut the forage crop and haul it to the cattle. System VIII is designed to handle or overcome these problems. Hence, under this system, green feeding in an exercise lot with a self-feeding wagon replaces the daily rotational grazing of the older cattle, characteristic of System VII. Otherwise, the two systems are similar.

Storage Feeding the Year Around, System IX

This system is similar to VIII with one main exception. Under VIII cows were fed green chop in the summer from a self-feeding wagon. In IX the older cattle are fed a full ration of stored forage the year around. To follow this practice, a mechanical bunk replaces the self-feeding wagon in VIII.

Another change, minor but important in keeping summer labor down, is that IX provides an automatically regulated water supply for all young cattle on pasture or in lots. This change, at a relatively nominal cost, saves 1½ hours per summer week.[12] Year-round storage feeding is assumed to increase the quantity of manure to be hauled to the point where several major cleanouts are required annually.

Horizontal Silo and a Double Five Herringbone, System X

System X is similar to IX except that (1) silage in this system is fed with a tractor scoop from a horizontal silo that takes the place of the upright silos and (2) a double five herringbone milking parlor is used instead of the double four herringbone. Since a horizontal silo can be built at much lower cost than an upright, the investment in new facilities for X are lower than for IX even though X has a larger milking parlor.

[12] Other systems too would benefit in a similar way by this change. This change suggests that all labor savings do not come at a high investment cost.

Table 3. A description of alternative dairy chore systems

Dairy chore system—number and general description		Major facilities and work procedures acquired and adopted in changing from System I to alternative systems		
No.	General description	Housing and general	Milking	Feeding
I.	A typical stanchion barn setup	.....	.....	.....
II.	A mechanized stanchion barn	Gutter cleaner	A third milker unit	Silage unloader
III.	A stanchion-loose housing switch system	Loafing shed and concrete yard	.....	Baled hay and silage fed outdoors once a day
IV.	A low-cost four-stall parlor, loose housing	As in III	A level floor parlor built in stanchion area, four stalls, two units	As in III
V.	A low-cost six-stall parlor, pipeline, loose housing	As in III	A level abreast parlor, milk house, bulk tank, three milker units	As in III except year-round hay feeding
VI.	A double four herringbone, loose housing	As in III	Eight stall, four pipeline unit herringbone with bulk tank in milk house	As in V
VII.	Improved pasture and forage program	As in III	As in VI	RAD pasture; silage unloader; silo, if herd is increased
VIII.	Green chop	As in III	As in VI	As in VII except RAD pasture replaced with green chop for older cattle
IX.	Year-round storage feeding	As in III	As in VI	Silage unloader and silo as in VII, mechanical feeding bunk, year-round feeding
X.	A double five herringbone, horizontal silo	As in III	Ten stall, five unit herringbone	Year-round storage feeding with horizontal silo

A Summary of the Various Systems

Table 3 brings together in capsule form the major changes required for a dairyman to shift from System I, the typical stanchion barn setup, to any one of the other systems. A quick glance at the table gives a picture of the major facilities and work procedures that distinguish the systems. Having identified the systems we now can evaluate them as alternatives for expanding the size of herd and for reducing the dairy chore labor.

A Comparison Of Chore Systems As Means For Expanding Herd Size

The majority of Minnesota dairymen produce milk in stanchion barns for a grade B market. Many are likely to continue to do so but some will reorganize their plants and turn to producing for a grade A market. But whether producing grade B or A milk, many dairymen are considering expansion of their herds. They may see two alternatives: either expanding the existing stanchion area or going to a milking parlor-loose housing system.

For some, capital is in short supply. Hence, changes in the plant to accommodate larger herds must be done at low cost, even if labor requirements for dairy increase substantially. On some farms, increasing herd size requires neither hiring extra labor nor drawing operator and family labor away from other productive work on the farm. On those farms where the operator and family labor supplies are ample but capital supplies are short, the labor required to expand herd size need not be considered as an added cost. In these instances, the labor is there whether used or not and its use in an expanded dairy enterprise comes at zero cost as long as other activities on the farm are carried on as efficiently as before. But on these farms with little capital, capital costs are a basic consideration in making investments to expand herd size. With little available, money must be invested where it can be expected to yield the highest returns if satisfactory incomes and living levels are to be attained. In these situations, investments in dairy housing and feeding facilities are likely to be more productive than in expensive milking systems. Hence, when herd size is increased, investments in housing and feeding facilities should precede outlays for costly milking systems, even though future plans call for such changes in the milking system.

On other farms, labor supplies are scarce relative to the available capital. On these farms labor costs must be considered when making investments to expand herd size. On farms where an expansion of the dairy herd either means hiring additional labor or drawing operator and family labor away from other productive work on the farm, the additional labor going into dairy represents an increase in costs.

Our analysis of alternative dairy chore systems has been made with these different labor-capital situations in mind. In this way, both capital short and labor short farmers can appraise the alternatives in terms of their particular situation. The analysis also has been made to fit those farmers who plan to expand the herd from 20 to 30 cows and for those

Table 4. Facilities added and their associated costs in changing from the typical stanchion barn chore system to alternative chore systems, for 20 cows and for each cow added over 20

Facility added	Systems where these added facilities are used*	Costs to change chore system at the 20-cow level	Cost per cow added over 20
		dollars	dollars
Stanchion barn	I, II	.....	400
Gutter cleaner	II	1,500	30
Pail milker unit	II	100	—
Silage unloader	II	1,200	—
Pole barn	III-X	1,500	50
Feed bunks	III-X	100	10
Concrete	III-X	400	20
Low-cost four-stall parlor	IV	300	—
Grade A six-stall parlor	V	1,000	—
Grade A equipment	V	500	—
Bulk tank	V-X	1,500	50
Herringbone eight-stall Pipeline milking equipment	VI-IX	6,500	—
Silo	VII-IX	.....	95
Silo unloader	VII-IX	1,200	20
Self-feeding wagon	VIII	500	—
Mechanical feeding bunk	IX	600	10
Herringbone ten-stall Pipeline milking equipment	X	7,200	—
Horizontal silo	X	1,800	10

* Systems VII, VIII, and IX are improved pasture and forage feeding systems and will be discussed separately.

who are thinking about doubling their herd size from 20 cows.

The various dairy chore systems are compared with System I, the typical stanchion barn setup as a base for comparison. Thus, increases in capital investments for herd expansion are additions to the existing plant investment required for a 20-cow herd handled under System I. Table 4 summarizes the capital costs needed to change from System I to alternative chore systems and to increase the size of herd through each system. This summary is presented here so that the reader can interpret the total additional capital requirements outlined on the following pages for the alternative systems. The meaning of the data in table 4 can be conveyed more clearly through illustration. Suppose a farmer is handling his 20-cow herd in a stanchion stall barn (System I) and wants to increase his herd to 30 cows by expanding the existing facilities. Table 4 shows that the cost per cow of adding stanchion barn facilities is $400. Hence, to expand the facilities to serve 10 more cows requires an increase of $4,000 in capital expenditure. On the other hand, if he wants to expand his herd by the same amount through System II, he needs to invest in a gutter cleaner ($1,800 or $1,500 + $30 × 10 cows), another pail milker unit ($100) and a silage unloader ($1,200) to convert to the new system. In addition, he needs to expand the existing stanchion facilities to house 10 more cows at a cost of $4,000. The total increase in capital expenditure then amounts to $7,100.

In the analysis of dairy chore systems as alternatives for expanding herd size, the increases in income can come from one or two sources. If the farmer increases the size of herd without changing from a grade B to grade A milk market, the additional income comes solely from having more cows. But if he increases his herd size and at the same time shifts from the sale of grade B to grade A milk, the additions to income come from (1) the additional cows and (2) the price premium attached to grade A over grade B milk. In the analysis, grade B milk was priced at $2.95 per cwt. and grade A at $3.10, a differential that yields a premium of 15 cents per cwt.

Since income per cow from the sale of milk is a function of the price of milk and how much milk she produces for sale, the analysis required an estimate of the milk production per cow for sale. This estimate was set at 10,000 pounds, which is higher than the state average of about 8,000. However, the state average has been increasing steadily. Moreover, some of the dairy chore systems in the analysis are hardly worthy as investment considerations unless cows are producing at a relatively high level and grade A milk is sold.

At the above prices, a cow producing 10,000 pounds of milk for sale yields an annual income of $295 if grade B milk is sold and $310 if grade A is sold. But these amounts are not available in full for paying off investments in new facilities. In the analysis these amounts are reduced by $170, which includes the cost of feed and direct cash expenses adjusted for sale of cull cows and surplus young stock. Thus, if grade B milk is sold, each cow added to the herd provides $125 ($295-$170) for paying off additional investments in facilities. Similarly, if grade A milk is sold, each cow provides $140.

Expanding Herds With Limited Capital

Table 5 shows how the various dairy chore systems compare as alternatives for expanding herd size. This table is of most interest to those farmers who are limited on capital relative to labor. Labor here is not included as an added cost of expanding the herd. Remember that the investment and income figures in this table are computed with System I, the typical stanchion barn setup as the basis for comparison.

To increase the herd by a certain number of cows requires considerably more capital with some systems than others. For example, to expand the herd from 20 to 30 cows with System I, the typical stanchion barn, requires an expansion of existing stanchion barn facilities at a capital expenditure of $4,000. A similar increase in herd size, accomplished through a change in dairy chore system from I to III, the switch system, calls for only $2,800 in new facilities. But if the herd is increased through a shift from I to X, the double five herringbone, new facilities require an investment of $14,900.

The table also reflects differences in additions to income as herd size is increased by a certain amount by means of the alternative dairy chore systems. For instance, increasing the herd from 20 to 30 cows through Systems I, II, III, and IV adds $1,250 to income available to repay the increase in investment while a similar increase in herd size through V, VI, and X adds $1,700. The difference here reflects the premium for grade A milk from the 20 cows already in the herd and from grade A milk sold from the 10 cows that are added. In other words, milk is assumed to be sold as grade B in the first four systems and as grade A in the last three; the reason behind this assumption is that the latter

Table 5. Additional capital investment needed for new facilities, increases in income above feed and expenses other than labor, and years required for the increases in income to pay for the investment in new facilities when expanding herd size under System I and by shifting from System I to alternative dairy chore systems

System	Herd size	Increases in capital investments: Housing and general	Milking	Feeding	Total	Increase in income above feed and expenses other than labor	Years for increases in income to pay for additional investment
	number	dollars	dollars	dollars	dollars	dollars	years
I							
Typical stanchion	20	...	...	...	...	...	...
	30	4,000	...	...	4,000	1,250	3.2
	40	8,000	...	...	8,000	2,500	3.2
II							
Mechanized stanchion	20	1,500	100	1,200	2,800	...	...
	30	5,800	100	1,200	7,100	1,250	5.7
	40	10,100	100	1,200	11,400	2,500	4.6
III							
Switch milking	20	1,900	...	100	2,000	...	...
	30	2,600	...	200	2,800	1,250	2.2
	40	3,300	...	300	3,600	2,500	1.4
IV							
Four-stall parlor	20	1,900	300	100	2,300	...	...
	30	2,600	300	200	3,100	1,250	2.5
	40	3,300	300	300	3,900	2,500	1.6
V							
Six-stall parlor	20	1,900	3,000	100	5,000	300	...
	30	2,600	3,500	200	6,300	1,700	3.7
	40	3,300	4,000	300	7,600	3,100	2.5
VI							
Double four herringbone	20	1,900	8,000	100	10,000	300	...
	30	2,600	8,500	200	11,300	1,700	6.6
	40	3,300	9,000	300	12,600	3,100	4.1
X							
Double five herringbone	20	1,900	8,700	1,900	12,500	300	...
	30	2,600	9,200	2,100	14,900	1,700	8.8
	40	3,300	9,700	2,300	15,300	3,100	4.9

systems are economic investments only for larger herds producing premium milk.

System III, the switch system or System IV, the low-cost four-stall parlor appear as the most favorable investments for the farmer with limited capital but ample labor who plans to expand his herd size. Handling a 20-cow herd with a typical stanchion barn chore system, he can increase his herd to 30 or 40 cows through either the switch system or the four-stall parlor with an investment that pays out more quickly than through any other system. Moreover, both III and IV have low-cost flexibility in use for other livestock should he decide to reduce dairy or move out entirely. The loafing shed, feeding floor, and feed bunks can be used equally as well for feeder cattle as for dairy.

Although the investment in IV, the four-stall parlor system, is not expected to pay out quite as quickly as in III, the switch milking system, IV has one advantage over III in the sense it takes somewhat less summer labor.[13] Even on farms with ample labor, the summer season is likely to be most demanding for that which is available.

However, in milking convenience, System IV with its level floor parlor is unlikely to be superior to the stanchions in III. As much stooping and squatting is required in this type of parlor as in stanchions.

The farmer with limited capital who is planning to increase his herd size and at the same time change from grade B to grade A milk production may want to consider System V, the six-stall parlor. It is a relatively low-cost dairy chore system for grade A milk production and the additional investment can be paid off in a shorter period than with either VI or X, the herringbone systems. Of course, a larger price differential between grade B and A milk than was used in this study would make Systems V, VI, and X more attractive as investments.

If the farmer with limited capital does consider Systems VI and X as alternatives for expanding his herd, then he should logically also give some thought to improved forage feeding dairy chore systems. These systems are similar to VI, the double four herringbone, except for methods of forage feeding. System VII uses daily rotational grazing, VIII uses green chop, and IX operates with year-round storage feeding.

Table 6 summarizes the increases in capital investments and in income and the time needed for the additions to income to pay off the investment for these systems. Again System I, the typical stanchion barn chore system, is used as a base for comparison and labor for herd expansion is not included as a cost.

These systems are high capital-using systems. A farmer handling a 20-cow herd with the typical stanchion barn chore system needs to be prepared for a capital expenditure of roughly between $13,500 and $17,000 if he increases his herd to 30 or 40 cows through these systems.

In regard to the time needed for the additional investments to pay off, any one of these three systems is hardly more favorable than the others. Other considerations become more vital in making a choice among them. System IX with its year-round storage feeding is less demanding of summer labor than the other two systems. But the time required to harvest forage for year-round feeding has not been included in IX; if this time were included, IX would be more demanding of summer labor than indicated in our analysis. Finally, possible improvements

[13] See table 13, page 29, for specific comparisons.

Table 6. Increases in capital expenditures and income and years required for the additional income to pay for the additional capital investment when expanding herd size through alternative improved forage feeding systems

System	Herd size	Increases in capital investments	Increases in income above feed and expenses other than labor	Years for increases in income to pay for additional investment
	number	dollars	dollars	
VII				
Improved pasture and forage feeding	20	11,200	300	
	30	13,560	1,700	8.0
	40	16,100	3,100	5.2
VIII				
Green chop	20	11,700	300	
	30	14,150	1,700	8.3
	40	16,600	3,100	5.4
IX				
Storage feeding	20	11,800	300	
	30	14,350	1,700	8.4
	40	16,900	3,100	5.5

in forage utilization and milk production have not been considered for any of the three systems. Any improvements here of course mean that fewer years would be required for the additions to income to pay off the increased capital expenditures; and one of these systems might result in greater improvements than the others. However, for System VII (as an example) with its daily rotational grazing to pay out as quickly as System VI, the double four herringbone, the improvements in forage utilization and milk production from daily rotational grazing alone would need to have an annual value of $800 in a 40-cow herd. This amount increases income above feed and cash expenses other than labor from $3,100 to $3,900. At $3.10 per cwt. for grade A milk, $800 is equivalent to 25,800 pounds of milk or 645 pounds per cow in a 40-cow herd.

Expanding Herds With Limited Labor

This section is of primary interest to the farmer who plans to expand the size of his dairy herd, who must either hire additional labor or divert his present labor from other productive work on the farm into dairy in order to increase the size of his dairy enterprise. Here additional labor in dairy has a cost and hence must be included in the analysis. In tables 7 and 8, summer labor is figured at $2.00 per hour and winter labor at $1.00.

Farmers severely limited on labor should seriously consider Systems IV and V, the four- and six-stall parlor systems, as alternatives for expanding herd size. Handling a 20-cow herd with a typical stanchion barn chore system, a farmer can increase his herd size through IV and V and pay off the investment in new facilities in less time than for any of the other chore systems.

In Systems IV and V cows can be added to the herd with considerably less increase in labor than they can in System III, the switch milking system. On farms with ample labor but limited capital, System III is a favorable alternative to consider when expanding herd size, not because it is labor efficient in adding

Table 7. Additional capital investment needed for new facilities; increases in income above feed, direct cash expenses, and labor; and years required for the increases in income to pay for the investment in new facilities when expanding herd size under System 1 and by shifting from System 1 to alternative dairy chore systems

System	Herd size	Cost of additional facilities needed to make change					Increase in income above feed and other allocated costs including labor	Years for increases in income to pay for additional investments
		Housing and general	Milking	Feeding	Total			
	number	dollars	dollars	dollars	dollars		dollars	years
I								
Typical stanchion	20	.....	.....	.....	.....		.....	....
	30	4,000	.....	.....	4,000		439	9.1
	40	8,000	.....	.....	8,000		878	9.1
II								
Mechanized stanchion	20	1,500	100	1,200	2,800		295	....
	30	5,800	100	1,200	7,100		744	9.5
	40	10,100	100	1,200	11,400		1,193	9.6
III								
Switch milking	20	1,900	.....	100	2,000		35	....
	30	2,600	.....	200	2,800		461	6.1
	40	3,300	.....	300	3,600		887	4.1
IV								
Four-stall parlor	20	1,900	300	100	2,300		233	....
	30	2,600	300	200	3,100		808	3.8
	40	3,300	300	300	3,900		1,382	2.8
V								
Six-stall parlor	20	1,900	3,000	100	5,000		761	....
	30	2,600	3,500	200	6,300		1,598	3.9
	40	3,300	4,000	300	7,600		2,434	3.1
VI								
Double four herringbone	20	1,900	8,000	100	10,000		640	....
	30	2,600	8,500	200	11,300		1,606	7.0
	40	3,300	9,000	300	12,600		2,573	4.9
X								
Double five herringbone	20	1,900	8,700	1,900	12,500		640	....
	30	2,600	9,200	2,100	14,900		1,631	9.1
	40	3,300	9,700	2,300	15,300		2,622	5.8

cows but because of its relatively low capital requirements.

System IV, the four-stall parlor system is less labor efficient for adding cows than VI and X, the herringbone systems. But the additional capital expenditure needed to expand the herd through VI and X more than offsets their higher labor efficiencies.

But System V, the six-stall parlor system, is about as labor efficient for adding cows as the herringbone systems. This fact together with its lower capital requirements make System V worthy of serious consideration for the farmer with limited labor who is planning to increase the size of his dairy herd. In spite of its higher capital requirements (as compared with IV, the four-stall) System V pays out almost as quickly as IV because it is more labor efficient and because part of the added income from this system comes from the price premium for grade A milk.

If the farmer with limited labor but ample capital does consider the herringbone systems as alternatives for herd expansion, perhaps he should also give some thought to the improved forage feeding systems of VII, VIII, and IX. Table 8 shows the time it takes for the increases in income to pay off the capital expenditures for these systems; the additional labor required to increase the size of herd is included as a cost.

It takes a little longer for these systems to pay out than it does for the herringbone systems. However, any increases in milk production and hence income that may come from improved pasture and forage feeding, from green chop or from storage feeding has not been considered in analyzing these systems. Any such increases mean that they would pay out more quickly than indicated.

In years required to pay off the investment the three systems in table 8 are about equal. Given this condition, other considerations become of greater importance in making a choice among them. Again it should be remembered that System IX with its year-round storage feeding demands less summer labor than the other two systems. This is an important consideration to the farmer with limited labor. But the time needed to harvest the forage for year-round feeding has not been included in the summer labor requirements for IX. Including this time may make it appear less favorable than our analysis suggests.

Table 8. Increases in capital expenditures and income and years required for the additions to income to pay for the additional capital investment when expanding herd size through alternative improved forage feeding systems

System	Herd size	Increases in capital investments	Increases in income above feed, direct cash expenses, and labor	Years for increases in income to pay for additional investment
	number	dollars	dollars	years
VII				
Improved pasture and forage feeding	20	11,200	710	.....
	30	13,650	1,637	8.3
	40	16,100	2,564	6.3
VIII				
Green chop	20	11,700	590	.....
	30	14,150	1,492	9.5
	40	16,600	2,395	6.9
IX				
Storage feeding	20	11,800	855	.....
	30	14,350	1,721	8.3
	40	16,900	2,588	6.5

Summary Remarks on Alternative Dairy Chore Systems for Expanding Herd Size

For the farmer with ample labor but limited capital, System III, the loose housing-switch milking system and System IV with its low-cost four-stall parlor and loafing shed merit serious consideration when expanding the dairy enterprise from 20 to 30 or 40 cows.

For the farmer with limited labor relative to capital, System IV and System V with its low-cost six-stall parlor, loafing shed, pipeline, and bulk tank are favorable alternatives to consider when increasing the dairy herd from 20 to 30 or 40 cows. Within this range of herd expansion, these two systems (particularly V) compare quite favorably with the higher capital using systems in labor efficiency. Systems IV and V, the four- and six-stall parlor systems, have higher time requirements for each cow added than do the higher capital using systems but they have lower fixed time.

The higher capital using systems (the herringbones, the improved pasture, the green chop, and the storage feeding systems) do really not show their high relative labor efficiency until herds reach a size of about 60 cows, a point where their comparatively high fixed time requirements are spread over a large number of cows.

From this analysis the higher capital using dairy chore systems appear as economic alternatives for expanding herd size primarily on farms where relatively large increases in herd size are planned and where capital supplies are ample but labor supplies are limiting.

A Comparison Of Chore Systems As Ways Of Reducing Labor For A Particular Size Herd

Some dairymen are looking for ways to reduce the labor used in dairy chores. They do not wish to cut back on their dairy enterprise to free labor that has a high value in alternative uses on the farm. Rather, they are looking for ways to change their dairy chore systems as a means of freeing labor. They realize that many of these changes require capital. But they believe their total farm income will increase by substituting some capital for labor in dairying and by using the labor saved in dairying elsewhere in the farm business.

This section compares the alternative dairy chore systems, previously described, as means for reducing labor in dairying. Again the comparisons are made with System I, the typical stanchion barn setup, as the base for comparison. Alternative chore systems are compared in terms of how much extra capital is required to change from System I to another system at the 20-, 30-, and 40-cow levels. Then on the basis of the quantity and value of labor saved by changing from I to another system, further comparisons of the systems are made by the length of time required for the value of labor saved to repay the additions in capital investment.

Once again, certain conditions must be set up about milk production per cow, capital costs, added income from milk, feed costs, and direct cash expenses adjusted for sale of cull cows and surplus

young stock. Such conditions are necessary in order to make meaningful comparisons among the chore systems.

These conditions are similar to those in the previous section. Since the various chore systems are compared with cow numbers fixed at certain levels, increases in income and production expenses associated with expansions in herd size do not enter into the analysis here. Two additional conditions in this analysis are:

(1) Any increase in milk production from the improved forage feeding systems (VII, VIII, and IX) is not used to reward labor or to pay off the capital costs; and

(2) While a change to a grade A market provides an increase in income it is not used to reward labor either. It can be viewed if the reader desires, as a fund to pay the additional interest on investment charges that may come about as more capital is put into dairy facilities. It is more than adequate for this purpose in the grade A alternatives.

Thus, the analysis in this section reduces to this simple form: "How many years are required for the value of the labor saved to equal the expenditure for new capital invested in dairy facilities?" To answer this question, however, means that conditions must be set up on how and at what levels to price labor in order to arrive at its value. A meaningful way is to price it at what it could earn elsewhere, either in another enterprise on the farm or off the farm, or at what it is worth in extra leisure.

In this analysis, labor for dairy chores is priced at $1 per hour in the winter and at $2 per hour in the summer and supplemental seasons. The value at which it is priced affects the analysis. If it were priced at higher levels, the expensive but more labor-efficient herringbone milking systems would appear more favorable than they do in these comparisons.

Tables 9, 10, and 11 summarize the analysis in this section. Table 9 shows the years required for the savings in labor to repay the new capital invested in dairy facilities for herds of 20 milk cows and their replacement stock. Table 10 presents the same information for a 30-cow herd and table 11 for a 40-cow herd.

Examination of these tables shows that Systems IV and V, the four- and six-stall parlor systems, are able to repay added capital sooner than most of the other alternatives. Neither of these systems calls for investment in an expensive parlor; they are designed with the lower cost level floor models. This suggests that while the more expensive parlors do save labor, it is not until the herd is quite large that the labor savings are likely to be worthwhile.

System II, the mechanized stanchion arrangement, also appears favorable at the 20-cow herd size but decreases in favor as herd size increases. Two reasons are evident. First, 62 percent of all the labor in this system is lower priced winter labor. This proportion is more than for any other system except System I, the typical stanchion barn system, with 64 percent, and IX, storage feeding, with 62 percent. Second, the capital costs are quite low since the only facilities added over System I are the silo unloader, milker, and gutter cleaner. The housing space requirements do not change.

System III, the switch system, appears quite unfavorable in these comparisons. One reason is that it actually uses more *total* summer labor at every herd size than does System I. It is the only alternative system that does. For this reason, it seems worthy of consideration only as a steppingstone to some other system with an improved milking arrangement—the "bottleneck" in the switch system.

System VI, with its eight-stall herringbone parlor appears as a questionable investment at the 20-cow level. At larger

Table 9. Changing chore system by substituting capital for labor—years necessary for the labor saved to repay the capital invested. (Labor charged at $1 per hour in the winter and at $2 per hour in the summer and supplemental seasons)

Changes made from System I at 20 cows	Units	Alternative chore systems									
		Grade B			Grade A						
		II	III	IV	V	VI	VII	VIII	IX	X
		Mechanized stanchion	Switch milking	Four-stall parlor	Six-stall parlor	Double four herringbone	Improved pasture	Green chop	Storage feeding	Double five herringbone
Cost of new facilities to go from System I to alternative system	Dollars	$2,800	$2,000	$2,300	$5,000	$10,000	$11,200	$11,700	$11,800	$12,500
Labor used by seasons										
Winter*	Hours	1,098	1,132	1,051	973	1,032	989	989	960	1,039
Summer and supplemental	Hours	648+	761+	703	628	660	678	705	587	655
Total per year†	Hours	1,746	1,893	1,754	1,601	1,692	1,667	1,694	1,547	1,694
Labor saved per year over System I	Hours	233	86	185	378	287	312	285	432	285
Value of labor saved by the alternative system†	Dollars	$295	$35	$233	$461	$340	$410	$290	$555	$340
Time to repay the added capital with the labor saved	Years	9.5	57.1	9.9	10.8	29.4	27.3	40.3	21.3	36.8

* System I labor needs are: 1,268 hours in winter and 711 hours in summer for 20 cows in the herd.
† Total labor for System I is valued at $2,690 for a 20-cow herd.

Table 10. Changing chore system by substituting capital for labor—years necessary for the labor saved to repay the capital invested. (Labor charged at $1 per hour in the winter and at $2 per hour in the summer and supplemental seasons)

Changes made from System I at 30 cows	Units	Alternative chore systems								
		Grade B			Grade A					
		II	III	IV	V	VI	VII	VIII	IX	X
		Mechanized stanchion	Switch milking	Four-stall parlor	Six-stall parlor	Double four herringbone	Improved pasture	Green chop	Storage feeding	Double five herringbone
Cost of new facilities to go from System I to alternative system	Dollars	$3,100	$2,800	$3,100	$7,600	$11,300	$13,650	$14,150	$14,350	$14,900
Labor used by seasons										
Winter*	Hours	1,450	1,486	1,346	1,222	1,228	1,201	1,201	1,189	1,219
Summer and supplemental	Hours	873	997	894	785	779	808	848	740	770
Total per year†	Hours	2,323	2,483	2,240	2,007	2,007	2,009	2,049	1,928	1,989
Labor saved per year over System I	Hours	258	98	341	574	574	572	533	653	592
Value of labor saved by the alternative system†	Dollars	$304	$86	$368	$709	$716	$683	$604	$832	$741
Time to repay the added capital with the labor saved	Years	10.2	32.6	8.4	10.7	15.8	20.0	23.9	17.2	20.1

* System I labor needs are: 1,661 hours in winter and 920 hours in summer for 30 cows in the herd.
† Total labor for System I is valued at $3,501 for a 30-cow herd.

Table 11. Changing chore system by substituting capital for labor—years necessary for the labor saved to repay the capital invested. (Labor charged at $1 per hour in the winter and at $2 per hour in the summer and supplemental seasons)

Changes made from System I at 40 cows	Units	Alternative chore systems								
		Grade B			Grade A					
		II	III	IV	V	VI	VII	VIII	IX	X
		Mechanized stanchion	Switch milking	Four-stall parlor	Six-stall parlor	Double four herringbone	Improved pasture	Green chop	Storage feeding	Double five herringbone
Cost of new facilities to go from System I to alternative system	Dollars	$3,400	$3,600	$3,900	$7,600	$12,600	$16,100	$16,600	$16,900	$15,300
Labor used by seasons										
Winter*	Hours	1,801	1,841	1,642	1,470	1,424	1,413	1,413	1,417	1,398
Summer and supplemental	Hours	1,098	1,231	1,083	944	898	939	991	892	885
Total per year†	Hours	2,899	3,072	2,725	2,414	2,322	2,352	2,404	2,309	2,283
Labor saved per year over System I	Hours	295	112	459	770	862	832	780	875	901
Value of labor saved by the alternative system†	Dollars	$316	$9	$504	$959	$1,094	$1,023	$918	$1,110	$1,145
Time to repay the added capital with the labor saved	Years	10.8	400.0	7.7	7.9	11.5	15.7	18.1	15.2	13.4

* System I labor needs are: 2,055 hours in winter and 1,129 hours in summer for 40 cows in the herd.
† Total labor for System I is valued at $4,313 for a 40-cow herd.

herd sizes it may very well be an alternative worthy of consideration.

Systems VII, VIII, and IX (improved pasture, green chop, and storage feeding) are essentially forage feeding modifications of VI. They show both increased labor and capital needs over VI. Under the conditions set forth in this analysis, they appear as feasible considerations for large herds only. Even then, unless offsetting gains in milk production materialize from the improved forage feeding not considered here, these systems do not show up favorably in this analysis. Most dairymen are unlikely to make these kinds of investments if it takes over 15 years to make them pay off in value of labor saved.

Two other aspects should be noted when comparing these three systems. One is that System VIII, with its green chopping, demands relatively more of the high priced summer labor than the other two systems. On the other hand, while System IX (storage feeding) shows up best in this comparison, no account is taken here of the increased labor needs of harvesting extra forage in this year-round storage feeding system.

The previous analysis leads up to a system that may be called "best for large herds." This alternative, System X, or the double five herringbone shows a rather rapid decrease in time needed for the value of labor saved to pay off the added capital as herd size is increased from 20 to 40. The fixed time for this system is high but the added time per added cow is relatively low. Hence, at herd sizes of 50 or more cows it becomes an alternative to consider for reducing labor chore time in dairying.

A Comparison Of Labor Requirements For Chore Systems

The core of this section consists of four tables that summarize and compare the labor requirements of the 10 chore systems. The first three of these tables are based on the labor needs per week in the periods previously mentioned, the winter-barn or yard feeding, the summer or pasture feeding, and the fall or supplemental forage feeding seasons of the year. These three tables show the fixed time, the added time per cow with associated young stock, and the total chore time per week for herds of 15 to 60 cows for each system.

A comparison of the data in tables 12, 13, and 14 will show that the fixed and added hours per cow per week will vary by system and by season. It also shows that the size of herd at which the systems are compared affects the way they rank in terms of total hours per week required to care for the herd.

A procedure has been presented earlier for developing estimates of total time per year for a given size herd. The total hours per week data in tables 12, 13, and 14 provide a shortcut method that will produce about the same results. One needs simply to multiply the total chore hours per week by the number of weeks per season and add up for all seasons. In this way one can adjust for seasons of any length.

However, the estimates based on this shortcut method will differ slightly from those based on the procedure presented earlier. One reason will be the matter of the rounding of figures in these tables. Another reason will be that this shortcut procedure neglects the time required to

Table 12. Winter season labor: fixed per system, per cow added, and total for the herd per week

System description	Winter labor (29 weeks)		Number of cows, with their associated young stock in herd				
	Fixed for systems	For an added cow	15	20	30	40	60
	hours per week		total chore hours per week to nearest hour				
Stanchions: "B" milk							
I. Typical: unmechanized	16.5	1.36	37	44	57	71	.....
II. Mechanized	13.5	1.21	32	38	50	62	.....
Loose housing: "B" milk							
III. Switch milking	14.0	1.16	31	37	49	60	83
IV. Four-stall level parlor	15.3	.95	30	34	44	53	72
Loose housing: "A" milk							
V. Six-stall level parlor: pipeline	16.7	.79	28	32	40	48	64
VI. Double four herringbone: pipeline	21.5	.61	31	34	40	46	58
Loose housing: improved feeding: "A" milk							
VII. RAD pasture and added silage	18.6	.66	29	32	39	45	58
VIII. Green chopping	18.6	.66	29	32	39	45	58
IX. Storage feeding	17.7	.67	28	31	38	44	58
X. Double five herringbone	24.0	.50	31	34	39	44	54

Table 13. Summer season labor: fixed per system, per cow added, and total per week for the herd

System description	Summer labor (15 weeks)		Number of cows, with their associated young stock in herd				
	Fixed for systems	For an added cow	15	20	30	40	60
	hours per week		total chore hours per week to nearest hour				
Stanchions: "B" milk							
I. Typical: unmechanized	12.5	.91	26	30	40	49	.....
II. Mechanized	8.2	.98	23	28	38	47	.....
Loose housing: "B" milk							
III. Switch milking	13.1	1.01	28	33	43	53	73
IV. Four-stall level parlor	14.4	.82	27	31	39	47	63
Loose housing: "A" milk							
V. Six-stall level parlor: pipeline	14.1	.69	24	28	35	42	55
VI. Double four herringbone: pipeline	18.9	.52	27	29	34	40	50
Loose housing: improved feeding: "A" milk							
VII. RAD pasture and added silage	19.5	.52	27	30	35	40	51
VIII. Green chopping	19.7	.60	29	32	38	44	57
IX. Storage feeding	12.3	.67	22	26	32	39	52
X. Double five herringbone	18.6	.50	26	29	33	38	48

Table 14. Supplemental season labor: fixed per system, per cow added, and total per week for the herd

System description	Supplemental season (8 weeks) labor		Number of cows, with their associated young stock in herd				
	Fixed for systems	For an added cow	15	20	30	40	60
	hours per week		total chore hours per week to nearest hour				
Stanchions: "B" milk							
I. Typical: unmechanized	13.7	.91	27	32	41	50	...
II. Mechanized	9.6	.98	24	29	39	49	...
Loose housing: "B" milk							
III. Switch milking	12.1	1.04	28	33	43	54	74
IV. Four-stall level parlor	13.4	.85	26	30	39	47	64
Loose housing: "A" milk							
V. Six-stall level parlor: pipeline	12.4	.69	23	26	33	40	54
VI. Double four herringbone: pipeline	17.3	.52	25	28	33	38	48
Loose housing: improved feeding: "A" milk							
VII. RAD pasture and added silage	15.5	.66	25	29	35	42	55
VIII. Green chopping	15.5	.66	25	29	35	42	55
IX. Storage feeding	12.3	.66	22	26	32	39	52
X. Double five herringbone	18.6	.50	26	29	33	38	48

Table 15. The effect of herd size on average hours per cow per year by systems: also the fixed time per system and added hours per cow per system

System description	Yearly hours of labor		Number of cows, with their associated young stock in herd				
	Fixed for systems	For an added cow	15	20	30	40	60
	hours per year		average hours per cow				
Stanchions: "B" milk							
I. Typical: unmechanized	774	60.2	112	99	86	80	...
II. Mechanized	593	57.6	97	87	77	73	...
Loose housing: "B" milk							
III. Switch milking	715	59.0	107	95	83	77	71
IV. Four-stall level parlor	784	48.5	101	88	75	68	62
Loose housing: "A" milk							
V. Six-stall level parlor: pipeline	812	40.6	95	81	68	61	54
VI. Double four herringbone: pipeline	1,063	31.5	102	85	67	58	49
Loose housing: improved feeding: "A" milk							
VII. RAD pasture and added silage	981	34.3	100	83	67	59	51
VIII. Green chopping	984	35.5	101	85	68	60	52
IX. Storage feeding	785	38.1	90	77	64	58	51
X. Double five herringbone	1,105	29.4	103	84	66	57	48

open silos and clean out the manure pack. Those jobs were not allocated by weeks but appear in the yearly totals.[14]

Table 15 is the fourth table of comparisons. It is similar in construction to the other three and presents the labor requirements on an annual basis. It does not present, however, the total annual hours for herds of various sizes. Instead it shows the results of dividing the total hours by number of cows and thus produces the traditional "average hours per cow per year."

The previous analysis suggests that this type of comparison is not an entirely valid one to use for selecting among systems. It has several faults. It covers up the differences between systems by seasons or weeks and thus also the demands for labor at critical times. Put another way, if labor is valued differently through the year this procedure does not let one consider this in comparing systems. A comparison by shorter periods of time can include this factor in the analysis.

Further, the figure, "hours per cow" as an average for herds of varying size fails to point out the effect of herd size on average labor requirements. Also, it fails to accurately indicate the time required to add another cow to the herd. However, hours per cow are presented in table 15 in such a manner that the reader can observe how herd size and chore system do influence average labor requirements.

A comparison of the labor data in tables 12, 13, 14, and 15 for these 10 systems suggests certain general conclusions that would apply to any other chore system developed from the same data. These general conclusions are:

(1) The size, or scale of the dairy enterprise is an important factor in the efficiency and economy of labor use for any dairy chore system. The systems discussed show that labor efficiency or economy varies among systems as herd size changes. Some systems are better for big herds, others for small. But irrespective of system:

(a) As herd size increases, total labor needs show a less than proportional increase,

(b) As herd size increases, hours per cow in the herd decrease. Thus, there is an increase in efficiency as measured in hours per cow.

(2) The dairy husbandry practices and techniques may also affect labor needs. Some changes in practices may actually improve care and reduce labor. Others may have the opposite effect. Some do not seem to influence labor needs. And once again the effect on efficiency is influenced by the herd size.

[14] Labor for these tasks was priced in the earlier analysis at $1 per hour on the assumption that this work would be done at times when there was little demand for labor elsewhere.

Appendix A:
Analyzing A Single Task

The dairy labor data in this study can also be used to select the "best" way to do a particular task. For example, a dairyman may wish to know whether winter feeding of silage from an upright silo takes more time than from a horizontal. This dairyman feeds 30 head—20 cows and 10 young stock. In his plans the silage from the upright is to be fed once a day by throwing it down into a wagon-bunk, in which the silage is hauled from the service yard side of the barn into the barnyard for feeding. He further plans the horizontal as a trench dug into a nearby hillside, and that silage is hauled from it to the barnyard once a day on a tractor snowscoop, a common procedure for feeding from this type of silo. The necessary information from table 3, Appendix B, is summarized in table 1, Appendix A, and shows that .23 of an hour per week is saved by feeding from a horizontal with a tractor scoop.

From the figures in table 1, Appendix A, the dairyman can also determine how much time it takes to feed from both silos at the same time. The answer is 5.69 hours fixed time plus .031 hours per each head fed or a total of 6.63 hours for 30 head. Note that this amount is the same as 5.69 hours plus .047 times the number of cows (20) in the herd. Note the similarity between the headings in table 1, Appendix A, and those in table 3, Appendix B.

Table 1. A procedure for selecting a silage feeding system on the basis of labor use. (Two task functions are abstracted from table 3, Appendix B, to illustrate how these data may be used)

Number	Task and description of method	See table 3, Appendix B: Hours of fixed time required per week	See table 3, Appendix B: Hours per week to add for each animal handled	Hours to feed 30 head	See table 3, Appendix B: Animals handled as a percentage of cows in herd	Hours per week to add for each cow in herd	Hours to feed silage to a herd of 20 cows and their replacements
		A	B	C = A + B × 30	D	E = B × D	F = C = A + E × 20
	Silage feeding: upright silos						
7	One time per day, hand methods, hauled to bunk	2.49	.031	3.43	150%	.047	3.43
	Silage feeding: Horizontal silos						
13	Tractor scoop direct to bunk one time per day	3.20	.....	3.20	150%	.....	3.20
	Savings in labor per week in winter season by using method 13 instead of 7			.23 (hours per week for 20 cows or 30 head)			.23
	Labor used per week if both tasks are done during that week	5.69	.031	6.63	.....	.047	6.63
	Read the above line as follows: (5.69 hrs. + .031 hrs. per head × 30 head fed) = 6.63 hrs. = (5.69 hrs. + .047 hrs. per cow × 20 cows in herd)						

Appendix B:
Basic Labor Data

The information in tables 1 through 5 has been referred to several times in this bulletin. The tables enumerate many task functions for dairy chore labor.

Table 1. Labor used in 1 week of the winter barn feeding season—stanchion barns

Number	Task and description of methods	Hours of fixed time required per week	Hours per week to add for each animal handled	Animals handled as a percentage of cows in herd	Hours per week to add for each cow in herd
		hours	hours	percent	hours
	Milking				
1	Two single units, worker, barns with rows arranged lengthwise	0.65	.812	89	.723
2	Three single units, one worker, barns with rows arranged lengthwise —1.69		.724	89	.644
	Cleaning and preparation of utensils				
3	Two single units, manufacturing milk, cans	3.62	.....	.....	.....
5	Three single units, manufacturing milk, cans	4.42	.....	.....	.....
	Hay feeding: stanchion cattle				
11	Baled hay, fed twice a day	1.47	.036	107	.038
	Silage feeding				
12	Mechanical unloader with cart	0.77	.062	105	.065
13	Manually unloaded with cart	1.40	.062	105	.065
	Grain feeding				
15	Fed twice a day	.99	.038	103	.039
	Manure handling				
16	Gutter cleaner	2.26	.063	107	.067
17	Conventional methods (composite)	2.81	.124	107	.132
	Bedding				
19	Baled and chopped (composite)	1.08	.029	107	.031
20	**Other routine work**	0.55	.055	111	.061
21	**Care of dairy cattle not in stanchions**	2.80	.183	92	.168
	Miscellaneous labor				
23	Dairy cattle in stanchions	.96	.....	.....	.....
24	Dairy cattle not in stanchions	.18	.....	.....	.....
45	Open silo: 2.17 hours (per silo)	2.17	.....	.....	.....
46	Feed grinding (65.4 pounds per week per cow in herd)	.....	.100	100	.100
	System I—totals for a winter week; Lines 1, 3, 11, 13, 15, 17, 19-24, 46	16.51	.....	.....	1.357
	System II—totals for a winter week; Lines 2,* 5,* 11, 12,* 15, 16,* 19-24, 46	13.52	.....	.....	1.213

* Changes from System I.

Source: Abstracted from more complete tables in H. J. Aune and L. M. Day, "Determining the Effect of Size of Herd and Equipment on Dairy Chore Labor," *Journal of Farm Economics*, Vol. XLI, August 1959, pp. 577, 579. Similar information on these and other work methods is available in Minnesota Station Bulletin 449.

Table 2. Labor used in a week of the summer pasture feeding season, stanchion barns

Number	Task and description of methods	Hours of fixed time required per week	Hours per week to add for each animal handled	Animals handled as a percentage of cows in herd	Hours per week to add for each cow in herd
		hours	hours	percent	hours
	Milking				
1	Two single units, barns with rows arranged lengthwise	2.28	.652	84	.548
2	Three single units, one worker, barns with rows arranged lengthwise —2.99		.735	84	.617
	Cleaning and preparation of utensils				
3	Two single units, manufacturing milk, cans	3.72	.....	.....	.....
5	Three single units, manufacturing milk, cans	4.32	.....	.....	.....
	Hay feeding (supplemental season)				
9	Baled hay, fed outside	1.41	.....	.....	.....
	Grain feeding				
15	Fed twice a day	1.72	.....	.....	.....
	Manure handling				
16	Gutter cleaner	1.63	.....	.....	.....
18	Conventional methods, manufacturing milk producers	1.05	.....	.....	.....
19	**Bedding** —0.19		.050	98	.049
20	**Other routine work**	2.82	.....	.....	.....
	Care of dairy cattle not in stanchions				
21	Pens only —0.16		.367	52	.191
22	Pastured separately only	0.48	.067	101	.068
	Miscellaneous labor				
23	Dairy cattle in stanchions	0.62	.....	.....	.....
24	Dairy cattle not in stanchions —0.08		.013	100	.013
46	Feed grinding (65.4 pounds per week per cow in herd)	.....	.040	.....	.040
	System I—totals: Pasture Season Lines 1, 3, 15, 18-24, 46	12.26	.....	.....	.908
	Add line 9 for Supplemental Season	13.67	.....	.....	.908
	System II—totals: Pasture Season Lines 2,* 5,* 15, 16,* 19-24, 46	8.17	.....	.....	.977
	Add line 9 for Supplemental Season	9.58	.....	.....	.977

* Changes from System I.

Source: Abstracted from more complete tables in H. J. Aune and L. M. Day, "Determining the Effect of Size of Herd and Equipment on Dairy Chore Labor," *Journal of Farm Economics*, Vol. XLI, August 1959, pp. 577, 579. Similar information on these and other work methods is available in Minnesota Station Bulletin 449.

Table 3. Labor used in 1 week of the winter barn feeding season: loose housing

Number	Task and description of methods	Hours of fixed time required per week	Hours per week to add for each animal handled	Animals handled as a percentage of cows in herd	Hours per week to add for each cow in herd
		hours	hours	percent	hours
	Hay feeding				
1	Baled: fed 1 time per day (adjacent storage)	1.53	.012	150	.018
2	Baled: fed 1 time per day (hauled)	1.44	.012	150	.019
3	Baled: fed 2 times per day (adjacent storage)	0.85	.025	150	.037
4	Baled: fed 2 times per day (hauled)	1.93	.025	150	.037
5	Chopped: fed 1 time per day (adjacent storage)	1.02	.026	150	.039
	Silage feeding: upright silos				
6	1 time per day: hand methods (adjacent bunk)	1.03	.060	150	.090
7	1 time per day: hand methods (hauled to bunk)	2.49	.031	150	.047
8	1 time per day: unloader to adjacent bunk	—1.85	.097	150	.146
9	1 time per day: unloader to mechanical bunk	—2.74	.098	150	.147
10	2 times per day: unloader to mechanical bunk	—1.52	.099	150	.149
	Silage feeding: horizontal silos				
11	Self fed 1 time per day (65 head and less)	2.40	.....	.....	.....
12	Self fed 2 times per day (65 head and more)	3.90	.....	.....	.....
13	Tractor scoop direct to bunk: 1 time per day	3.20	.....	.....	.....
14	Tractor scoop hauled to bunk: 1 time per day	4.70	.....	.....	.....
	Calf care and feeding				
21	Calves have automatic water	1.84	.114	50	.057
22	Calves are watered by hose or pails	—.83	.339	50	.169
	General cleaning				
23	All herds (includes scraping yard and holding area)	0.39	.069	100‡	.069
	Bedding the herd				
24	All types bedding: Grade A milk	1.41	.034	150	.052
25	All types bedding: Grade B milk	.82	.030	150	.045
	Preparation for milking				
26	Grade A: automatic pipeline washer, 2 units	2.92	.....	.....	.....
27	Grade A: automatic pipeline washer, 3 and 4 units	4.03	.....	.....	.....
28	Grade A: pipeline, no washer, 2 units	2.91	.....	.....	.....
29	Grade A: pipeline, no washer, 3 and 4 units	3.73	.....	.....	.....
30	Grade B: pipeline (all) 3 and 4 units	2.92	.....	.....	.....
31	Grades A and B: pail units, 2 units	2.23	.....	.....	.....
32	Grades A and B: pail units, 3 and 4 units	3.24	.....	.....	.....

Table 3 (Continued). Labor used in 1 week of the winter barn feeding season: loose housing

Number	Task and description of methods	Hours of fixed time required per week	Hours per week to add for each animal handled	Animals handled as a percentage of cows in herd	Hours per week to add for each cow in herd
		hours	hours	percent	hours
	Actual milking (one operator)				
33	Switch system in stanchions,* 2 units	—.14	.952	89	.847
34	Level abreast walk through:* 2 units, 4 stall	1.19	.722	89	.642
35	Level abreast walk through: 3 units, 6 stall	—1.21	.530	89	.472
36	Side opening, no pipeline: 2 units, 3 stall	5.70	.500	89	.445
37	Side opening, pipeline: 3 units, 3 stall	6.16	.477	89	.425
38	Side opening, pipeline: 4 units, 4 stall	5.90	.369	89	.328
39	Lane stalls, no pipeline: 2 units, 4 stall	4.99	.659	89	.587
40	Herringbone,* pipeline: 3 units, 6 stall†	1.13	.438	89	.390
41	Herringbone, pipeline: 4 units, 8 stall	1.30	.328	89	.292
42	Herringbone, pipeline: 5 units, 10 stall	1.60	.306	89	.272
43	Herringbone, pipeline: 6 units, 12 stall	1.74	.256	89	.228
	Cleanup after milking				
44	Grade A: pipeline, parlor hosed out	5.63	.....	.....	.....
45	Grade B: pipeline, parlor hosed out	5.32	.....	.....	.....
46	Grade A: pail units, parlor hosed out	7.06	.....	.....	.....
47	Grade B: pail units, parlor hosed out	3.44	.....	.....	.....
48	Average when parlor is not hosed out	3.33	.....	.....	.....
	Cleaning the bulk tank				
49	All tank sizes and types	1.71	.....	.....	.....
	Irregularly performed miscellaneous task: average time per week				
50	Care of fresh cows and new calves, general health care	0.26	.010	100‡	.010
51	Breeding chores: using a bull	.05	.011	100	.011
52	Breeding chores: artificially	—.00	.011	100	.011
53	Grain grinding: mill at home	1.18	.009	100	.009
54	Other miscellaneous including minor (fence and other) repairs	1.51	.....	.....	.....

Lines or tasks from table 3 that are added together to estimate a winter week's chore time in the loose housing systems:

System III includes lines: 1, 6, 21, 23, 25, 31, 33, 48, 50, 52, 53, 54.
System IV includes lines: 1, 6, 21, 23, 25, 31, 34, 48, 50, 52, 53, 54.
System V includes lines: 1, 6, 21, 23, 24, 29, 35, 48, 49, 50, 52, 53, 54.
System VI includes lines: 1, 6, 21, 23, 24, 29, 41, 44, 49, 50, 52, 53, 54.
System VII includes lines: 1, 8, 21, 23, 24, 29, 41, 44, 49, 50, 52, 53, 54.
System VIII includes lines: 1, 8, 21, 23, 24, 29, 41, 44, 49, 50, 52, 53, 54.
System IX includes lines: 1, 9, 21, 23, 24, 29, 41, 44, 49, 50, 52, 53, 54.
System X includes lines: 1, 13, 21, 23, 24, 29, 42, 44, 49, 50, 52, 53, 54.

* Because of insufficient cooperators using certain milking systems the data were supplemented with task functions developed from the following sources:

(a) Switch Systems: Unpublished data obtained by Robert Knisely, Dairy Department, Michigan State University, in a survey of Michigan DHIA herds in January 1959.

(b) Level abreast parlors: Thayer Cleaver, *A Comparison of Milking Practices, East, West, and Midwest*, a mimeograph of Farm Buildings Section, AERB, ARS, USDA (post 1954).

(c) Herringbone Parlors: Earl Fuller and Russell E. Larson, "Herringbone Milking Parlors," *Minnesota Farm and Home Science*, Vol. XVII, No. 2, pp. 7 and 18, February 1960.

† Limited data would also indicate that the six-stall, three-pipeline unit lane parlor should perform similar to the six-stall, three-unit Herringbone.

‡ All functions for general cleaning, irregularly performed tasks and cleaning out the manure pack are based on the number of cows in the herd rather than the number of animals handled. This should be kept in mind when making estimates from these data.

Table 4. Labor used in 1 week of the summer pasture and supplemental season: loose housing

Number	Task and description of methods	Hours of fixed time required per week	Hours per week to add for each animal handled	Animals handled as a percentage of cows in herd	Hours per week to add for each cow in herd
		hours	hours	percent	hours
	Hay feeding				
1	Baled: fed 1 time per day (or less)	0.54	.026	120	.031
3	Baled: fed 2 times per day	1.03	.026	120	.031
5	Chopped: fed 1 time per day (adjacent storage)	0.46	.026	120	.031
	Silage feeding: upright silos				
6	One time per day: hand methods (adjacent bunk)	0.72	.055	120	.066
	Silage feeding: horizontal silos				
11	Self fed	2.04	.....	.....	.....
13	Tractor scoop direct to bunk	3.24	.....	.....	.....
	Feeding green chop (soilage)				
15	Self-feeding wagon	1.72	.068	120	.082
16	Power unloading wagon	1.93	.117	120	.140
17	Wagon unloaded by hand	2.05	.153	120	.184
	Pasturing and herding				
18	When green chop feeding	1.42	.....	.....	.....
19	Regular pasturing: lane to barn	2.33	.....	.....	.....
20	Daily rotational pasturing	2.95	.....	.....	.....
	Calf care and feeding				
21	Calves have automatic water	—.96	.341	43	.146
22	Calves are watered by hose or pails	.58	.342	43	.146
	General cleaning				
23	All herds (includes scraping yard and holding area)	.92	.021	100‡	.021
	Bedding the herd				
24	All bedding	.93	.016	25	.004
	Preparation for milking				
26	Grade A: automatic pipeline washer, 2 units	2.90	.....	.....	.....
27	Grade A: automatic pipeline washer, 3 and 4 units	3.77	.....	.....	.....
28	Grade A: pipeline, no washer, 2 units	2.68	.....	.....	.....
29	Grade A: pipeline, no washer, 3 and 4 units	3.35	.....	.....	.....
30	Grade B: pipeline (all), 3 and 4 units	2.83	.....	.....	.....
31	Grade A and B: pail units, 2 units	2.38	.....	.....	.....
32	Grade A and B: pail units, 3 and 4 units	2.86	.....	.....	.....
	Actual milking (one operator)				
33	Switch system: in stanchions,* 2 units	—.14	.952	84	.800
34	Level abreast walk through,* 2 units, 4 stall	1.19	.722	84	.606
35	Level abreast walk through, 3 units, 6 stall	—1.21	.530	84	.445
36	Side opening, no pipeline, 2 units, 3 stall	5.70	.500	84	.420

Table 4 (Continued). Labor used in 1 week of the summer pasture and supplemental season: loose housing

Number	Task and description of methods	Hours of fixed time required per week	Hours per week to add for each animal handled	Animals handled as a percentage of cows in herd	Hours per week to add for each cow in herd
		hours	hours	percent	hours
37	Side opening, pipeline, 3 units, 3 stall	4.25	.475	84	.399
38	Side opening, pipeline, 4 units, 4 stall	6.79	.309	84	.260
39	Lane stalls, no pipeline, 2 units, 4 stall	2.92	.687	84	.577
40	Herringbone,* pipeline, 3 units, 6 stall†	1.13	.438	84	.368
41	Herringbone, pipeline, 4 units, 8 stall	1.30	.328	84	.276
42	Herringbone, pipeline, 5 units, 10 stall	1.60	.306	84	.257
43	Herringbone, pipeline, 6 units, 12 stall	1.74	.256	84	.215
	Cleanup after milking				
44	Grade A: pipeline, parlor hosed out	5.57	.....	.....	.....
45	Grade B: pipeline, parlor hosed out	4.78	.....	.....	.....
46	Grade A: pail units, parlor hosed out	7.66	.....	.....	.....
47	Grade B: pail units, parlor hosed out	4.27	.....	.....	.....
48	Average when parlor is not hosed out	3.94	.....	.....	.....
	Cleaning the bulk tank				
49	All tank sizes and types	1.25	.....	.....	.....
	Irregularly performed miscellaneous tasks: average time per week				
50	Care of fresh cows and new calves and general health care	0.21	.008	100‡	.008
51	Breeding chores: using a bull	0.23	.002	100	.002
52	Breeding chores: artificially	—0.09	.008	100	.008
53	Grain grinding: mill at home	0.16	.023	100	.023
54	Other miscellaneous including minor (fence and other) repairs	1.83	.....	100	.....

Lines or tasks from table 4 that are added together to estimate a week's chore time in the loose housing system:

Numbers in brackets ( ) are included in summer season totals only.
Numbers that are starred * are included in supplemental season totals only.
Numbers that are neither starred nor bracketed are in both season totals.
System III includes lines: 1,* 19, 21,* (22), 23, 24, 31, 33, 48, 50, 52, 53, 54.
System IV includes lines: 1,* 19, 21,* (22), 23, 24, 31, 34, 48, 50, 52, 53, 54.
System V includes lines: 1,* 19, 21,* (22), 23, 24, 29, 35, 48, 49, 50, 52, 53, 54.
System VI includes lines: 1, 19, 21,* (22), 23, 24, 29, 41, 44, 49, 50, 52, 53, 54.
System VII includes lines: 1, 8,* 19,* (20), 21,* (22), 23, 24, 29, 41, 44, 49, 50, 52, 53, 54.
System VIII includes lines: 1, 8,* (15, 18), 19,* 21,* (22), 23, 24, 29, 41, 44, 49, 50, 52, 53, 54.
System IX includes lines: 1, 9, 21, 23, 24, 29, 41, 44, 49, 50, 52, 53, 54.
System X includes lines: 1, 13, 21, 23, 24, 29, 42, 44, 49, 50, 52, 53, 54.

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Table 5. Labor used in 1 year for nonchore loose housing dairy work

Number	Task and description of methods	Hours of fixed time required per year	Hours per year to add for each cow in herd
	Cleaning out the manure pack		
56	"Usual procedure": 1 major cleanout plus several smaller ones	15.28	1.938*
57	Several major cleanouts spread throughout the year	—20.76	3.544*
	Opening and cleaning: time per silo		
58	Opening an upright by hand	1.86	.....
59	Opening an upright with an unloader	4.83	.....
60	Cleaning and repairing an upright	4.00	.....
61	Opening a horizontal	2.21	.....

Lines or tasks from table 5 that are added together to estimate the yearly time to open silos and remove the manure pack in the loose housing system:
Systems III through VIII include lines 56 and 58.
System IX includes lines 57 and 58.
System X includes lines 57 and 61.

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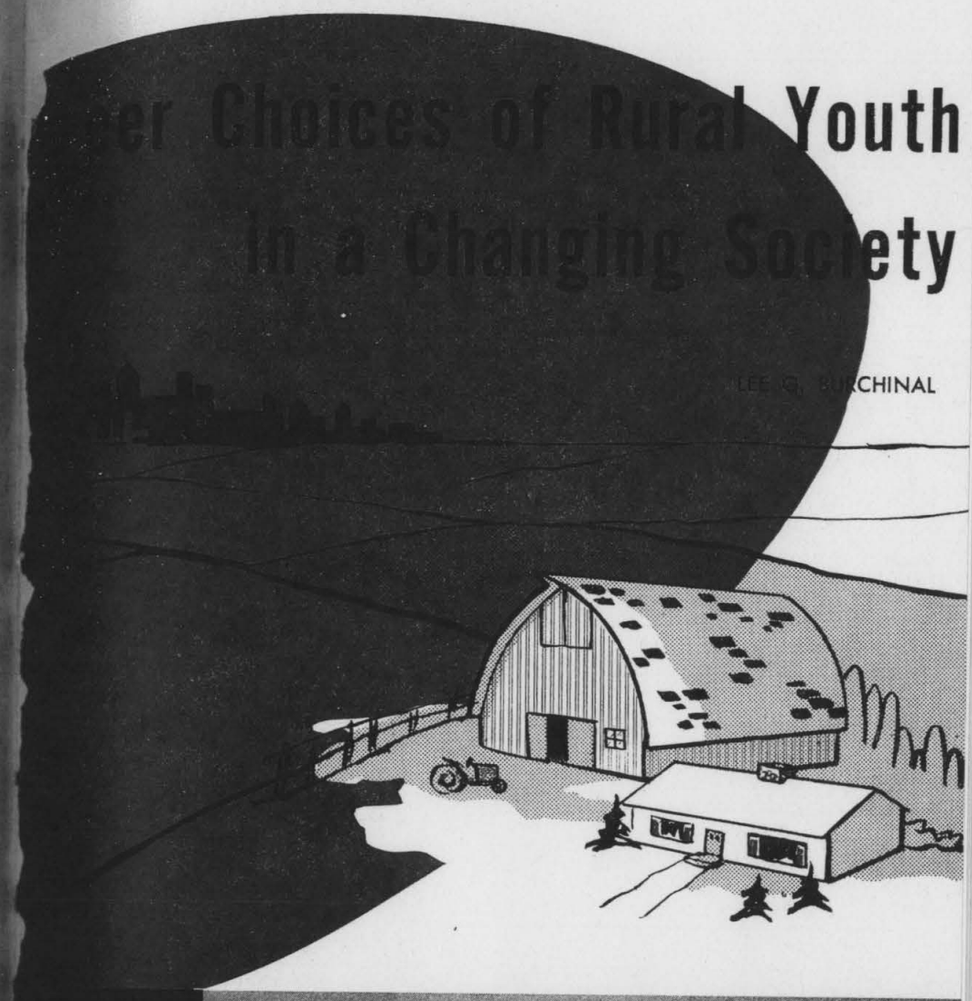
Information on labor for evaluating possible changes in farm organization is available for stanchion herds in Minnesota Agricultural Experiment Station Bulletin 449, *Effect of Herd Size on Dairy Chore Labor.* Station Bulletin 451, *Labor Used in Cattle Feeding* provides labor data for alternative beef feeding systems, while Station Bulletin 445, *Planning Farms for Increased Profits* shows how budgeting can be used for organizing labor data and other information into total farming plans. These publications, together with this bulletin, have been published by the Minnesota Station as aids to farm planning. Further bulletins are in process to point out the changes in total farm organization that appear profitable for various areas of the state.

...er Choices of Rural Youth
...in a Changing Society

...LEE G. BURCHINAL



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