SOME MICHIGAN DAIRY FARM ORGANIZATIONS DESIGNED TO USE LABOR EFFICIENTLY

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Earl Inman Fuller

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by

Earl Inman Fuller

AN ABSTRACT

Submitted to the College of Agriculture of Michigan
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Approved Glenn Johnson

ABSTRACT

The purpose of this study was to design dairy farm organizations which are competitive for labor with Michigan industry in wages, working conditions and fringe benefits. The usefulness of the study lies in its ability to improve the relative position of dairy farm workers and dairy farms as a business in our economy. This was acknowledged to be a farm management problem which required the incorporation of new technology into new farm organizations for solution. It was necessary to consider aspects of human behavior, of the work environment, of crop and livestock husbandry and of their various interactions. The data used were obtained from case studies of labor efficient and successful dairy farmers, from recent literature and from researchers and extension personnel.

The following are some of the procedures suggested by the study for increasing the earning power of labor and improving working conditions:

1. Dairy enterprise; Use loose housing and design a building layout so that all areas are observable from the milk house to save steps and make herd management easier. Build a milking room capable of handling a minimum of forty cows per man per hour. Milking rooms where this is possible were observed and are felt capable of wider usage. Some designs appear capable of permitting a swing man to milk at about the same rate; an important consideration in making

labor competitive. The whole chore work environment can be simplified and made more flexible in its demands for time by using self feeding forage structures, easy to clean materials, adequate and specialized tools, efficient work methods, and by design to save or even eliminate work travel and effort.

2. Crops enterprise; Labor adequate to handle the dairy enterprise and provide swing workers for days off is sufficient to handle most field work as well on specialized dairy farms. While time can be saved in many operations by supplying adequate and well designed equipment, and by careful coordination, the one big problem is harvesting sufficient high quality forage for a large dairy herd. For this task, procedures are discussed with high capacity, adequately powered forage harvesters as the key to solving this problem. Under Michigan conditions, it is felt that corn and grass silage stored in horizontal silos can supply the major part of this kind of forage more economically than can the other alternatives observed on the farms in the study. It is evident that the coordination and integration of tasks in forage harvest is of great importance in producing a large volume of high quality material.

3. Maintenance and repair; The production of crops and livestock implies a need for maintenance and repair. Inasmuch as dairy chores must be done every day and crops work is seasonal, off seasons provide time which can be spent

productively at these tasks. Good tools, a shop and skilled workers are necessary. Attention to maintenance, repair and construction needs can supply new and maintain old capitol items at considerable savings to the firm as well as reduce time requirements for other work during rush seasons.

4. Personnel relationships; It is the "sum total" of wages, working conditions and fringe benefits which must be compared with conditions in industry if dairy farms are to compete for labor. An understanding of human behavior, flexibility in job assignment, provision for social security and compensation insurance, active employee-employer communication and sufficient labor flexibility to provide vacations and days off must be built into an organization if it is to be competitive for labor.

5. Management; On most farms, time spent managing conflicts with time spent laboring. Further, the more units of production, the more important the making of correct managerial decisions become. For these reasons, the development of a labor efficient dairy farm requires that management be efficient as well. A pleasant well organized office and record system is necessary. Specialization decreases the number of different kinds of decisions managers must make. For most people, an improvement in the abilities to observe and analyze would help their ability to make decisions. Environments which permit delegation of supervision and contain built-in double checks on management are suggested.

Budgets are developed for situations varying from 30 cows producing 10,000 pounds of 3.5 percent milk per cow and one man, up to one with 360 cows producing 12,000 pounds of milk per cow and handled by nine men. In the former case, returns were too low to pay a five percent return on the investment and \$4,800 in wages to the operator. Such an operation has difficulty in providing working conditions and fringe benefits comparable to those in industry with four dollar milk and other corresponding economic conditions. Milk at \$4.25 does not improve the situation sufficiently either.

In the two man operations, working conditions improved and a business profit was made. However a truly competitive organization from the labor standpoint was not obtained. The three men operations appeared to be more nearly competitive.

In the case of the 360 cow budgets, developed under the same general assumptions, it appeared that wages, working conditions, fringe benefits and business profits could be such as to compete with industry. A farm of this size would require an investment of over \$600,000. Inasmuch as such a sum is likely to require farm financing of a different type than is common today, this study suggests a need for further work in the area of farm credit if Michigan dairy farmers are to compete for labor.

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CHAPTER I

THE PROBLEM

Today, many of Michigan's commercial dairy farm operators are confronted with the following:

1. Labor incomes on most Michigan farms have declined recently.

2. Many have well paying, off-the-farm alternatives for the use of their labor.

3. In spite of recent technological advances, there are limitations on how much farm operators can accomplish and hence, how much they can earn at the prices our economy places on the products they produce.

4. Hired labor often fails to earn high enough returns to justify its use.

5. A trend seems toward larger farms with higher investment per farm and greater production per worker in order to maintain living standards.

6. Greater and greater emphasis is being placed on the management of resources as investments increase in farming.

7. Off the farm occupations seem capable of yielding more leisure and more attractive working conditions.

8. Adjustment to present economic trends is deterred because of low salvage values for many fixed assets.

Labor earns less in farming than in most other segments of our society. Yet, according to <u>Productivity of Resources Used on Commercial Farms</u>, it is the chief single input item in the major part of our agricultural economy.[1] When labor earnings are figured residually, as in the Michigan Farm Account Project, net labor income has accounted for around one-half of the net returns in farming over the past few years.

Technology has changed very rapidly in the last century in this country. With it has come social and economic changes. The majority of the labor force now works 40 hours per week. The United Automobile Workers are now considering a 32 hour week. Working in automobile manufacturing is a major alternative for Michigan farm labor. By contrast, dairying as typically organized is a long hours per day, seven days a week occupation. As our society now values their production, many dairy farmers ask if farming has opportunities equal to industry for them.

Concurrently with these seemingly better labor alternatives, it must also be remembered that Michigan dairy farmers have good markets and that they hold a large investment in farming.

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[1] Edwin Strand, Earl O. Heady and James H. Seagraves, <u>Productivity of Resources Used on Commercial Farms</u>, U.S.D.A. Technical Bul. 1128, November, 1955, p. 22.

Thus, the problem of labor earnings is particularly crucial on Michigan dairy farms today. They need ways to make their labor pay as well as off-the-farm alternatives. Michigan dairymen also need help to make their investments pay as well as investments in comparable businesses.

Review of Literature Indicating the Magnitude and Seriousness of the Problem

Most available data fall into three groups. The first two show the importance of the problem and suggest some solutions. They are (1) functional analyses of the earning power of input categories and (2) accounting analyses of farm businesses leading to estimates of residual earnings for family labor, all labor, and operator's labor and management. The third group is made up of labor efficiency studies for different building arrangements and crop production practices.

Both of the first two groups present a gloomy picture of labor earnings. Data within the groups are not strictly comparable because of differences in selection criteria and in the year each was collected. However, they are recent data and, in general, comparable.

Wagley estimated the marginal value productivity of input categories on Ingham-County dairy farms for 1952.[2]

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[2]Robert Vance Wagley, Marginal Productivities of Investments and Expenditures, Selected Ingham County Farms, 1952, Unpublished M.S. Thesis, Department of Agricultural Economics, Michigan State College, 1953.

His data were fitted to a Cobb-Douglas function. Results showed a marginal value product for labor of $30.19 for the last month of labor used. As will be noted shortly, this estimate was soon questioned for being too low. However, changes tried in order to get marginal value products nearer to the prices for their respective inputs could not raise the earning power for the last month of labor used past $51.60. The market price for hired labor in this area varies from $150 to $200 per month usually with additional benefits. At the same time, Wagley's original estimates showed labor earning $69 for the sixth month, $58 for the ninth, $30 for the twelfth and only $28 for the eighteenth month. In this same year, Oldsmobile in Lansing was paying a starting wage of around $1.80 per hour. Wagley concluded that the earning power of labor was too low to cover hired labor charges. He therefore suggested that less labor be used relative to other inputs but that the use of other inputs should, such as livestock-forage, land and machinery, be expanded. At the same time, he pointed out that improvement in the technology of labor use might also be a fruitful area in which to work.

Carter attempted to modify the Cobb-Douglas in order to destroy certain characteristics implied in the function fitted by Wagley.[3] The characteristic of concern was the

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[3] Harold O. Carter, Modification of the Cobb-Douglas Function to Destroy Constant Elasticity and Symmetry, Unpublished M. S. Thesis, Department of Agricultural Economics, Michigan State University, 1955.

implicit assumption that machinery or livestock-forage substitute for labor over an unlimited range. This is to say that unlimited amounts of machinery and livestock-forage can be handled with a fixed amount of labor and that such reorganizations would continue to increase gross income indefinitely. It was felt that a function with these characteristics might underestimate the marginal value productivity of labor.

With these criticisms in mind, Carter proceeded to modify the Cobb-Douglas function to eliminate certain of its undesirable characteristics. Working with Wagley's data, he limited the substitutability between machinery, or livestock-forage and labor. His modification introduced a ridge on the production surface. It's location was determined by a man's capacity to do work. The ridge was a straight line passing through the origin and through investments of $1300 in livestock-forage and $1000 in machinery for each month of labor used. The new fit was not statistically better. However, a slightly higher marginal value product for labor did result. Where Wagley obtained a $30.19 figure for the twelfth month, Carter obtained $86.27, an amount still to low to compete with off the farm alternatives.

Trant in a study designed to find a method for adjusting marginal value product estimates for changing prices fitted

1952 data for some selected northern Michigan farms.[4] He found that the "usual" farm was returning $15.11 for the last month of labor used. At the same time the earning power of labor and all the inputs associated with labor returned $16.97 per day. His conclusions were that too much labor was being used relative to other inputs and that labor was being paid from the earnings of other investments.

Schuh, while estimating a short run supply curve for milk in the Detroit milk shed, found labor difficult to price.[5] As some labor requirements do vary with milk production, he had to consider some labor as variable within the year even if fixed for the farm as a whole. He finally used 50¢ per hour which was below the wage rate and higher than the marginal value product. When he did this, he pointed out that during seasonal labor peaks, the opportunity cost of labor is high.

In a study of resource productivity for the entire United States, Strand, Heady, and Seagraves arrived at simi-

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[4] Gerald Ion Trant, A Technique of Adjusting Marginal Value Product Estimates for Changing Prices, Unpublished M. S. Thesis, Department of Agricultural Economics, Michigan State University, 1954.

[5] George Edward Schuh, A Short Run Supply Curve Estimate for Fluid Milk, Detroit Milk Shed, October 1951-September 1952, Unpublished M. S. Thesis, Department of Agricultural Economics, Michigan State College, 1954, pp. 44-45 and 51-54.

lar figures and conclusions.[6] Their data were for 1949, by farming areas. They concluded, from both functional analysis and residual analyses, that many farm families can attain a desirable level of living only if they increase the productivity of their labor inputs.

The U.S.D.A. publication, Agricultural Charts for 1956 indicated further the seriousness of the problem.[7] The income of people living on farms in the United States, in 1954, included $1.00 from off-farm sources for every $2.00 obtained from farming. The average total income per person in the United States is $1,837 for non-farmers and $913 for farm people in spite of an average investment of $14,000 per farm worker. These charts also point out that as our society develops man hours decrease in agriculture while output per worker increases. They go on to illustrate that the smallest efficiency gains in crops are those in hay production and the gains in livestock have not come as rapidly as those in crops. This would indicate that hay producing dairy farms are in a particularly crucial situation. Dairy farms in eastern Wisconsin returned only $.81 per hour with an average net income of $4,948 in 1951--a relatively good year.

Doneth in the Michigan Farm Business Report for 1955

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[6] E. G. Strand, et.al., op. cit.

[7] U.S.D.A., A.M.S., A.R.S., Agricultural Outlook Charts - 1956, Washington, D. C., November, 1955.

points out much the same problem.[8] His data indicate that it is time for effective measures to maintain dairy farm incomes. He points out that 34 percent of the 539 farmers in the project had labor incomes of zero or less--more than any year since the depression! While the particular accounting procedures used may make returns to labor and management appear worse than they really are, it is evident that returns are unsatisfactory. Interest on investment for the average farm in the data, by way of contrast, was $1,878. It is interesting to note that this unsatisfactory condition exists in spite of an increase in work units accomplished per man of 35 percent from 1947 to 1955.

Much literature exists which can be helpful in increasing labor productivity. Much of it (popular, technical, or descriptive) describes methods for combining inputs and the results thereof. However, most of this literature deals with either dairy production, or crops, or some other particular enterprise--not with the integration of the whole into a farm organization to satisfy the needs of Michigan dairy farmers.

Farm work simplification studies and materials handling techniques are extremely useful but open to the same criticism. While they may offer good enterprise data, they do not

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[8] John C. Doneth, "Michigan Farm Business Report for 1955," The Quarterly Bulletin, Michigan State University, Agricultural Experiment Station, Vol. 39, No. 2, November 1956, pp. 299 ff.

suggest a complete farm organization.

Some General Hypotheses and Assumptions

Several hypotheses and assumptions are made in this thesis.

First, it is hypothesized that solutions to the problem of low labor earnings exist and that these solutions can be adopted by farm operators. This amounts to a conviction that new and better resource combinations and technologies can be developed, learned and put into practice. Capable dairymen are required to place the solutions into force. Such people are available as dairy husbandry is skilled work performed by individuals at least as capable as the skilled workers of industry.

This thesis is normative in the sense that it attempts to make dairy farm labor earnings comparable to those of skilled industrial labor. Further, it is based on the conviction that the man who manages a dairy farm should receive management rewards and profits comparable to those secured by other individuals in the economy having similar responsibilities with regard to capital controlled and output produced.

At this stage, whether labor and management is performed by the same person has little bearing on the problem. What is important in that before labor can be performed in the specified environment, management must develop the environment. Certain assumptions are then required concerning management.[9] It is assumed management can be learned and improved.

Possible Effects on Farms and on Agriculture

Research on technological change should ask what such change might mean to both individual farms and to the agricultural economy as a whole. Examination can be simplified by dividing the effects into short and long run effects.

First of all, the ability to produce at lower unit cost would show a definite advantage to those farms which are the first innovators. Over time, such advantage tends to disappear. Even in competitive agriculture however, certain advantages might remain. Efficient use of machinery and relatively smaller investments in machinery and buildings reduce the problem of high fixed costs over time.

In the short run, the tendency is to increase the size of dairy units. This means fewer units which, with higher production per cow, will place greater economic pressures on inefficient producers. While in the long run there may always be some relatively inefficient producers, more mobility of resources to and from agriculture may make it possible to attain better adjustments for most individuals remaining in

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[9] Lawrence A. Bradford and Glenn L. Johnson, Farm Management Analysis, John Wiley and Sons, New York, 1953, pp. 11-12.

dairy farming.

If larger farming units and competitive wage rates are attained there may be a greater division between labor and management than exists today. Entirely new credit arrangements may evolve; just as family grocery store financing went out with the advent of the supermarket, family farm financing may go out with the one family dairy farm. That this is in conflict with the values, beliefs and goals held by society today may be true. But over time, attitudes change. With such change may come changes in the relationship of man to the soil, crops and livestock. To argue that this is good or bad is an open issue beyond the scope of this thesis; however, this thesis will develop some of the possible alternatives.

The Approach to the Problem

This chapter stated the problem and pointed out its severity. It also set up working hypotheses with which the thesis will attempt to solve the problem. A short examination of some possible effects of successfully increasing the earning power of labor by adopting new technology was made.

The remainder of the thesis has three parts. First, an approach to the problem is developed. Second, alternative techniques and systems for increasing the efficiency of labor utilization are examined and evaluated. Third, the analysis, conclusions and recommendations are presented.

Chapter II presents the approach taken to the problem. The approach is one of using data and principles related to many aspects of dairy farm organization. Various aspects of human behavior, engineering, physical relationships and economics are considered. A criteria for use in selecting between alternatives is discussed.

The second part consists of five chapters which present alternative ways of organizing a dairy farm to use labor efficiently. These chapters serve to add empirical content to the conceptual framework. More specifically, Chapter III deals with the tasks of dairy husbandry and the environment in which these tasks are performed. Chapter IV continues similarly with the tasks of crop production. Chapter V covers the ever-present maintenance and repair tasks found on dairy farms. The next two empirical chapters deal more closely with the relationships between the people involved and their jobs. Chapter VI discusses personnel management, particularly as it occurs in larger operations. Chapter VII shows how management can be spread over more units of production to utilize labor and managerial time more effectively.

In the third part, Chapter VIII brings the earlier results together in budgets for various sized specialized dairy farms.

Chapter IX proposes a possible bulletin for presenting the results of the study. It also expresses the general conclusions of the study.

CHAPTER II

THE APPROACH TO THE PROBLEM

The nature and severity of the low labor productivity problem discussed in Chapter I suggested that procedures for maximizing profits within existing technologies were not adequate for its solution. Thus, functional analysis, linear programming and the usual type of budgeting based on coefficients obtained from surveys did not appear powerful enough to gain the desired results. Rather, new combinations of inputs, new technologies and new dairy farm organizations were needed. The problem appeared to be more nearly one of changing the coefficients of production functions rather than one of maxmizing profits on a given function.

It seemed that a maximum of research product could be obtained from the limited resources available by (1) finding out what the "best" farmers were doing, (2) inquiring what they would like to do to improve their organizations, (3) gathering additional information from other people and relevant literature, and (4) combining and synthesizing organizations superior to any observed. The succeeding sections will discuss the specific procedures used.

The Case Study Approach -- What Farmers Are Doing and Would Like To Do.

One of the most important approaches was to search out, visit, interview and do case studies on dairy farms using labor efficiently. In seeking these farms, information was sought from farmers, county agents, businessmen, extension people and, in fact, any source which provided helpful leads. When searching for interviewees, limits of at least thirty cows per man equivalent with a production of 400 pounds of fat per cow were specified. All interviewees had not reached both of these goals. Yet in terms of production, all produced at least 250,000 pounds and some over 350,000 pounds of milk per man. By reputation and by these measurements, all were efficient in the use of labor and good managers. In addition, many conducted enterprises of a supplementary nature to their dairy operation even though they all could be considered specialized operators. Most of them produced essentially all of the feed inputs required though some purchased part of their grain.

A total of 46 farmers were interviewed. They were questioned relative to the organization they had and the work methods they used. Job time requirements were requested. Experiences with alternative work methods were investigated. Plans concerning new, and as yet untried procedures, were discussed and the results recorded. Questions about their experiences with various machines, equipment and buildings were included. An attempt was made to secure the farmer's opinions relative to the management problems involved in operating large dairy farms.

Other Sources of Information -- Other Workers and Published Reports

Similar kinds of information were gleaned from extension specialists and other authorities to add breadth to the experience of the interviewed farmers and insights as to possible application of the study. Their observations included methods of doing things, and merits of different types of equipment and building layouts, and, perhaps most important, the coordination and management difficulties experienced by their clientele.

While rarely cited in the thesis, recent popular and timely writings on various aspects of the problem aided greatly in the analysis. Popular farm magazines often contain reports of recent commercial and farmer development of machines, equipment and buildings. They also report on farmer experience with new operating methods as well as the current recommendations of both experiment station and private researchers.

Information gleaned from these reports often found its way into the analysis in combination with data from other sources. It also served as an aid in evaluating methods proposed by others. It was felt necessary in many cases, to require more information than contained in popular reports of one case or of one method. General speaking, it was found that the reports of formal research offered more valid data than the popular writings, yet each provided a check on the other and the analysis rests on ideas from both in generous quantities.

Procedures Used in Combining and Synthesizing Organizations

In developing meaningful organizations, it was necessary to devote some thought to selecting a reasonable set of assumptions. For purposes of this study, it was assumedthat the economic environment faced by Michigan's dairy farms was the one for which the farm organizations should be developed. It was further assumed that soils, topography and climate similar to those with which most Michigan dairy farmers operate should be considered.

It was also necessary to consider the people to whom the study was directed. It is directed to about the same type of individuals found on Michigan's 20 cow or larger successful dairy farms today insofar as skill, managerial ability and ambition are concerned. It is further assumed that they see sufficient value in leisure to desire an operation in which no one man is indispensable; are honest with themselves and others; alert and willing to accept change and risk taking realistically; and last, but not least, put a high value on learning about changing conditions which might affect their operation.

At this stage in the study, the approach to the problem required taking the best seen, the best heard of, the best read about, the best conceptualized and putting them all together into farm organizations.

To select the "best" required a basis for evaluation. In the matter at hand, three questions formed this basis. (1) It was asked if an alternative was workable under practical farm conditions. (2) It was further asked if the alternative would increase labor productivity and if so how much. Most increases in productivity came from an adopting new technologies, though some came from marginal adjustment in the use of inputs as well. (3) The effect of an alternative on the ability of a farm organization to provide working conditions and fringe benefits comparable to those of industry was also asked. Because of the many complexities of farm organization common sense and judgement were necessary to help answer all of these questions.

Budgeting As An Approach to Farm Organization

Budgeting was used as guide for selecting and evaluating alternatives in the study. A look at relative costs, returns and investments were required in choosing between alternative farm organizations. Consideration was taken of timing, labor loads, accomplishment rates and the underlying coefficients upon which the alternatives were based.

A series of budgets will be presented in Chapter VIII to illustrate the results. This method was selected for several reasons. First of all, it allowed a comparison of added costs and returns with associated changes in net profit. It also allowed application of the discussed procedures for task

accomplishment to occur under the "usual" conditions of Michigan dairying. Further, necessary rates of task accomplishment at varying rates of output were made explicit. Also, the majority of necessary assumptions were brought to light by this procedure.

Budgets also aid in pointing out the economic relationships between factors and products. This must be done if a sound evaluation is to be made of the relationships held between the human element and the other factors of production.

CHAPTER III

DAIRY HUSBANDRY AND BUILDING REQUIREMENTS

This and the following four chapters present the information and data collected and used in this study. These five chapters, as a unit, present important considerations in organizing a specialized dairy farm to use labor efficiently. They discuss the various tasks required and indicate superior methods for organization into a total farm business.

The Tasks of Dairy Husbandry and the Work Areas in Which They are Done

This chapter deals directly with the tasks involved in caring for dairy cattle. It attempts to discover and evaluate new and efficient working environments. Each task is examined individually and in relationship to the whole.

Stanchions Compared to Loose Housing

Considerable discussion and investigation has taken place in the last ten years comparing loose housing with stanchion dairy systems.[1] Both have been shown to have certain advantages. Both were investigated in this study.

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[1] For a rather complete bibliography of recent literature see: R. C. Angus and W. L. Barr, "An Appraisal of Research Literature Dealing with Loose and Convention Dairy Cattle Housing: A Review," Journal of Dairy Science, Vol. 38, No. 4, April 1955, p. 391.

After observation of both types, it became apparent that although some farmers could handle thirty cows per man in a stanchion system, it required higher machinery and equipment investment to reach comparable milk production per man. It appears that without still higher investments in pipeline milkers and automatic feeding equipment, little opportunity for improvement of labor efficiency in good stanchion systems can be expected. It is true that work simplification techniques are helpful, but more job elements exist in the stanchion barn regardless of techniques. For example bedding has to be put in each stall each day. Each stall has to be visited twice a day for milking. Stalls can be opened in groups but it is difficult to close them other than individually. When labor is replaced with mechanical equipment maintenance problems arise. A broken down gutter cleaner on Sunday, with half the labor force gone, or during rush work seasons is an unpleasant time consumer.

One of the main arguments put forth by stanchion barn operators against the use of loose housing is that it is more difficult to keep track of individual animals. Not one of the loose housing operators visited would agree. The usual comment was that many old ideas of what good dairy husbandry consists of must be discarded even though certain basics remain the same. Such comments were underlined by one operator who depended entirely upon hired labor for the operation of a 60 cow herd. Another operator with 29 cows and a butter fat average of 549 pounds made similar comments.

Farmer opinion varied widely as to just how much personal attention individual cows need in loose housing systems. The suggestions made here call for more attention than was found in a hundred cow herd with a 375 pound fat average but probably less than found in the smaller herd with a 549 pound average. Little research has been done which is of help here. The reason for this is probably the difficulty encountered in measuring the value of time spent on individual attention with cows of different quality and inherent capacity.

Task Performance in the Six Areas of a Loose Housing System

Recommendations for the construction of loose housing systems call for the designation of six separate and distinct areas. These are: (1) a feeding area, (2) a loafing area, (3) a paved yard, (4) a maternity and small calf area, (5) an area for young stock and (6) a milking area.[2] The following discussion considers each in turn.

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[2] For a discussion of this and many recommendations to follow, a wealth of literature exists. Most of it is designed for operations of twenty to thirty cows, however. For some of the best see:
L. H. Brown, B. F. Cargill and R. R. Bookhout, Pen-Type Dairy Barns, Special Bulletin 363 (First Revision), Michigan State College, East Lansing, Michigan, 1952. Also: C. J. Fenzau and R. N. VanArsdall, Meeting Dairy Market Sanitation Requirements Economically, Market Research Report Number 64, United States Department of Agriculture, Washington, D. C., May 1954.

The Feeding Area

Under present economic conditions, all interviewees find it necessary either to bale or chop their hay. From the feeding standpoint each has certain advantages and disadvantages. There was little common agreement between farmers relative to the comparative merit of the two systems. On particular farms, the merits seemed to depend upon the type of storage and feeders used.

Chopped hay is the easiest to feed from ground level storage with self feeders. If properly made, it is as palatable and as nutritious as baled hay.[3] Dust need not be a problem if mow dried or if it is not moved in feeding. Storage should be diversified if the different groups of cattle are separated. Waste can be kept to a minimum with properly designed feeding racks.[4]

Baled hay is easier to handle if hay must be moved to be fed. Moving hay of any type takes time. A handy tool for feeding hay is either a pitch-fork or bale hook with a mower blade welded to the shank of the tool. With such a tool,

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[3] C. R. Hoglund, High Quality Roughage Reduces Dairy Costs, Special Bulletin 390, Michigan State College, East Lansing, Michigan, February 1954, p. 8.

[4] B. F. Cargill and N. P. Ralston, "Progress Report on Loose Housing for Dairy Cattle in Steel Buildings," Quarterly Bulletin, Michigan Agricultural Experiment Station, Vol. 38, No. 1, Aug. 1955, p. 8. Also: J. R. McCalmount, Bunker Silos, Agricultural Information Bulletin, No. 149, U.S.D.A., Feb. 1956, p. 8.

bales may be moved and opened in a minimum of time. Several qualities of hay may be stored in one mow for later feeding simply by using different combinations of colored twine to designate the various qualities. Baled hay need not be shaken out to be fed particularly if the feeders have upright members which force a cow to turn her head sideways to withdraw it as this will prevent her from pulling hay out of the manger. This can be done with the usual "V" type opening or a more economical method is to simply slant all upright members in one direction. If boss cows tend to be troublesome in the feeding area, another method is to eliminate upright members in favor of a narrow opening made by the horizontal pieces which also force a cow to turn her head to withdraw it.

In feeding either baled or chopped hay, mangers must be cleaned of waste hay periodically. Sufficient hand tools should be made available in all areas where feeding is done as circular travel in feeding saves time. Tools can be rotated so that no back tracking is necessary. Various sized tools permits using the proper ones for each task. It is possible to make feeders which do not require daily attendance particularly if they can be seen from the milkhouse with a casual glance.

<u>Types of Hay Storage</u>

Under present conditions, it is hard to justify the construction of overhead hay storage as such storage requires moving the hay to the feeding area. However, if a farmer has an overhead mow, feeding can still be done fairly rapidly. One method is to build a feeder under one or both sides of the mow. These feeders can be filled from overhead with one handling. A feeder may also be extended at right angles to the mow and equipped with a mow level catwalk for rapid feeding.

Inside feeding areas become filthy rapidly. They require more time to keep clean and in general are less satisfactory than outdoor feeding areas. Cows do not mind eating outdoors. In fact when given a choice, many seem to prefer it even in sub-zero weather.

Hay can also be fed in a mechanical feeder which is loaded in the mow and moved to the feeding area. Such feeders may require loading only every other day. Ropes can be laid out on the mow floor so that hay can be stacked on them. When hay is required, a rope is pulled and the bales are tipped down out of the mow.

Other methods are non-mechanical, less expensive to build, and require less attention and time. Of these the most popular is the ground level feeding barn with moveable feeding gates which are pushed in as the hay is fed out. A drying system is easily installed in this type of storage.

Some hay storages are open on one side only. In general, this type may require more movement of hay and mangers to get the hay fed. It offers more protection from rain and snow than other self-feeding types.

Another type is open on all sides, with feeders usually

on the two long sides. This type requires a long overhanging roof for protection of the hay and also of the cattle. It is easy to feed several lots of cattle from one such feeder. A fifty ton feeder may be built for eight hundred dollars. Baled hay is usually unloaded directly into place in this type.

A still more economical hay storage is available for chopped hay.[5] It consists of eight poles spaced in a circle of 23 foot diameter with a self-feeding fence at the bottom and snow fence for sides. This structure requires the least labor of all and five hundred dollars supplies fifty tons of storage space.

A new method is now being tried on some farms. A structure similar to a long six foot wide corn crib is constructed from poles with a self-feeding fence at the bottom and snow fence or used woven wire for sides. Chopped hay of 30 to 35 percent moisture has been kept in this type. Experience has been limited with this structure. Some operators have found mold in the center of the crib. Some have felt it necessary to add a roof to this type structure.[6]

The difference in chore time saved by selecting any one of the above self-feeding structuresis not great. Five minutes per day should feed hay to thirty cows in any

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[5] Gene C. Shove, Kenneth K. Barnes and Hobart Bergsford, "A Self-feeding Hay-Storage Structure," Iowa Farm Science, Iowa State College, Ames, Iowa, Vol. 8, No. 12, June 1954, p. 12f.

[6] Harold J. Larsen, "Complete Hay Dryer," Michigan Farmer, East Lansing, Michigan, Vol. 226, No. 8, Oct. 20, 1956, p. 30.

Figure 1
Self feeding hay storage structure

Note:
(1) Mow dryer opening
(2) Feeding fence
(3) Home grown lumber sides

Figure 2
Covered silage feeding area

Note:
(1) Jamesway mechanical silage feeder
(2) Long narrow bunk and shelter
(3) Wooden yard fence
(4) Two silos grouped with room for more

of them including those which use baled hay. Fifteen minutes should feed a hundred or more cows. However, a type which offers shelter to the herd may become a loafing area if the herd is expanded. While this type is more expensive to build, it does permit added flexibility.

Of those observed, the circular type appeared to be the least expensive to build and to require the least feeding labor. It can go unattended for several days. With a dryer installed it can produce very high quality hay also. It is easy to diversify storage with this type structure. If found necessary, a roof and an overhanging shelter around its bottom could easily be added.

Silage Feeding

The larger Michigan dairy farmer today usually requires storage for both grass and corn silage. Essentially, there are three types of permanent silos to choose between.

The first is the traditional upright silo. If equipped with an automatic feed bunk and unloader, the only labor needed in feeding is for operating switches, occasionally lowering the unloader and removing the silo doors. However, even in the large diameter sizes, uprights require a high initial investment. Mechanical feeding equipment requires adjustment and repair are subject to failure at feeding time.

From a feeding standpoint, there are two types of horizontal silos.[7] One type, holding silage around 8 to 10 feet

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[7] T. J. Brevik, W. H. Friday and R. L. Maddex, Horizontal Silos, Farm Building Series Circular 723, Michigan State College, Cooperative Extension Service, East Lansing, Apr. 1955, p. 11,12; Also, J. R. McCalmont, Ibid., pp. 7-8.

Figure 3
Automatic silage feeder

Note:
(1) Rotating silage bunk
(2) Control box for unloader and bunk
(3) This is a 20x60 silo 50 head can eat at one time

Figure 4
Bunker silo

Note:
(1) Clean condition of the feeding area
(2) Long poles for supporting a hay storage-feeder addition
(3) This herd (29 cows) has a herd average of 549 pounds of fat

deep, cannot be entirely self-fed. The silage is usually fed by a tractor and loader in feed bunks located in nearby pens. However, the silage can be cut down with a chain saw or some other device and self fed. Regardless of how feeding is done from this type, more labor is used than with a lower walled silo.

By contrast, silos with walls 6 feet high can be entirely self-fed except for an occasional small pen of cattle which may not have access to them. To be satisfactory, this type of silo must have a concrete floor with sufficient slope to carry liquids away from the feeding face. Two lots may be fed from one end if an electric fence is used to divide the feeding face. The majority of farmers visited had found a charged wire to be sufficient as a feeding fence. While the open end may face in any direction, a southern exposure is preferable from a freezing and shelter standpoint. Some operators feel that this type of silo has increased fly problems.

Recently the building of horizontal silos in portable sections has been proposed.[8] While this may cost more than some other designs, it may have a place on some farms.

Because of the small amount of labor involved in

[8] Norval H. Curry and Ray E. Armstrong, "Portable Bunker Silos," Iowa Farm Science, Iowa State College, Ames, Iowa, Vol. 11, No. 2, August, 1955, p. 3f.

feeding from any of the three, it is difficult to justify the selection of any one type solely on the basis of differences in labor requirements. Either the upright or the low horizontal type should not require over ten minutes per day, on the average, of chore time. With proper management, wastage of feed is not a major problem with any one type; however, capital requirements are. Horizontal silos can be built for one-fourth to one-half of what an upright would cost. If capital is limited, it is hard to justify investment in an upright. This is particularly true if storage methods are used which keep spoilage losses close to those found in uprights.

Grain Feeding

In loose housing, grain serves as an incentive to bring cows into the milking room though systems can be built where this is unnecessary. Part of the grain could be mixed into the silage at filling time or it may be fed in bunks in the lot.

Heifers sometimes get no grain until moved in with the milking herd. If they do get grain, it, too, can be fed with the silage. If desired it also could be fed in bunks--mechanical ones if necessary. There are types of calf feeds which may be self-fed during the first four or six months. In most cases hand feeding twice a day is preferred.

Storage of the dairy ration in hoppers directly over each stall in the milking room is an easily attained ideal in many designs. It is suggested that the milking center be made part of a structure which also contains space for maternity cows and small calves. As will be pointed out later, such a design has several labor saving advantages. It also provides room for a feed grinding center. If such a design is adopted, then this same building might just as well become the farm mixing center for all dairy feed. A hammer mill, preferably of the power take-off type, may be kept at ground level in the building. Small grains may be stored over-head along with the ground feed. Corn can be brought to the building at the time of mixing. In some cases a crib for ear corn might also be overhead. Sacked feed could be stored either above or at ground level. No more noise or dust problems need be encountered than with a similar system in a stanchion barn.

Several interviewees have found bottomless fifty gallon oil barrels to be ideal overhead grain hoppers for such a system. They do not clog as readily as do hoppers which slant in at the bottom where they attach to the downspouts. Others have found that a small chain hanging freely in the downspouts lessen clogging.

Asbestos cement board makes an inexpensive, rat proof lining for grain bins but must be supported with a rough lumber backing if subject to much pressure. An additional outlet should be provided from the mixed grain bin so that feed may be sacked off if required or fed to the young cattle mechanically.

Provision can be made in such a system for weighing feeds and, possibly, cattle on the same scales. Space should also be allowed for a mixer if it is later found to be necessary. A dust collector on the hammer mill is virtually a must. If corn is to be shelled, it, too, may be stored overhead. A grain cracker can then be substituted for the hammer mill but some provision for mixing may be required.

Bedding and the Loafing Area

Many types of bedding may be used in loafing areas. The most common is straw. If straw is used and no traffic lanes develop on the bedded area, some farmers argue that no more is needed on, a per-head basis, than what was used previously in stanchions. If the straw is stored overhead, building costs are increased, more labor is involved in bedding, and ventilation is often reduced.

Chopped straw is more absorbent than longer baled straw. It requires a large fork to carry it as rapidly as bales can be distributed. However, it does not need shaking out. If the bale strings are cut before they are dropped from overhead, considerable of the shaking out can be eliminated. If sufficient straw is available much of the distribution or shaking out may be left to the herd itself. Chopped straw is hard to handle in the wind. Buildings over thirty feet wide tend to increase bedding time if hand methods are used.

Sufficient hand tools should be made available at all

bedding locations to do the job in a minimum of time. Long handled potato hooks for pulling down either bales or chopped straw stacks are handy. Extra large forks for chopped straw and bale hooks with attached knives for bales are almost a necessity when convenience is considered. If chopped straw (or hay) must be carried to calf pens, a length of woven wire with pole handles on the ends may be helpful.

The future may well hold the development of a mechanical device which can pick up straw from a pile and blow it over the bedded area. Such a device could be used with other types of bedding also.

Sawdust can eliminate the daily bedding chore entirely if available. When piled three feet deep, it was the cleanest bedding observed on any farm. Even in midsummer, no flies were evident in the loafing shed. While sawdust may be mixed with straw, this is not recommended. A good method consists of first piling sawdust into the area to a depth of three feet. At two week intervals, it is necessary to stir the top foot with a cultivator or similar tool. When this layer becomes saturated with manure, it is removed, exposing a fresh layer. Removal need not take place oftener than once or twice a year. Mixing in straw makes stirring impossible.

Many other materials can be used for bedding. Chopped corn stalks taken from the fields after picking are serviceable. Poor, waste hay is often used. Corn cobs, preferably crushed, makes good bedding. Uncrushed corn cobs make a good floor

Figure 5
Loafing area

Note:
(1) Clean condition
(2) Pole construction
(3) Transluent roof panels
(4) Roof slopes so a large straw area is along the rear
(5) Open shed front

Figure 6
General Layout

Note:
(1) Open hay storage in center which obstructs observation
(2) Twin bunker silos
(3) Open front loafing area

for the holding area if it is inside as daily cleaning can then be dispensed with. These types of bedding can often be spread with a manure spreader or some type of dump or self-unloading wagon. Some farmers have even run untied straw bales through a power take-off manure spreader to bed the loafing area.

Most farmers visited preferred complete open fronts on their loafing areas for reasons of economy, elimination of traffic over the bedded area and as an aid to ventilation. The newer trussed type of rafter structure eliminates interior poles and, saves cleaning and bedding time.

The Yard and General Building Arrangement

Herds which take over an hour to milk should not be held on the bedding. The surface will become punched up, the cows dirty, and more time and bedding is required than if a concrete area is provided. An outside holding area is a common thing for both winter and summer use. Such an area is less costly and creates less of a fly problem. Scraping of the holding area is still likely to be a daily task unless some method of automatic flush washing can be devised.

It was noted that northern and western Michigan farmers, where more snow is received, seemed to be more concerned with covered feeding and holding areas. Yet even in the north and west, open horizontal silos and open holding pens are in operation, many preferring the outside areas except for days of driving cold rains and wet sloppy snows. They often feel that such shelter is not worth the added cost considering the few times needed. At any rate, it would seem that these features need not be primary design or construction considerations.

Several general recommendations are in order relative to the paved yard. It should be designed so that the entire area can be cleaned from a tractor seat. This means that it should be smooth with adequate drainage. A curb around the edge will help keep the manure where a scraper blade can get it. Loafing barns and horizontal silos should drain into the yard. There should be cattle guard entrances and exits for tractors and wagons. A manure pit which will allow manure to be directly pushed into a spreader is ideal. Concrete should extend into the loafing barns a short distance. Eaves sloping into the yard must be supplied with eave troughs.

As herds become larger, the relative advantage of pasturing becomes less. This is true because of the need for herding cows to and from pasture as well as the pasture trampling which occurs with a large herd. If pasturing is discontinued, an auxiliary exercise lot covered in part with gravel may help keep the cow's feet in shape. A lot with some shade trees away from the buildings and the flies is of value especially if summer green chop or storage feeding is practiced.

<u>An Important Recommendation</u>

The most important recommendation of all is of a different nature. <u>The entire dairy plant should be observable from the milk house</u>. The man who runs the system will spend much of his time there. If observation is easy, he will do a better job of it. If he can check visually for cows in estrum, for adequate feed, bedding and water, for cows about to calve or for sickness, without leaving the center which contains the records, tools and medicines, many steps will be saved, more cows can be taken care of per man and a good job of husbandry becomes simpler and easier. This recommendation is an important part of the design of the whole dairy system to allow labor to care for more and higher producing cows.

Other Recommendations Concerning General Arrangement

With the same type of reasoning, some other recommendations can be made. With larger herds, two exits from the milking room may be justified. The second one could be operated to block the first whenever a cow needing treatment or a cow in estrum needs to be separated. This door could lead to a shunt pen which would serve as a breeding, treating and sorting pen. It should have a loading dock, breeding stalls and stocks. It should have gates opening to the open yard, to the heifer and dry cow area and to the maternity area. Provision should be made for confining cows in estrum. Corn cobs over concrete would make an ideal bedding for this area.

Maternity Cows, Small Calves, Young Cattle and Dry Cows

Some farmers allow dry cows to run with the herd permitting them to calve in the regular loafing area. The calf is taken away a day or two later. Whether such a method should be recommended is doubtful. But if it is compatible with good husbandry for a large herd of high producing cows, it is the simplest answer to the care of maternity cows.

Even if maternity cows are separated into individual pens, individual care should be minimized. Making pens readily observable from the milk house is a good first step. When a number calve at the same time, as is likely to happen in a large herd, milking them in the milking room may save time and is facilitated by providing a lane to move them to the milking room. There is no good reason that they need to be fed silage in these pens. A source of hay which could be essentially self-fed to them would be helpful. Automatic waters for each pen are important labor savers.

Pens for small calves should be nearby so long as the calves require pail feeding. Bedding and hay should be close at hand. Both can be stored over the pens. This is perhaps the best answer to bedding all small pens. Pail holders or nipple pails save labor at feeding time. If several calves run together, stanchions should be provided for milk and grain feeding. Milk can be measured more quickly than weighed if the pails are properly marked.

Pens for calves should be draft free and dry. This does not necessarily mean warm housing. Manure pack bedding is satisfactory. Calf identification can be simplified by taking a picture record of each individual animal soon after birth.

Some farmers let the entire herd run together except for calves of less than six months. Others have separate pens for unbred heifers, bred heifers and dry cows, and for the milking herd. Others allow dry cows to stay with the herd. All seemed reasonably satisfied with the system they were using.

In general it seems that several requirements must be met in caring for young cattle and dry cows. Facilities should make observation of the herd easy. Feeding and cleaning should be done in a minimum of time. Some individual attention is necessary to keep high quality animals and maintain herd health. With hay and silage self-feeders, regular daily feeding might even be eliminated.

As farmer opinion seems to vary so widely concerning arrangements for dry cows and young stock, it appears that many different methods work about equally well. Perhaps the biggest factor in the design of facilities for dry cows and young stock on most of the farms was the size and type of buildings available at the start of the expansion.

Perhaps the best advice is to try the easiest and cheapest method first and then build in modifications as they are found necessary. Planning should provide for self-feeding of roughages. The herd should be observable from the milk house. The area should also open into the shunt pen so that individual animals may be bred or shifted to the maternity or milking herd areas when necessary. Some farmers allow a young bull to run with their heifers.

When grain feeding is necessary, it may be fed either on the silage or in bunks which ever works better. However, many farmers feel that excellent roughage alone will make heifers big enough to breed for 2 year old freshening.

It could be said that success breeds success. Good feeding, good breeding, and good health make good heifers which in turn make good cows. Time spent caring for good cows is more productive than time spent on poor ones. Even so, the methods whereby cattle are cared for should not involve unnecessary individualized feeding or bedding nor does a man have to move to the animal if the animal can come to the man.

The Milkhouse and Milking Room

From the standpoint of time involved in dairy tasks, the milkhouse and milking room is the most important area in the whole dairy system. In the overall systems being developed here, eighty percent or more of the time spent in dairy chores is spent in this area. With a large herd over half of the time will be spent milking. This task, then, is one which is probably worthwhile considering most carefully.

Probably no perfect universal design will ever be devised. There are too many farm to farm variations in terms of management systems, herd size and quality, individual skill, effort and values. Still, certain goals and ideals can be developed and pursued.[9]

If the whole dairy plant is observable from the milk house, a big first step has been taken. This minimizes the number of trips necessary to complete other tasks and promotes circular travel. Herd record keeping is made easier and more pleasant. A feeling of pride on the part of the operator is more easily established.

In looking ahead, mechanical roughage feeding controls may some day be located there. When combined with adequate summer cooling, winter heat, insulated walls and windows, and suitable light and paint, a pleasant and unfatiguing atmosphere conducive to good dairy husbandry can be developed. Such a work area may provide working conditions superior to those in many factories and, even, some offices.

Time spent in keeping things clean does not produce saleable product. The use of materials which require a very minimum of time spent cleaning will free cleaning labor for more productive tasks. Tile, stainless steel, cement asbestos board and concrete floors are such materials. Fly screens, drains and surfaces to which dirt will not tend to stick are important. So are cleaning methods which substitute water

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9 For construction details see: J. S. Boyd, et.al. Milkhouses, Planning and Construction, Extension Bulletin 325, Michigan State College, Cooperative Extension Service, East Lansing, Michigan, June, 1954, pp. 8ff.
Literature which discusses milking rooms similarly is still lacking in scope and in emperical data to make adequate comparisons between designs. This is particularly true for operations of forty or more cows. Various studies do give some information. See: L.H. Brown, et.al., op.cit., pp. 19f. Also, C. J. Fenzau and R. N. VanArsdall, op.cit., p. 18.

pressure, or mechanical flushing and brushing, for time and labor.

In the study, many types of milking systems were observed. One operator could put 50 cows per hour through his one man system. Another, even with his wife's help, milked only 14 cows per hour. Four other operators milked at the rate of 40 cows per hour. Observation of three milking rooms indicate it should be possible to milk, as a minimum, 40 cows per hour; the conclusion is drawn that a room, which, by its construction, does not allow at least this rate of milking should not be considered by the larger operator. It is worthy of note that all operators interviewed who had herd averages of at least 500 pounds of fat felt that one man cannot milk this fast and pay proper attention to his cows. These people felt that 25 or 30 cows per hour was a more reasonable rate. Perhaps this is true, yet this is still an insufficient reason for building a room which restricts the milking rate to this number. Difficulties in designing experiments to determine optimum milking rates, methods and equipment leave many aspects of this most important problem unsolved. Many variables exist in terms of mastitis susceptability, individualities of both cows and operators, the effect of inheritance on milking speed, and the extent to which additional individual personal attention is required by high producing cows.

Milking is not the only job done in the milking room. The time required for preparation, grain feeding, cleanup and handling problem cows should be minimized.

It is hard to conceive of a system which will require less than one-half hour extra per milking to accomplish these tasks.

Recommended Construction Features

In an attempt to design a good milking system, many of the construction and equipment details deserve close scrutiny from the standpoint of both capital and labor requirements for different features. It is difficult to establish the order of importance here. Thus, it is possible that different designs than discussed would have very little effect on the whole system. However, it is felt the methods presented here will work and that they are improvements over the methods observed in the study.

Insulated walls and windows conserve heat and make a more comfortable place in which to work in the winter. In summer, the same construction combined with ventilating fans also add to the operator's comfort. A fan blowing air directly in the milker pit in warm weather can aid in doing a good job of milking. In winter, heated air is helpful for similar reasons. Some farmers are installing gas space heaters controlled to maintain 40 degrees except at milking time when the temperature is raised to 65. The same gas source is used to heat water. Heat from the milk tank should be vented in summer and saved in winter for operator comfort.

Florescent lights save electricity if used where lights are required for long periods of time. A light under each cow aids in cleaning the udder. Windows between the milk house and milk room allow closer observation of the whole operation and hence save steps. Windows in doors allow the operator to see what is on the other side without opening them. Windows strategically placed allow the observation of the whole layout from the milk house. Clear glass blocks placed low enough for observation from the pit can serve the same purpose in the milking room.

Latex paint is easy to wash. So is asbestos cement board. Concrete floors should be rough enough to minimize slippage, yet smooth enough to insure rapid cleaning. Sufficient scrapers, brushes and brooms stored in the milk room hasten cleaning. An old car bumper, cut to size, with an attached handle makes a serviceable scraper.

The use of lime on the floors may save time particularly in the winter. A simple way of spreading lime is to put the lime in a burlap bag, attach a string, and drag the device over the floor. In summer most farmers seemed to prefer to hose the parlor out. One advocated wetting the walls prior to milking to prevent the manure from sticking. Several had their hose or hoses attached to a mixed hot and cold water line so that the same system could be used to wash udders. If lime is used on the floor, then pail and towel type udder washing is necessary.

Good floor drainage facilitates cleaning. Drains under the hind quarters of each animal shortens the distance for liquids and semi-liquids to be pushed. Shallow gutters along the walls drain the floor area quickly if the floor is sloped to them. A well drained and daily cleaned holding area keeps dirt out of the milking room. Steps at the entrance also help.

Cows can climb the thirty inches of elevation to a milking platform if suitable entrances and exists are provided. A milking room and milk house at the same level saves effort on the part of the operator. If the cows must cross over the milker pit a steel plate ramp, suitably counter balanced, eliminates cow steps inside the room and minimizes dirt in the pit. Sharp corners slow cow movements and should be eliminated if possible. Self-closing doors should be used in all cases. Exit doors should be self-opening. The possibility of a net to sweep flies off at the entrance and treadle type fly sprayers at the exit should be considered.

Rope controls on doors, grain feeders and gates which are centralized to eliminate steps can also be helpful. In future mechanical or electronic devices may perform these functions automatically or at a touch of a button. The second exit door for separating cows out of the herd requires similar controls.

Equipment should not only be economical in first cost but simple to operate and easy to maintain and keep clean. Though stalls can be made on the farm which are as serviceable as purchased ones, many farmers preferred to purchase theirs because of time limitations and appearance.

The majority of the farmers preferred short tube "Surge milkers." They felt that less time was required to attach, machine strip and detach a machine which need not be hand held during these operations. They particularly felt that the short tube machine was helpful with problem cows with three quarters or pendulous udders. Most felt that the disadvantage of not being able to dip the teat cups between cows was either not important or that they were willing to spend the extra time necessary to dip each cup individually.

Some long tube operators have found that a rubber ball serves to shut off the milk flow on one teat cup provided the cup is emptied of milk before the machine is detached. Others feel that machine stripping can be aided by putting a weight in the claw or pulling forward on the milker hoses.

Most operators felt that a filter in the line for each cow and a hose or claw where the milk flow was visible were both important. No operator visited was using a milker claw which shuts off the vacuum to each cup when that quarter is dry although such a device is on the market. One man had tried the device a few years ago and found it unsuccessful.

The concensus of opinion was that any man who could use two pail units could use three pipeline units in the same procedure. No operations were observed where one man attempted to use more than three units while following recommended rapid milking procedures.[10] Some milking rooms have

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[10] Russell E. Horwood, W. W. Snider, and Earl Weaver, Good Milking Practices, Extension Bulletin 293, Michigan State College, Cooperative Extension Service, East Lansing, Michigan, October 1948.

been designed to reduce milker unit idle time to a minimum. This may or may not be a good thing. An idle unit is less expensive than an idle man. Many farmers purchase extra tractors with this in mind. At the same time, the number of job elements a man can handle in a process like milking is limited. Because it is, too many units may actually slow him down.

Operators who had visible weight jars, such as the "Chore-Boy," felt they were easy to keep clean and offered a constant check on the health and production of each cow. Some jars have gages on the side which make "weighing" of the milk particularly easy. They also make it easy to see when a cow has completed milking. They also serve as containers for abnormal milk or milk from fresh cows.

Another device for speeding the milking of an abnormal quarter is a mason jar with a teat cup attached to the lid. Another hose then goes from the lid to the regular milker claw.

A large clock with a sweep second hand helps the milker pace himself. A radio can make the job more pleasant. An intercom system to the farm house and maintenance center can save many steps. A telephone in the milkhouse speeds calling of the inseminator and keeps the operator from forgetting to call later.

At the present rate of grain feeding, few farmers were experiencing trouble with slow eating cows. In this connection, it was the author's observation that if the operator meant business so did the cows. One operator had installed wet feeding equipment to speed up eating. He had placed water closet tanks above each stall; a pull of a rope tripped about one quart of water into the feeder after the grain was poured in.

Grain should be fed to each cow according to production. When the herd becomes large this task tends to be neglected. In herds of fairly uniform capacity this may be justifiable.

Operators might find a blackboard on one wall of the room with the number of each cow listed in her approximate milking order and followed by her grain ration as being sufficient. The grain ration would then be changed each test day. At the time of actual feeding, a glance at the cows identification chain, then at the blackboard and then a pull on the feeding mechanism will require not more than twenty seconds per cow.

Another suggested improvement would be an attachment on the neck chain which would, by color or number, specify the amount of grain to be fed. This would eliminate the need for the blackboard. Selecting the amount to feed would become a case of simple association. Because of its simplicity, this method seems more likely than other methods to get done properly.

An area which remains uncluttered during milking aids efficiency. So does an area which is no larger than necessary. Sufficient water pressure, hot water, vacuum and a source of standby electrical power are other things to consider.

A milker washing system which requires a minimum of operator time is very important. Preparation and clean up of the milker need not take more than 15 minutes of time per milking if mechanical or vacuum power is allowed to aid in the process. When questioned, operators reported operating costs varying from five to thirty dollars per month for different systems.

When the milker vacuum pump, as well as the compressor on direct expansion type coolers, is outside the milk house, the reduction in noise level increases productivity by reducing fatigue and distraction.

Some of the Different Milking Rooms Observed

During the study many arrangements were observed. Some are worthy of brief description here as examples of what has been done and the results obtained.

Probably the easiest design to work in consisted of a pit recessed about 24 inches and supplied with a regular typist chair. The operator handled one unit on each side of the four foot wide pit. As these two cows ate their grain and were milked, a third was prepared at the rear of the pit in what was, essentially, a wash stall. Gates were designed to face the third animal in the direction of the cow which would finish milking first. This design allowed one man to milk from 18 to 24 cows per hour.

Two other "prep" types of designs were encountered. The first consisted of two wash stalls in lane fashion on one side of the parlor. A side opening stall for milking was located on the end. Two additional side opening stalls were located across the pit from the wash stalls. With this system one man could milk from 30 to 35 cows per hour.

Another method requires two men for operation. Two wash stalls were located at the rear of the pit. Ahead of each were two side opening milking stalls. A total of four milking units was operated by one man while two more cows were being prepared by another. The second man did not need any particular skill. In fact, he was not kept busy. From 55 to 65 cows could be milked per hour.

One farm had a similar setup except there was one wash and three milking stalls on each side of the pit. Three men were required, two to milk and one unskilled worker to wash udders. When unskilled labor is available for milking, this is a good way of using it. However, it is indispensable in this system. Vacations and time off schedules have to be adjusted accordingly. Often times it might be better to keep part of the labor force free to do other chores and field work. Whether the milking rate of 80 to 90 cows per hour is worth these inconveniences is questionable.

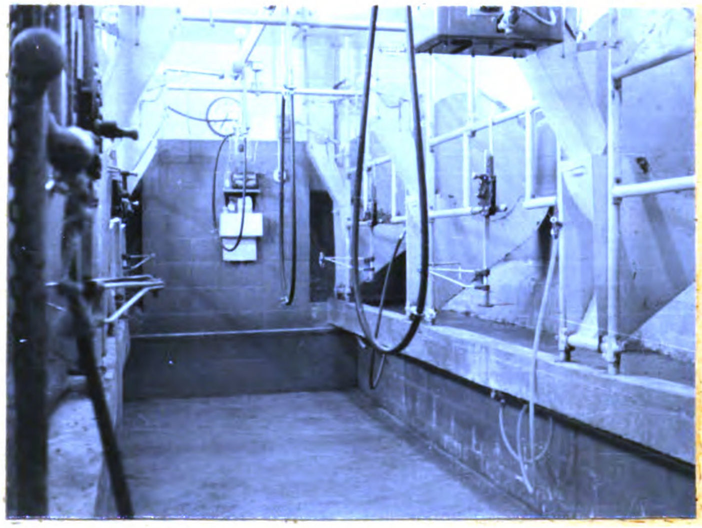
Perhaps the most common design involved three side opening stalls in a row. Rates as low as 14 cows per hour were observed here, but determined men could put 30 cows per hour through this type in the same length of time. From a labor efficiency standpoint, it is necessary to discard this type in favor of the same three stalls placed in a "U" shape.

Figure 7
"U" Shaped Milking room

Note:
(1) Surge side opening stalls
(2) Surge suspended milker

Figure 8
3-on-a-side lane type milking room

Note:
(1) Heater, clock, radio and towels
(2) Udder wash hoses
(3) Rope controls to feed and control stanchions from the rear of the pit



With a "U" design, the whole pit is not over ten feet long and eight feet wide. Only one such parlor was found but the regular operator could milk up to 50 cows per hour; a minimum of grain was fed, slow milkers were culled and the relief man could not operate this fast. With such a small pit, few steps were required between job elements and milker "down-time" was reduced.

As an alternative, it would be interesting to see how efficient a design with stalls on all four sides of the milker pit would be. The fourth stall could serve either as a milking or as a wash stall. To the author's knowledge no such room has been built. With a small square pit less time would be spent walking; however, questions exist relative to just how many job elements a man can handle in this type of milking room.

Two milking rooms with lane type stalls were observed which had three stalls on a side. An operator can milk 40 cows per hour in this type. To do so, he is busy but not hurrying. This type requires less concentration than do side opening types. Because it does, it is easy to work in when tired and/or sleepy. For the same reason, it is an easy one for a substitute man or a new operator to handle. Walls seem to splatter up rather badly and cleaning this type of milking room required more time than some other parlors. Considerable walking was necessary in this design.

By way of comparison, two on a side, lane type, milking

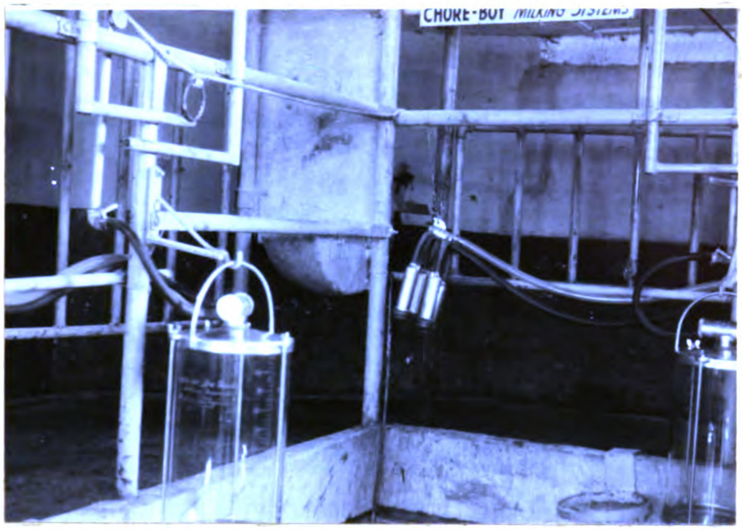


Figure 9
Homemade stalls

Note:
(1) Visible weigh pails
(2) Long-tube milker

Figure 10
Homemade stalls

Note:
(1) This is a 6 milking, 2 prep and 3 man unit, the picture shows one side only

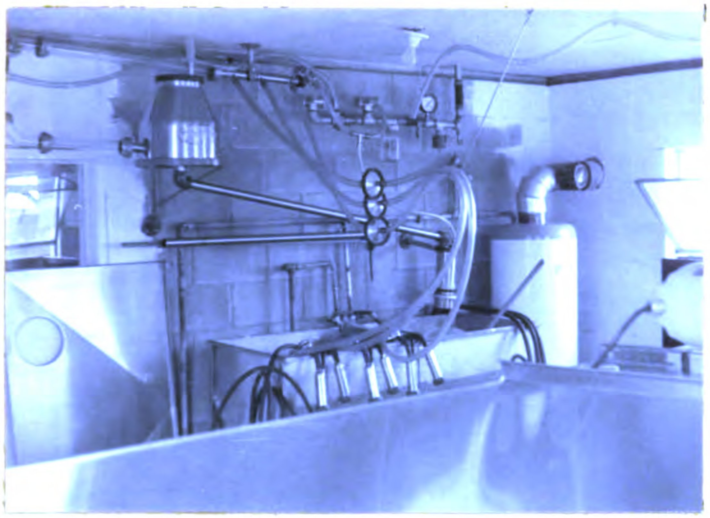


Figure 11
Chore-Boy vacuum milk releaser and washer

(1) Window into the milking room
(2) Glass pipe

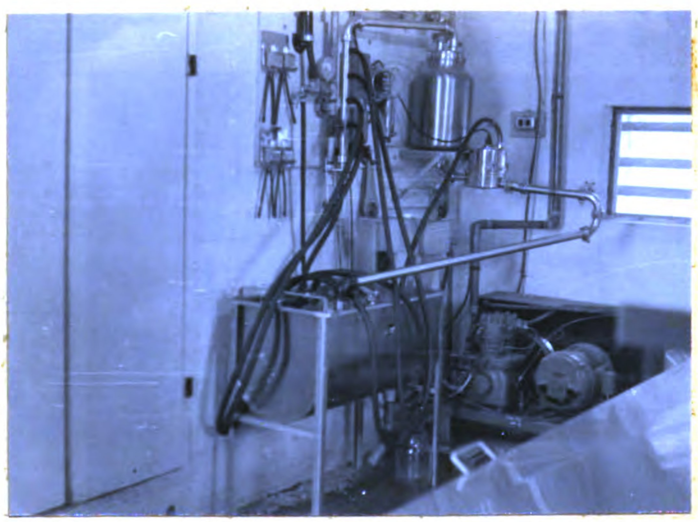


Figure 12
Surge electric releaser and separate automatic washer

rooms equipped with two pipeline units did not seem to keep the operator busy. Speed of operation ranged from 20 to 25 cows per hour. Slow milkers tended to slow up the whole operation proportionally more in this milking room. With herds of 30 or less cows, however, the larger size may not pay because of added investment and cleaning time. Perhaps the most economical one to build is this type with the front stalls facing the milkhouse and cows exiting to both sides. To equip this room, 2 milker units and pipeline serve the front two stalls only; the back stalls being used as wash stalls. If operated in this way, a slow cow would not hold another cow in the back stall.

Recently another type of system has been developed in New Zealand.[11] Still more recently, it has spread to England. It is claimed to be operated with one man at rates of 70 or even 90 cows per hour. One man brings in the cows, washes the udders, uses a strip cup, handles eight to ten units and machine strips the cows. After deducting time for changing cow groups, about forty to fifty seconds of individual attention time per cow remain. They feed no grain but grain feeders could easily be added if desired.

This system is referred to as the "Herringbone Bail."

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11 John Bletcher, "Sixteen Cows in a Herringbone Bail," Farmer and Stock Breeder, Vol. 70, No. 3469, 17 April 1956, p. 52 and George Wardrop, "Herringbone Bails in Norfolk," Farmer and Stock Breeder, Vol. 70, No. 3495, 16 October 1956, p. 67.

It consists of cow platforms on either side of a center pit. Eight to ten cows are on each side. Cows stand at about a thirty degree angle facing out from the pit with about three feet of the side of the cow exposed to the operator. A zig-zag rump rail holds the cows in place. There are no partitions between the cows. A gate at the front and a chain at the rear hold the whole group. A "bail" holding 16 cows requires about as much space as a three on a side lane type milking room and appears to be cheaper to build.

If this system can be operated under American conditions, it offers more in the way of solving the labor problems of the specialized dairyman than any other recent technological advance. Problems exist in adaptation. What is the effect on herd health and the required individuality of attention, particularly with cows of high producing ability? Certainly with this system of milking observation must be made easy in order that proper care can be given the cows outside the milking room such as mastitis treatment or getting cows bred.

In observing milking parlors in operation, it appeared that if a man was determined that his particular system would work for him that it did. Of those observed, the author believes that the three-on-a-side, lane type design has the most to offer. It allows milking 40 cows per hour. Even though particular people may not want to operate it this fast, it can be so operated. It keeps the operator uniformly busy; not a hurry and wait situation. It is a pit type and hence less fatiguing to work in. It is easy to clean and relatively inexpensive to construct, particularly if the stalls are built at home. Sufficient time is available for problem cows.

Integration into a System

After suitable buildings are laid out and proper equipment for feeding, bedding and milking is provided, the general physical environment for task performance of the major tasks has been established. Yet, problems of integrating the individual tasks into a system of dairy husbandry and management remain. These problems seem to grow faster than herd size. However, it is the author's feeling that certain simple procedures can be devised to make good herd management for larger herds less troublesome than the slipshod methods found on many farms today.

Determination to succeed is necessary. So is a certain amount of periodic account-taking or mental check-listing. Still with methods of simplifying observations, these procedures need require no great mental effort.

Probably the first place to start is with a system of animal identification. Each mature animal should carry three marks of identification. By neck chain, or by brand, she needs one mark to identify her as an individual. By a combination of a letter and two numerals her age could also be included. A second useful item would be either the date she is to be bred, or the date she calved, or the date she is expected to freshen. The third is the amount of her grain ration. The latter two should be readily changeable and a regular period set aside to do this. Probably the best time is on the day after milk weights are taken.

One man made neck chains from some used car skid chains. He cut 3x2 inch pieces of metal upon which he welded raised numbers on both sides. One set of numbers was then placed on each side of the chain. It was a simple matter to snap on tags to signify breeding information and grain ration. Tags should be readable from both sides. A color and/or a letter-number code may help.

Once a good system of individual identification is established, many necessary jobs can be made easy. A simple diary form can be made whereby estrums, breedings, sicknesses, calvings, weather and ration changes can be noted as they are observed or performed. This form can be carried on a clip board into the milking room at milking time but left at the desk in the milkhouse at other times. From this diary, the milk weights and the herd testing reports, a constant herd record can easily be maintained.

Several practices can further simplify record keeping if desired. One operator freshens his whole herd in the last half of the year. This means the estrums, calvings and dry periods occur only during certain intervals. Although this does require a certain amount of additional culling, 90 percent of the milk can be sold as base, calves can be raised in groups, and very few cows are in milk during first crop haying.

Cows can be dried up on a specified day of the week. When it is time to dry them up the majority will respond to nothing more than a simple cessation of grain feeding and milking. A check of udder condition should be made four to five days later.

In herds larger than what can be milked in two hours a division of the herd might well be considered. One possible way would be to put the early lactators, which produce more, require more grain and must be watched for estrums in one group. Cows which are in late lactation, and are soon to be dried up, could then make up the second group. Both groups could still be run through the same milking room. Yet the whole idea may only add to time requirements with no particular advantage. Lots of one-hundred cows with 50 young stock were observed running together.

Cows probably should not be held for milking without access to feed for over two hours. Dry hay may be the answer inasmuch as most of them will still leave hay willingly in order to get grain during milking.

The possibility of one operator milking in the morning and another at night should be considered. This system creates less change during Sundays, days off and vacations. It serves as a double check on husbandry and production. It can make a shorter work day during the winter season. It keeps two individuals completely familiar with the dairy herd. It insures against sickness and hired help quitting.

Herd health and fly problems can best be handled before they start. Concrete and good drainage are necessary. Manure in the yard should usually be scraped off every day that it does not freeze. Concrete in large yards substitute for labor in smaller ones in this respect. Provision should be made for brushing off flies and for a foot rot treatment box at the milking room entrance. Fly traps and power fly sprayers aid cleanliness.

Over time, farmers may try to breed a cow which works well in this system. Cows which do not measure up can be culled as replacements become available. Most dairymen visited are still keeping the majority of their female offspring. They want big, rugged, high roughage capacity, long lived animals. They want ones which will produce at least 10,000 pounds of milk a year largely from good roughage. They do not want boss cows. They want relatively fast milkers, without sensitive udders. Some have suggested that if you consider flexibility in labor requirements and imperfect knowledge in forage production, it is unwise to try for a 500 pound butter fat average.[12]

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[12] For the opinions of the future trends in dairying by one authority see: W. E. Petersen, "Tomorrows Answers to Today's Producer Problems," Holstein-Friesian World, Vol. 53, No. 16, Aug. 18, 1956, pp. 11ff.

Chore Case Studies

As examples of what can be done in the way of chore operations, three case study descriptions are presented.

The first example is that of a man who has actually used a stop watch to time alternative methods for doing chores. He was quoted as saying,"Five seconds wasted in my chores amounts to an hour per year."

Cows are loafed in the basement of the barn. Hay, bedding, and grain are stored overhead. Hay is fed evenings in a bunk which separates the paved lot for heifers and dry cows from the lot for the milking herd. When straw is used for bedding it is pushed down through the loft floor after the bale strings are cut. It is then distributed but only partially shook out. If shavings or corn cobs are used, they are pushed down the same holes with a scraper blade on the tractor. Grain is fed in inside bunks to dry cows and heifers. It is fed at milking to the rest of the herd.

Corn silage is stored in a 20x60 tower silo equipped with an unloader and rotating feed bunk. It is fed in the morning to both lots by changing the position of an electric wire to allow access to the silo. The concrete barn yard is scraped regularly.

A wing located at one end of the barn contains 13 stanchions for milking. It also contains pens for small calves as well as access to the milk house. The back wall of the milking room contains blackboards which retain a running account of cows in estrum, production and breeding. The feed alley has an overhead track feed carrier which is filled from the barn floor.

The entire herd of 50 cows is bred to freshen from July through December. By this method over 90 percent of the milk may be sold as base. Chores do not interfere with hay making to any great extent, as only about 10 cows are in milk during June. The herd is pastured during the summer months. Calves are raised in groups. Cows are sold which do not freshen during the last half of the year.

Two or three people usually do chores as a team. The operator feeds grain, helps change groups in the milking room, and feeds silage or hay as required. He may also treat mastitis, care for maternity cows or do some bedding if time permits. His 16 year old son operates two "Surge" pail milker units at the rate of about 25 cows per hour. A younger son, age 8, puts the milk in the cooler, helps feed calves and clean up during the evening chores.

By attention to details, such as a cart and hoist to ease the handling of milk cans so that the eight year old can do the work of a man, two and a half hours permit completion of chores for the entire herd during winter months; in June, three-fourths of an hour is sufficient.

Another operator handles a 100 cow herd with $2\frac{1}{2}$ man equivalents while producing the forage for the entire herd on

200 acres. All animals of breeding age run in one lot. Hay is in an open sided shelter. Silage, both grass and corn, is in horizontal silos from which it is either self-fed or fed in portable trailer type bunks. Dry lot feeding is practiced the year around.

The original barn has space for the younger calves and maternity cows. The latter are in a row of stanchions. Two men are required to milk, though one may be entirely unskilled. Chores take a total of eleven to twelve man hours per day. Of this, eight hours are required for milking, including preparation and clean-up. The rest is taken up with calves, maternity cows, bedding and feeding.

Grain comes down to each of the four milking and two prep stalls. Milk is piped to a bulk tank. Equipment includes an automatic line and milker washer. In 1955, this operator sold 900,000 pounds of milk. The herd average was 375 pounds of butter fat.

By way of contrast, one operator with a herd average of 549 pounds of fat on 29 cows has found it necessary to spend considerably more time with his cattle. In producing 420,000 pounds of milk, while buying his grain and hiring his horizontal silos filled, he used about 1.3 man equivalents. In the summer, this herd requires six hours of labor in chores per day. In winter seven or eight hours are required. Some pasturing is done. The operator feels that it is necessary to do all the milking himself, making it extremely difficult for him to get away from the farm at any time. He says that there is 100 pounds of fat in his herd average in care alone. He also feels that any and all field work should hold a second priority to cow care, this in spite of the fact that his herd average was built on forage so good that grain feeding did not exceed one pound of grain to four pounds of milk.

In milking, he has found that one "Surge" pail unit is all he generally wants to handle. He milks in 10 stanchions in the basement of his old barn. Young calves are also housed there. Hay is stored over head and fed outside. Silage, both grass and corn, is for the most part self-fed from the horizontal silos. The older cattle bed in a pole barn. Some silage must be thrown down from a small upright silo.

Conclusions

This Chapter has pointed out five methods for increasing labor efficiency insofar as building and equipment arrangements are concerned.

First, center the milk house to make the entire arrangement visible from there; this allows most tasks to be accomplished with circular travel and a minimum of walking.

Second, design buildings and equipment to require the very minimum of time and effort in feeding, bedding and cleaning.

Third, design a milking system to fit the quantity and quality of labor available. Restrict dairy barn labor requirements to at least one-half of the available labor force.

__Fourth,__ reduce time requirements per cow to a minimum consistent with the need for individual care and record keeping.

__Fifth,__ remember that the other four will work if the man who performs them wants them to. When he finds the atmosphero pleasant, remains alert, accepts change as normal, and is not over-fatigued, he is enticed to remain master of the operation. Even so, he need not be a particularly superior individual; if he can learn and put into effect the recommended methods for operating a milking machine, he should be able to learn how to work in this system given adequate incentives.

CHAPTER IV

THE CROPPING PROGRAM AND LABOR UTILIZATION

This chapter is the second in the group of five which presents the information and ideas used in designing the final organizations. It deals with the problems of making efficient use of labor in producing forage and grain for the dairy herd.

Alternative systems of crop production vary widely in requirements for time and labor. Inasmuch as crop production is seasonal in nature, the problems which arise require a different approach than do dairy husbandry tasks. To gain high productivity from labor, its use over time must be reasonably full and even. Seasonal labor requirements conflict with full, even employment even though labor has a high earning power when weather or other seasonal hazards are encountered. When hay harvest and milking conflict because of insufficient labor to do both at the same time, the opportunity cost of labor in either use is high.

Profitable crop production must incorporate economic principles covering capital and land use as well as labor productivity. Thus, machinery requirements and soil fertility levels are also involved in increasing the productivity of labor. Timeliness in operation makes for maximum returns from expended resources. Further, quality of and therefore the value of, output influences the earning power of the inputs used.

On the specialized dairy farm, only a few cropping operations really need close examination. If sufficient labor is available to accomplish these operations, then other tasks fit in easily. Corn and grass are the two crops which compete most seriously with dairy husbandry for labor. Others, such as small grains, are planted and harvested at times and in quantities which do not seem to create labor peaks and timeliness problems, hence they can rather be regarded as supplementary enterprises which tend to keep labor more fully employed and thus tend to raise general profitability to the firm over time.

Some General Considerations in Machine Use for Crop Production

Men and machines do the work on the farm. Neither should be used where the additional costs involved are greater than the additional returns from use. Inasmuch as both are required, they complement each other. They are not perfect complements, however, as it is possible to substitute an additional increment of one for the other.

Versatility of machine use is important. This is particularly true in crop production where specialized machines tend to sit idle over long periods of time while multi-purpose machines can be used more days per year. As examples, consider a tractor which is in use all year long, or a field chopper which can harvest hay, silage, bedding, and even small grains if desired, in contrast to a combine or a corn planter.

Some machines can be eliminated entirely by the selection of the correct system. Blowers, for instance, are not needed with horizontal silos or with hay if an elevator is available.

Low cost machines can often substitute for much higher cost ones. A used dump truck suitable for farm use can be purchased for approximately one-half of what a new dump wagon will cost and is more versatile. Some operators keep machines which duplicate each other. They argue that the insurance of timeliness and the suitability to the job make this action worth more than the economy of purchasing one machine to do both jobs. The most common example observed was the baler and the chopper both in use on the same farm.

Machines are not perfect. From a labor use standpoint, few farm machines even approach the ideal of simple fool-proof operation. Part of the problem lies in the difficulty of finding and weighing the importance of various goals in design. Not only must machines be economical in first cost and maintenance but they must be capable of operation by people with only limited ability along these lines. From the labor use point of view certain goals can be defined. A machine should be capable of operation under adverse conditions of topography, stones, trash, and poor or damaged crops. Time spent unplugging a plow or pick-up attachment not only slows an operation but may affect a whole chain of other operations.

Machines should be easy to hitch and unhitch. They should be simple to adjust, maintain, repair, grease and operate. The quieter a machine is, the less fatiguing its operation.

Farm machinery changes quickly and depreciates the same way. A look into the future reveals a need for flexibility in today's decisions. Relatively higher machine investments are probably in the offing, but so is improved performance. Hydraulics, power steering, electric power takeoffs, less noise and less vibration can all be expected to reduce operator fatigue. Easier greasing and sharpening, quicker repair features, and greater capacities will tend to reduce field breakdown problems and increase labor accomplishment rates.

Regardless of design improvements, the biggest problem will still be the integration of tasks for smooth and efficient operation. Partial solutions include greasing during otherwise unavoidable delays and keeping a mobile repair center in the field. Major repairs and overhauls should be made out of season. Time spent then is a small price to pay for the elimination of delays in field work.

Equipping men with adequate sized tools makes an efficient balanced operation possible. Jobs done by crew are restricted by the slowest machine in the job. Often times an additional man is in the crew for insurance flexibility. Perhaps a better method would be job rotation or extra equipment standing by instead.

In short, goals of reduction in machine expense and labor efficiency need not always conflict. If the operator selects machines of a size, design and condition to allow available labor to complete field work on time he tends to raise the earning power of labor over time. He must consider alternative uses of time, the capacity and trustworthiness of machines, flexibility, obsolescence and integration of the investment into the total equipment inventory. Field layout, soil fertility, and improved crop practices are also necessary considerations in selecting machines and in gaining high labor productivity.

Machinery and Work Methods for Forage Harvest

In attempting to gain full employment at an even and highly productive rate for labor in crop production, the biggest problem involves harvesting the first cutting of hay. Under Michigan conditions roughly two-thirds of the crop is harvested in the first cutting. The interval between early and full bloom for alfalfa is usually about three weeks. For good yields and a high quality, the crop must be harvested during this time. This season, which starts in mid-June, carries considerable weather hazard from summer rains.

In developing a profitable dairy farm, reduction of labor costs is restricted by a need for the production of high quality forage.[1] In forage harvest, labor which is fixed

[1] For methods and farmer experiences in producing high quality forage see: C. R. Hoglund, High Quality Roughage Reduced Dairy Costs, Agricultural Experiment Station, Michigan State University, Sp. Bul. 390, Feb. 1954. Also: C. R. Hoglund, et. al., "Forage Quality and Protein Feeding of Dairy Cows," Quarterly Bulletin, Mich. Agr. Exp. Stat., Vol. 38, No. 3, Feb. 1956.

to the firm should be spread over as many units of product as compatible with high quality. At the same time, it may pay to hire additional labor for this task. Still depending on seasonal help can lead to disaster if for any reason it ceases to be available.

In visiting the farms in the study, a wide variety of harvesting methods and forage qualities were observed. Rates of hay harvest, both in total tons per hour and in tons per man hour varied widely. It would appear that the man who ran the system, his ability to coordinate, and his determination to get the job done on time, were as important as the system used.

All systems centered around chopping and/or baling. Some methods used included: chopping the first cutting for silage, mow drying it or field curing it.[2] On the same farm, the second cutting might be baled in order to ration it out where desired in later feeding. Other farms insiled part of the first cutting but baled all the rest of their hay. On still others, everything was chopped or everything baled. Some baler owners used a crusher but none mow dried baled hay. Some operators believed it advisable to green chop or feed from storage the year around. While this increased the hay harvesting task, they felt that the advantages outweighed the disadvantages.

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[2] Karl A. Vary, Hay Harvesting Methods and Costs, Agricultural Experiment Station, Michigan State University, Sp. Bul. 392, May 1954 discusses the merits of various methods. However, his data cites 1946-50 performance records which are now somewhat out of date.

Chopping Grass Silage

Putting the first hay crop into grass silage seems to be an alternative worthy of wider useage than is common today. It requires a relatively low machine and storage space investment, produces high quality forage, and if high capacity machines and good coordination is provided, gets the first cutting of hay harvested as rapidly as any other.

Due to the weather hazard in June, grass silage can often be made on days when making dry hay is out of the question. Grass silage makes excellent forage provided approved practices relative to state of maturity, moisture content and storage facilities are carried out.[3] While on occasion other methods can compete with it, year in and year out, under what is known about forage quality today, it is doubtful that as good a quality forage can be produced by other means.

The key to successful forage chopping seems to be a high capacity, adequately powered harvester.[4] Choppers are made today which carry manufacturer's ratings of over 30 tons of silage per hour. Some farmers in the study reported that

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[3] C. R. Hoglund, *op. cit.*, Sp. Bul. 390, pp. 8-9.

[4] C. R. Hoglund, *et. al.*, op. cit., pp. 419-24.

with this type of chopper, they could average at least 20 tons per hour considering minor delays and breakdowns.

At this point a digression is called for to show what this means in terms of forage harvested. Many dairy farms could easily use 1,000 tons of grass silage yearly. With a first cutting of 6 tons of silage, 168 acres of forage would be required. While operating steadily, 6 loads of 3.3 tons each would have to be taken care of per hour. Under most conditions, this calls for three hauling units (either trucks or wagons) with each unit making one trip every 30 minutes. To accomplish all this, mow hay ahead of the chopper, and either handle a blower or a packing tractor would take a crew of from five to eight men. Yet, if three weeks are available to get the entire job done, three men could do it with good scheduling and integration. Thus, while the task is enormous, it can be fitted to the labor and time available over fairly wide ranges. What follows will discuss techniques for doing this.

The best silage can be made at early bloom. At the same time, direct-cut chopping results in silage of high moisture content causing souring and seepage of certain valuable food nutrients. From half bloom on, direct cutting is usually more successful. However, due to the limited capacity of direct-cut attachments, the mowing and pick up method may still have an advantage. Thus, it is hard to eliminate a mower from the system.

However, it is possible to mow and windrow at the same time. While it may take slightly longer, wilting of the silage will still occur. Those operators with experience have found that a windrower mounted on the cutter bar works as well as a side rake.

Two types of windrowers are available. One type places the windrow behind the tractor in such a manner as to make it possible to put two windrows together. Under usual conditions, two windrows together reduce chopper travel and increase capacity. However, this type of windrower often bunches the grass and reduces chopping capacity. A second type places the windrow in the center of the swath without appreciable bunching. This means that half the field will have to be raked in order to place two windrows together. When the silage is raked, stones are likely to get into the windrow. When it is simply windrowed with an attachment, this is no problem. Later in the season with a motor mounted chopper, and with a mid-mounted mower-windrower, the chopper could be pulled by the same tractor that mows and thereby makes essentially a seven foot direct cut unit.

Recently a new mower said to be capable of mowing 6 acres per hour has appeared on the market. It consists of two 7 foot cutter bars, one mid-mounted and the other extended into the field past the first and rear mounted. This machine is made by the Kosh Company. A ground driven trailer mower, if of sufficient capacity, could be towed similarly behind any draw bar mounted type to accomplish the same end.

In order to save labor, trucks can be towed behind the chopper if a special hitch is provided and the terrain is not too rugged. However, the only operator interviewed who had tried this experienced difficulty from breaking a casting in the truck's steering mechanism. Improvement is called for here.

Another type hitch could be devised with a motor driven chopper whereby the machine is pulled by the truck being loaded. If the two units were run side by side and with all controls accessible from the truck cab, the advantages of truck hauling could be obtained without a man actually operating the chopper. By necessity, any such hitching device would have to be quick, simple and almost automatic in operation.

Men and time can be saved in hauling also. Large hauling units and unloading devices which require no manual attention are steps in the right direction. Generally speaking, trucks which dump hydraulically provide a versatile device for hauling materials on a farm. Three farmers who work together at silage making had each purchased used dump trucks for 300 dollars a piece.[5] To these, they had added higher sides, the back of which were built out over the dump gate supported in a horizontal position. In working in horizontal silos, they found snow tires desirable. With the longer hauls

[5] See the case study descripton on page 87

which become necessary as herd size increases, hauling with trucks becomes more important.

Hydraulic type dump wagons or trucks unload faster than other types of wagons and trucks. However, if a blower or elevator is used, dumping may have the disadvantage of plugging in which case the false endgate type works better. As a good and inexpensive substitute, a rake device may be extended from a manure loader frame to pull the forage off into a hopper. The same device might prove to be a useful bedding tool in loose housing. For unloading in a horizontal silo another inexpensive device is a length of woven wire laid on the wagon bed and then up over the front. To unload, another tractor is hitched to the top end and the load is rolled -- not pulled -- off. It can then be spread out by continuing to pull on the wire.

Another time-saving feature useable to speed hauling operations with wagons is an automatic coupler. This device closes around a wagon clevis pin automatically. It is released by pulling a rope. If the wagon tongues are supplied with springs to float them for height and both the chopper and hauling tractor are supplied with couplers, neither driver needs to leave his tractor to change wagons. Total costs for three wagons floaters and two couplers run less than 25 dollars.

In building forage boxes, considerable money and time can be saved by using corrugated steel roofing for sides as compared to wood which is expensive and heavy. One place where money should not be spared in first cost is in diagonal bracing. In order of cost, unloading devices run as follows: lowest is either the rake attachment for a manure loader or woven wire to roll the load off, next is the false endgate type followed by the canvas bottom. Most expensive are the hydraulic dump and the endless chain types. The method of unloading determines which will operate the fastest and most satisfactorily.

In the upright silo, the silage should be distributed to exclude air and insure against spoilage. A distributor can be built or purchased to do the job with little attention. The best type observed for grass silage consists of a sloped concave shaped trough located in the center of the silo under the blower pipe. When rotated rapidly by an electric motor it threw the silage to the wall of the silo and allowed it to settle without trapping appreciable amounts of air. If an elevator is used for silo filling, trapped air seems to be less of a problem. Regardless of which is used, most operators still feel that a man in addition to the hauler is needed to keep things functioning smoothly. Perhaps some of the newer and more automatic unloading devices can overcome this.

To save time in filling a horizontal silo packing should be done while filling. This means a man and tractor are needed in the silo at all times. If the tractor is equipped with a manure loader, the teeth dropped to a vertical position can be of considerable aid in spreading the fill. At filling rates of 20 tons or more per hour, two packing tractors may be necessary to insure a tight pack. Wagons or trucks which can unload while still moving have a definite time advantage in horizontal silos. If an earth ramp does not close one end of the silo, perhaps a wood or metal runway should be provided to get the loads up to the top. The author would like to try a road contractor's "sheep's foot" type roller in the hope that it might improve the efficiency of packing horizontal silos. For that matter, the newer high capacity choppers might well call for hauling units similar to the "big wheel" type road builders use.

This one method (ênsileing) of harvesting the first cutting hay crop has been discussed quite thoroughly. There were several reasons for doing this. It gave an opportunity to discuss how various pieces of machinery fit together into a system. It demonstrated one of the simplest methods for harvesting large volumes of high quality forage with limited time and labor. It proved to be the method which is least influenced by weather. It allowed the use of storage space and machinery investments which are relatively low in cost as compared to other methods soon to be discussed. When properly stored, grass silage may be carried over for three to four years with practically no loss of nutrients. In this way, it can become an important source of feed insurance.

Grass silage also has its disadvantages. When stored in an upright silo it packs extremely hard and is the source of an unpleasant odor when fed. When stored in horizontal silos, spoilage is often a problem. However, an air-tight cover such as a plastic sheet or wet sawdust can reduce this spoilage to a level comparable with upright storage. Spoiled silage and seepage tend to increase fly problems. Perhaps one of the greatest hazards in grass silage is the possibility of storing a large proportion of total roughage in this form only later to discover that the palatability or digestibility of the feed is less than anticipated. Some farmers had experienced these difficulties but lack explanations for them.

Another way to save time at harvest and hence even out peak labor loads is to ensile forage in the field rather than at the barn. Shorter hauls during the harvesting season result. In the winter, the silage can be hauled to the barns and fed either in bunks or over the face of self-feeding silos placed there, as some silo space at the buildings would still be necessary for fall, spring and bad weather feeding. A dump truck, a manure loader, a chain saw for cutting silage loose and suitable feeding bunks would be necessary to make this system work. A self unloading wagon could be used, but in as much as dump wagons and large rectangular type feeders[6] cost less and do the same job, these are the recommended pieces of equipment.

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[6] See page 22 for a reference to this type plan.

Other Methods Using a Forage Harvester

There are other systems which should be mentioned. Some farmers have been very successful with field cured chopped hay providing weather hazards were not too great and the hay need not be moved to be fed. Others have produced excellent forage by mow drying chopped hay. Drying costs tend to run around a dollar a ton and hay harvesting rates are regulated by dryer capacity.[7]

Elevators are generally preferable to blowers in putting chopped hay in a mow. However, there is at least one blower (manufactured by the Kools Company) which will handle mow drying hay without gumming up and plugging. This blower also had the greatest capacity observed in the study. It can handle two and one-half tons of silage in five minutes if fed steadily. With either a elevator or blower, a distributor to spread the hay evenly in the mow will save labor and speed drying.

One farmer had made his own mow dryer fan for a materials cost of about sixty dollars. He purchased a used five horsepower electric motor, some V-belts, pulleys, bearings and a used wooden airplane propeller. By welding a simple but rigid frame together and rebalancing the shortened propeller, he had a fan capable of handling a mow 16 feet wide, 50 feet long and 20 feet deep.

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7 W. H. Sheldon, et. al., Barn Hay Driers in Michigan, Agricultural Experiment Station, Michigan State University, Cir. Bul. 219 (Second Edition), April 1953, pp. 5-9.

In an attempt to harvest chopped forage more economically, some farmers have tried the new rotary hammer type chopper. Results have not been too favorable. This machine tends to produce a shredded type product which is bulky to haul and does not pack well. Hammers break off in stony fields and a ragged stubble is left if an operator attempts to drive fast enough to get any great capacity. One man had tried to pick up straw with one from the windrow but found this extremely slow. No one interviewed had tried to harvest corn silage or corn stalks for bedding with one.

To get a chopper to operate at 20 tons of silage per hour, or 7 tons of hay per hour, many conditions must be satisfied. Not only must it be possible to haul the forage this fast but the chopper must operate steadily. This means that it must have a pickup which does not plug, it must be of large capacity, it must be adequately powered, and it must not break down. Some features to watch for in purchasing follow: Some choppers may be sharpened without removing the knives. Some have rather positive feed pickups. Some require less power than other similar capacity machines. In selecting a machine from the standpoint of economy, first cost as well as operating costs are important.

Expected Accomplishment Rates Using a Forage Harvester

Three men, three small or medium sized tractors, a manure loader, a mower and windrowing attachment, a siderake, two used dump trucks or three wagons, an elevator and a large motor driven chopper can make a complete forage harvesting unit capable of harvesting all silage, hay and bedding for a sixty cow dairy farm.

Including minor delays, this unit should be able to handle 350 tons of silage each week of operation. One hundred tons of hay could be harvested in the same time period. This would involve about ten acres of grass silage per day. Mowing requires three and one-third hours. At a chopping and hauling rate of only twelve tons per hour (a more practical rate for a smaller crew), six hours of time would be required. During these six hours, one man and a tractor would have to be at the silo almost continuously. Twelve tons per hour will require three or four loads chopped, hauled and unloaded per hour. According to the farmers interviewed, this type of equipment should have no trouble operating at this rate.

Actually these performance estimates are rather conservative including considerable time for delay between jobs, minor breakdowns, servicing, bad weather and other normally encountered hazards. With more attention paid to scheduling, a smaller harvester might serve just as well. In fact two men can perform the same work in the same time by working seven or eight hours per day if both can interchange on all jobs to insure against scheduling delays. If two men were to do the entire job, they might well consider quite carefully such items as truck-chopper or wagon-chopper hitches. They might also consider increasing corn production for silage to lower the need for grass silage or hay. Methods of corn spraying or cultivation to reduce time requirements here will also be important. Managing pastures to require less harvested roughages will also have added value.

Baling Hay

Some excellent methods for handling baled hay were also observed. Many baler owners justify baling from the standpoint of greater rates of accomplishment alone. Small or underpowered choppers may have led them to this conclusion. Available storage space is another factor. To bale hay often requires investments in both baling and chopping equipment. The work is harder and crew size is usually as large or larger than for chopping.

There are three general methods which allow three men to make up a baling crew capable of operating as fast as the new high speed balers function. In all three, a wagon is hitched to the baler and two men are required in the field full time. The third man must then haul as rapidly as the baler operates.

One method requires hauling to ground level storage on wagons hydraulically controlled to tilt to a complete vertical position. This same wagon bed must be equipped with strong vertical back members capable of supporting the entire load when the bed is tilted. The load is backed into the storage area, tilted, deposited and the wagon is pulled ahead to free the back members from the load.

Another method consists of using a regular bale elevator emptying onto a ridge line conveyor equipped with a trip-off device. The third way is to use a winch operated hay carrier system with slings or a special baled hay fork and an automatic return. In either of the latter cases, storage space must be available where the bales need not be stacked into place.

A recent development is a type of bale wagon which loads and unloads itself automatically.[8] Various devices such as bale sleds and bale loaders are also on the market. With more limited labor, such devices may find a place on many farms where they are not used today.

To save energy and time in unloading hay, either in round or square bales, an elevator hopper should be built which will take the bale in any position. With such a device the bales can be half dragged, half dumped into place without lifting. When used with a ridge line elevator, this system allows the carrying of bales into storage to the full lineal capacity of the elevator.

Some farmers felt that the use of a bale loader to pick up bales from the ground actually takes less time than to

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[8] F. Leland Elam, "Load Bales From the Tractor Seat," Farm Journal, Vol. 81, No. 5, May 1957, p. 74F.

pull a wagon behind the baler. No data are available either to prove or disapprove this theory. It does allow the use of trucks for hauling which has an advantage on long hauls. In some cases it is also true that the baler must slow down in order to keep the bales on the wagon.

The weather hazard for baling hay can be reduced by crushing. While crushing either slows the mowing operation or adds another task to hay making, it can be justified, in the large operation, on the basis of improvement in quality alone.

Without the weather hazard, baled hay can be put up as rapidly as grass silage but total digestable nutrients and protein harvested per acre are not likely to be as high. According to information collected in the study, three men should be able to do all the work in putting up 100 tons of baled hay per week of operation.

Pelleting Hay

If, in the future, hay pelleting becomes practical, hay making will become very similar to grain harvesting today. The storage space required today will be reduced by one half and it will be stored, dried and fed completely with bins, gravity and elevators.

Some Observed Systems

To add concreteness to this discussion of methods for harvesting high quality forage rapidly with a minimum of labor, it is worth describing some of the systems actually employed on farms visited. The first, a baling operation on a one-family farm is an outstanding example of what management can do. First of all by controlled fall freshening, very few of the 50 cows on this 177 tillable acre farm are in milk in June. Hay is field cured and each good haying day is run the same way. Hay mowed and raked on a previous day is turned over when it has dried off on top. Meanwhile, as much hay is mowed as can be baled in one afternoon. This hay is raked the first time around noon. The father and his teen-age son are available for doing these tasks.

In the afternoon, one drives the tractor while the other loads bales. A younger son hauls the wagons to the barn. Automatic hitches are used. When three wagons are full, the younger son drives the baler tractor while the father goes to the barn to unload. The mother drives a truck on the hay rope and the bales are unloaded with a special baled hay fork. The bales are not stacked. This family has put as many as 21 tons of hay in the mow in one afternoon when weather conditions required the baling of two day's cutting. However, they average closer to 7 acres or 14 tons per day.

The second operation shows what efficient machine coordination will do when farmers work together. Three brothers, each owned a share of a ten year old, large, motor-mounted, forage harvester. They also each own an old used dump truck. When operating, they require one man mowing steadily while a second rakes two swaths into one windrow. A third man pulls the chopper while three haul. Two packing tractors are required to keep up. As each brother has a hired man and one has two teen-age children no additional labor is hired.

They harvest an average of around 23 tons of grass silage per hour. They have sometimes put in 30 tons. This amounts to 12 loads per hour or a load every five minutes. To be fair to all, they rotate priorities from one year to the next as to which farm will be done first.

Another one-man farm uses a mow drying system. Hay is mowed and windrowed in one operation. He does not even own a rake. The hay field cures so long as it is not likely to rain. Hay is chopped with a nine year old machine. It is hauled on dump wagons fashioned from ancient dump trucks and elevated into the barn on a forty foot elevator. Distribution is by hand. A circular hay feeder is also filled. The same drying fan is used for both. The operator and one other man, working only when they felt the weather to be right, were able to put 200 tons in the mow in three weeks. This included only about 12 days actually worked in the fields.

Other Field Work

With modern equipment and methods, no real timing problems need occur on the specialized dairy farm expect at forage harvest. For this reason, this section will discuss alternatives only briefly except for pointing out that methods which are relatively economical in the use of labor are generally low in total cost.

Modern farmers tend to equip themselves with equipment large enough to insure against bad weather. While this is good to a point, it can be overdone. It is hard for instance to justify a four bottom tractor and plow on a basis of 100 acres plowed per year. If such a tractor is used to run a forage harvester, it may be more nearly justified. But even here, a mounted motor and a small tractor may be more economical. The major consideration is often a matter of the alternative uses for the labor and capital required in operating various sized machines. Certainly as the price paid for labor increases, so does the justification for larger machines to accomplish the same amount of work.

Oat Planting and Harvest

Traditionally spring field work starts with oat planting and forages are seeded in the oats. In most years, this task can be accomplished without conflicting with corn planting. Because oats are a low value crop, newer methods of forage seedings have been proposed which tend to conflict even less with other field work.[9] In this type of operation the advantages of multiple hitches should be considered. For instance, a spike tooth drag can be mounted underneath the drill tongue while a cultipacker is towed behind.[10] Another time saver is larger

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[9] C. R. Hoglund, Economics of Alternative Methods of Establishing and Harvesting Forage Crops, Agricultural Economics Department, Michigan State University, Dec. 1956, Ag. Econ. No. 669.

[10] Ray L. Cook, "Are Your Tillage Methods Up to Date?" Hoard's Dairyman, Vol. 98, No. 6, Mar. 25, 1953, p. 271.

hoppers on the ordinary drill. Hydraulic lifts have considerable advantage over power lifts in both time and ease of operation of a drill.

Oats can be harvested either as silage in June or as grain and straw in July. While the latter method involves less conflict in the use of labor and helps solve the bedding problem, the former may be more profitable.[11]

If oat silage is made, timing is critical; the silage must be made when the oats are in the early dough stage which conflicts with hay harvest in mid-June in southern Michigan. The procedure is the same as grass silage harvest.

After combining, straw must be clipped and swathed. The windrow attachment may or may not work well here. Otherwise the procedure is the same as when baling or chopping dry hay except that timing is usually less critical.

Manure Handling

Manure hauling is usually started when the ground is still frozen. With the coming of spring rains and thaws it is often not completed until time to plow for corn. Two large spreaders, a tractor mounted manure loader, and two men make an efficient unit for hauls of one half mile or less.[12] A tractor is needed for each spreader unless the claw and ring

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[11] C. R. Hoglund, Agricultural Economics No. 669, op. cit., pp. 5-6, 8-13.

[12] B. F. Cargill, N. P. Ralson, op. cit., pp. 14-16.

type hitch designed by the Ferguson Company for three point hitch tractors is used. This same hitch can be a time saver for any heavy tongued implement. If only one man is available, he can work efficiently with this equipment.

A loader with live hydraulic power and a hydraulic cylinder dump on the bucket is a definite advantage. In the yard, a scraper blade on the rear of the tractor can save time, especially if the manure can be pushed directly into the spreader. With most tractors, additional weights on the rear speed loading. So does power steering on the tractor. Skill in operation on the part of a driver is something which must be learned by finding just how fast his equipment will work as conditions vary.[13] The newer power take-off spreaders are designed to operate when wheel drive models cannot.

Fertilizer and Lime Spreading

Fertilizer and lime spreading are jobs which can be done throughout the year. With materials coming in bulk much of this work is now done on a custom basis. Some farmers have found ways of doing this same job about as efficiently themselves. Some have purchased equipment in partnership. Others rent equipment. Some use field spreaders and dump trucks and get by with little additional equipment costs. Three of the farmers visited had purchased an old used lime

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[13] Ibid.

truck for hauling their lime and fertilizer in bulk. This is an example of how farmers can get their own labor to do more work, spread their equipment cost and take advantage of bulk rates on materials.

Sacked fertilizers are still likely to be found on farms for years to come. So are other sacked materials such as feed supplement and cement. For this reason a pallet lift is a low cost addition to a manure loader frame which could be used on many farms. Fertilizer can be loaded on wagons or trucks in this way. Pallet boxes can serve as silage feeders for small lots of cattle. Pallets can store cement and feed up where it is dry and in a minimum of space. Small loads of hay or straw can also be rapidly transported this way.

The newer methods of handling fertilizer in liquid form can be labor savers also. Planters, sprayers and holding tanks are now on the market. Actually, the main thing the farmer must consider is the cost of nutrients placed in the soil regardless of whether they are in a solid, liquid or a gaseous state.

Corn Production

Even the corn crop no longer need provide any extreme peak loads on labor requirements. By using minimum tillage methods, two men can plow and plant ten acres per day with a two bottom plow and two row planter.[14] With somewhat larger

[14] Ray L. Cook, op. cit., p. 271.

equipment, two men could double this rate.

Practically all of the interviewees had tried minimum tillage methods; some have had more success than others. It appears that tilth, organic matter level and amount of moisture in the soil were the factors which governed how successful they were. On well managed soils of suitable moisture content, the soil may be prepared by this method with savings in time and money.

As Vaughan and Hardin point out, the reason corn rows stop at the end of the field is to rest the horses.[15] They report that corn planted around the field can result in 5 to 10 percent savings of time and labor. The savings in so doing are not just in planting but also in cultivating and chopping or picking.

With rotary hoes, four row cultivators, and large row crop sprayers, no problems need arise in getting the crop taken care while harvesting the first cutting of hay. Whether or not such equipment is justified on any particular farm depends not only on what labor costs but also on the scale of operation. To use four row cultivators requires four row corn planters. To get sufficient soil compaction in the row with the four row planter may take special precautions at planting time. The time may soon come when corn will require no work from planting to harvest.

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15 Lawrence M. Vaughan and Lowell S. Hardin, Farm Work Simplification, John Wiley and Sons, New York, 1949, p. 66.

There is a two band fertilizer planter on the market today which can place high nitrogen fertilizer below the seed to eliminate the need for mid-season sidedressing. Wide row planters for seeding forages in corn are also available. This type of operation may also reduce labor requirements, particularly if a satisfactory high speed seeding method can be found. The new stubble-mulch planter is another tool which should be considered as an alterative, at least in some areas.

Most farmers could increase the amount of forage and corn produced quite easily by devising rotations whereby the crops do not conflict in time requirements. Pre-emergence spraying, rotary hoeing, June spraying, judicious pasturing and early crop pasturing can all work to this end. There are enough alternatives to permit a good system to be built for most of Michigan's soils and weather. Sudan grass and pasture rye may also fit in to serve this end.

The necessary equipment and methods for corn silage harvest have been covered by the discussion on grass silage. Good corn silage harvested at the early dent stage can account for much of the total digestable nutrients needed to balance high protein grass silage.[16] High capacity equipment is important here also. The date of harvest is critical. The whole job should be done within ten days for best results. Production

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[16] C. R. Hoglund, et. al., op. cit., pp. 425-26.

of corn of two different maturities may help.

The bunker silo serves as well for corn silage as for grass. Because there is no need to mow or rake, the capacity of the same crew in tonnage per day is greater for corn. Averaging 12 tons per hour for a six hour day permits a total of 700 tons to be put up in 10 days by two men provided rain and major breakdowns do not occur.

For most Michigan farmers, additional corn raised for grain is profitable. In years of a poor hay crop, part of this corn may be insiled to provide insurance against adverse weather. It also is a crop which can be stored or sold if a surplus is raised.

Sufficient time is available to harvest the entire crop with a one row corn picker at the acreage found on most specialized Michigan dairy farms. Newer pickers are designed to save more of the crop, be easier to grease and to allow separation of the snapping rolls from the tractor seat for safety and speed.

Other alternatives for corn harvest include the corn combine and the combination picker-chopper. It is unlikely that either will prove to be profitable with the limited corn acreage of any but the very large specialized dairy farm unless they undergo further development.

Modern corn cribs with draglines in the bottom and elevators for both filling and emptying require very little labor. A design which will allow the farm elevator hopper to sit underneath the crib when in use is ideal and entirely possible on most farms. Such a structure constructed of poles set in a 14 foot circle with a raised concrete floor and center drag line pit need cost only about 30 cents per bushel of space. This includes woven wire sides, center ventilating duct and a sheet metal roof.

Fencing and Gates

The farmers interviewed had solved much of their fencing problems either with electric temporary fencing or by dry lot feeding. While several mentioned that they wished they had good permanent farm boundary fences, they felt that alternative uses for their resources carried a higher priority. Some reported poor luck with electric fence, particularly during droughty periods.

Easy opening gates and cattle guards are low cost items which can lessen time requirements on many farms. Mechanical winders and post hole diggers also help. A kit of special fencing tools lends "extra hands" in fencing work to relieve the farmer of some of the rather unpleasant work associated with fence repair.

Further Considerations In Field Work

Most farmers find it necessary to spend further time in field work at such tasks as stump and stone removal and land drainage. Little can be said here which has general application. However, a manure loader, a stone boat, dynamite, and a dump truck speed as well as ease such operations. Bull-dozers and other earth handling machinery have progressed to the point where a farmer should consider changing the lay of problem land areas by hiring these machines.

There are several thumb rules that a farm manager can keep in mind for saving time and effort in crop production. In doing so he should remember that even small savings multiplied over many units can be important. For this reason it behooves him to keep abreast of new technology. Once he has done this, the following questions serve as a constant check list for any given farm and its equipment.

(1) Can additional field obstructions such as rocks or trees be removed?

(2) Would more off-season maintenance avoid unnecessary field delays and breakdowns?

(3) Would larger seed and fertilizer containers decrease the time at filling stops?

(4) Would bulk handling reduce time at filling stops?

(5) Are fields as large as practical? Long narrow ones are preferable for tractors. Avoid odd shapes and small sizes.

(6) Could planting, cultivating and harvesting be done around the field to advantage?

(7) Could rectangular fields be run away from the buildings to save travel time?

(8) Where can cattle guards replace gates to advantage?

(9) Could operations be combined to utilize load capacity?

(10) Is the maximum use being made of easy-to-change electric fencing?

(11) Are labor and machinery used on the best land first when a choice is necessary to insure highest returns in case of future delays?

(12) Are equipment and work schedules such as to allow night work if need be?

This list is not exhaustive. Even so it does point out the types of questions a man should ask himself if he truly wants to save labor in field work.

Conclusions

The biggest problem in field work is the harvesting of forage. While a system can be designed to allow a very minimum of labor, timeliness considerations are such as to make most operators hire additional labor here. With careful planning this may not be necessary.

With modern machinery, the other field work can usually be fitted in even in the short field day of a dairy farm. Many of the keys to fast operation are items of low cost items such as row crop sprayers, once over tillage, hydraulic loaders, pallets and automatic hitches.

In the final analysis, the appreciation of timeliness and the coordination of activities will probably affect how rapidly things can be done just as much as having machines of the very latest design and large capacity.

CHAPTER V

BUILDING AND EQUIPMENT MAINTENANCE, REPAIR AND CONSTRUCTION

This is the third of the five chapters dealing with tasks involved in operating a specialized dairy farm. When buildings and equipment depreciate, wear out, or break the problem of repair and maintenance arises. When new buildings are required someone must build them. The discussion in this chapter deals with how these tasks can increase the overall earning power of labor on dairy farms.

The Importance of Maintenance, Repair and Construction

To increase the overall earning power of labor most repair, maintenance and construction must be done when livestock and crop work is not pressing. This provides an opportunity for productive work for the farm labor force in off seasons. Even though equipped with the same tools, it may not always be possible to make farm labor as productive at these tasks as is skilled labor. However, with mechanics charging three, or even four dollars per hour, farm labor need not produce equal services to be profitable.

A few farms may be found where labor is so fully employed with livestock husbandry and crop production that no time exists for these tasks but such farms are rare. To justify such a farm economically the labor must, over time, show earnings at the margin equal to the rates paid carpenters and other skilled mechanics after adjustment for performance differentials. So long as crop production is seasonal and cows must be milked twice a day, this is hard to do. In the more usual case, difficulty occurs in keeping farm labor earning as much per day as skilled repair and maintenance labor costs per day.

Farming production items are continually either wearing out or becoming obsolete. Many can be repaired or replaced at a considerable saving of capital and operating expense by building the new ones which go into the business. Under capital restrictions larger capital expansions can often be justified this way.

Not only is this true of the farm business but also of the farm home. Large dairy farms with two or more houses and barns equipped with modern plumbing, heating, lighting and appliances will require a regular flow of services for maintenance and repair. Farm shop tools can serve both farm and home and hence be more economical to both. These same service functions tend to raise the earning power of labor by simply reducing costs which would otherwise have to be borne out of the funds paid to the families involved.

The same argument holds for construction of new homes and farm buildings. The majority of the newer facilities seen during the study were built in this way. The owners of them were justly proud of their handiwork.

Experience of the Interviewees as a Source of Information

The experience of the interviewed farmers offered little data to lend empirical content to this discussion. Some seemed to spend most of their spare time building and repairing buildings and equipment. These people had been able to reduce the cash cost of these items appreciably by so doing. They tended to caution others about the time necessary to get a new piece of equipment operating smoothly and of the risk of failure.

Others were not so inclined and tended to argue that their time was best spent elsewhere. They would argue that it is best to buy equipment or hire construction done so that "you will be sure it will work." They seemed to feelit necessary to put a high cost on time spent adjusting and modifying machinery and equipment when field work is pressing. "I couldn't run the farm and do all that construction too," or "Maybe if you knew what you were doing you could make a wagon but I would rather buy mine" are two typical kinds of comments.

In the analysis of these interviews inherent talent and subjective considerations seemed to weigh heavily in the extent to which repair and maintenance functions were incorportated into a farm business. Some people have far greater ability to design and operate farm tools. Yet in most men these skills and abilities can be developed. If higher earning power for both capital and labor are desired, this is a fertile field upon which to spend time and energy.

The skill, interest and know-how for performing these tasks varies between people. Many individuals capable of handling tasks as exacting as milking should be able, under proper incentives, to learn how to do many of the repair, maintenance and construction jobs on a farm. Though such individuals may be unable to perform them with the skill of a good mechanic they may perform them more economically. Many simple concise books and manuals are available to aid anyone wishing to learn how to do these services. People can be hired or trained who are capable in this area.

Other Sources of Information

Empirical research is also lacking. While various discussions imply advantages in performing these jobs on the farm, no account of time requirements, costs and returns, or of the level of skill which might be expected from farm workers was found. Further research is called for in this area.

In lieu of empirical content, this chapter presents some tentative economic reasoning to support the case for the production of the major part of these services by a farms' regular labor force. It is difficult to say just what a "major part" means. Variations in the value of time, capital outlay, and available skill enter into any given decision.

Intrafirm production of maintenance, repair and construction services is really a form of vertical integration These services, no matter how supplied, are essential inputs. Industrial firms set up whole departments to perform them. Few farms can expect to employ even one man, full time, at these jobs. Yet with high machinery investments and seasonal crop production, fixed labor supplies can be profitably employed in these services.

To produce these services requires forward planning. Tools must be available. In an emergency, the services must be justified from an evaluation of the costs and returns where time may weigh heavily. Repairs out of season can often ease these decisions. So can the training of personnel. Truly, "a stitch in time can save nine."

As examples of what may be done, a list of rainy day jobs can be kept as they are noted. A priority system can be established for doing these tasks. As equipment is put away for the season, each can be tagged with essential information needed for winter overhaul.

Tools and facilities are necessary for this type of work. To provide them requires capital outlay. Capital should not be invested here if limited to the point where investment in such things as additional high producing cattle will show higher returns. On the other hand, savings in the construction of the stalls in one milking room could pay for a welder or might well buy another high producing cow. A trailer equipped as a mobile maintenance and repair unit might easily save sufficient time in one harvesting season to pay for itself. A set of bolt dies can save its cost in bolts and convenience in short order.

There will probably always remain some tasks on any farm which can best be hired done. When the degree of skill required is high, or time restrictions are short, or as often occurs certain subjective and personal considerations enter in, then it may pay to hire the job done.

Just how and where to spend maintenance time is another problem. The manager should try to balance costs and returns in what jobs should be done, which ones should be done first, how time and other fixed inputs shall be distributed between tasks, and the amount of effort it is worth while to expend on workmanship. It is hard to justify painting a machine which will wear out or become obsolete before it rusts out. On the other hand one group of farmers in the study had a forage harvester through which they put some 4 to 5 thousand tons of forage a year. The machine was ten years old and had cost around 200 dollars a year in repairs. They could see no justification for trading off their machine for a number of years to come.[1]

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[1] For a discussion of the factors to consider in buying and trading farm machinery see:
George Larson, Methods for Evaluating Important Factors Affecting Selection and Total Operating Costs of Farm Machinery, Unpublished Ph.D. Thesis, Department of Agricultural Engineering, Michigan State University, 1955.

The Farm Maintenance Center

A comfortable well-equipped farm shop is the key to gaining the time and incentive to do repair work on the farm in off-seasons. A shop of sufficient size to hold the largest piece of machinery on the farm should be provided. A wide range of tools capable of performing jobs in mechanics, carpentry, plumbing, electricity, and machine services are needed.

A 150 ampere welder is indispenable, but many of the saws, drills and grinders can be made to substitute for each other depending upon the required needs. Even a carbon arc attachment for a welder, if equipped with compressed air for blowing out metal, could substitute for an acetylene cutting torch.

In general, equipment which is portable should be given a priority for farm service over the more accurate but stationary types. As mentioned earlier, a mobile maintenance trailer can be very valuable. This unit should be equipped with the air compressor and power greasing equipment. An expandable work bench with rigid legs and a vise should be another feature. The farm source of emergency electric power could be mounted therein. Carriers for hand tools should be provided. A canvas for spreading on the ground to aid cleanliness and the finding of lost parts would be a nice addition. The whole unit could lift off so that the trailer could serve other uses.

To get maximum service from the farm maintenance center, it should be made easy to work in. There should be heat in winter and a fan in the summer. Lighting should be adequate for dark rainy days and for emergency night work. There should be an array of hoists, jacks, vises and such devices which lend "extra hands" when needed.

Considerable attention should be given to storing tools, parts and instruction manuals where they can be found quickly when needed. Most hand tools should either be in tool boxes or hung on the wall in front of the work bench. Rare is the farm shop which has all of the parts bins it could use. A desk for planning and for keeping instruction manuals can be a handy time saving feature.

Conclusions

In Chapter II the thesis maintained that to gain high rewards for labor in dairy farming, ways must be found for caring for a large number of high producing animals in a minimum of time. Chapter III discussed how farm labor might produce sufficient high quality feed to provide for this herd. At this point, the analysis left time which was unaccounted for by either dairy husbandry or crop production.

In this chapter attention was focused on the maintenance and repair services necessary in dairy husbandry and crop production. It was pointed out how these services can level out labor requirements and maintain fairly even employment throughout the year. Advantages in timeliness and in lower costs for the services as well as a possible greater convenience were argued. Personal considerations cannot be avoided. Aptitude, skill and pride in accomplishment all have a part. It was maintained that on most farms the possible gains are high enough for this kind of work so that considerable effort should be expended to accomplish most of these services. This may be done by purchasing repair equipment and either hiring or training personnel.

To have been more factual would require more empirical data than was available. Additional research in this field would be helpful. Even without data a strong case exists for considerable emphasis on this part of the farm business to improve the earning power of labor.

CHAPTER VI

PERSONNEL MANAGEMENT

The three immediately preceding chapters dealt with how labor as an input might accomplish more by improving the organization of the physical plant. This chapter deals with personnel management which is an equally important aspect of the work environment dealing with the somewhat less tangible things affecting a person's attitude toward his job and his proficiency at it.

Even the family farm operator who does the bulk of his own work has personnel problems when he uses family labor or seasonal hired help. Even when he uses his own labor, he wants to do so in as pleasant an environment as possible. It is to his advantage to consider health, safety, freedom from drudgery, leisure and security as he plans his business. Many dairy enterprises which are profitable in the prime of a man's life are dropped later when he becomes unwilling and/or unable to milk twice a day, seven days a week, fifty-two weeks per year. Thus, though this chapter is developed to deal with hired labor problems, the discussion has application to family farms as well.

Some Problems With Hired Labor

When farm businesses are operated to yield marginal returns for labor equal to industrial wage rates, the relative importance of hired labor becomes greater. This is true because it is no longer necessary to subsidize labor with the earnings of capital in order to get additional labor services, a practice which appears to be common on family farms.

While in general this is so, there are also disadvantages in becoming dependent on hired labor. The operator should ask himself how much of the management and supervision he personally wants to do. If he feels it is more profitable to share these functions with others then perhaps some sort of a partnership is a better arrangement. If a partnership is decided upon then the rewards for management and supervision will have to be shared as well. If he decides upon working with hired help then not only the rewards but also the responsibilities of personnel management and supervision fall to him. He must hire and fire. He must supervise, organize, lead and create incentives for others.

Whether in a family, a partnership, or in a rather impersonal employer-employee relationship, human beings interact. The human element in production makes subjective considerations important. People must be able to work together when necessary and as individuals when accomplishments are greater by so doing. Some jobs on a farm can be done most efficiently by one worker. Tractor driving is a common example. Other jobs are crew jobs which require team effort.

Forage harvesting is a crew job. Coordination of several individuals is important for efficiency. Furthermore, if farm work is to be truly comparable with off-farm employment, then many aspects of the work environment must be considered. Days off, vacations, job security and hours of work must all be at least roughly equivalent. The actual stress and fatigue of the work itself is another consideration. The challenge, the creativeness and the health aspects, both mental and physical, are other things which should not be forgotten.

Personnel Policies and Practices

Many things have to be considered in developing personnel policies and practices conducive to high labor productivity. Among the things necessary in designing a dairy farm organization which can compete for labor with industry is a consideration of the policies and practices of industry. The suggestions made in this section are made in view of what industry has to offer.

It may be noted that he who labors in a farm business does so because of certain incentives. The adequacy of these incentives govern to a large extent the quality and the accomplishment rates of labor. It is therefore assumed that improvement in incentives will tend to improve performance. These incentives can be classified as monetary and nonmonetary, each of which is discussed below.

Monetary Rewards and Incentives

Most Michigan dairy farm labor is paid a fixed monthly salary. This system needs modification to serve the farm organizations developed in this thesis. One policy which should be considered is to establish specified working hours and pay overtime for additional work. The work day could be changed with the seasons. If this policy is used, care may be needed to see that workers do not take advantage of the situation to increase their earnings.

Another policy which has considerable merit is some system of profit sharing and/or production bonus. Because of the difficulties in handling inventories, a gross product bonus is perhaps the best system for a specialized dairy farm. The main caution in its use is that some check on grain feeding rates be maintained to insure against over-feeding. If based on milk sales, some adjustment occurs with changing prices. It appears better to pay a production incentive bonus with each pay period rather than at less frequent intervals in order to gain a constant high level of effort.

A bonus plan should be simple and presented in writing. If based on production above a minimum, it should be attainable by even fairly good management. Two suggested methods are: (1) Three to six percent of the milk checks or (2) fifty cents to a dollar per 100 pounds of milk per cow sold above a specified minimum of say perhaps 8,000 pounds, depending upon butter fat production, prices, breed and similar factors.

Just what proportion of gross receipts should be allocated to a bonus plan is a difficult question. The answer depends upon the extent hired help serves to gain the production. If more than one man is involved then a bonus based on total sales will serve to form a group motive capable of creating a work team attitude. This is an important thing in gaining high labor productivity.

It seems that more and more of industry is turning to similar schemes in order to raise labor productivity. One of the better ones is the "Scanlon Plan" whereby a normal ratio of wages to output is established by bargaining.[1] Once this is established, the theory is that labor should profit from labor-savings and management from a better use of its assets. This sort of plan develops a labor-management team striving for the same goals and aware of joint problems in reaching these goals. The originator, Mr. J. J. Scanlon, points out that it is a flexible plan for use in many different situations but that it will not work without two prerequisites. These he says are (1) intelligent, alert, and objective laborers or labor leaders and (2) interested responsible managers willing to give and take in developing efficient production methods.

Non-Monetary Rewards and Incentives

In work as confining as dairying, an employee would probably be just as productive in the whole if he were given

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1 Russell W. Davenport, "Enterprise for Everyman," Fortune, Vol. 41, No. 1, January 1950, pp. 55-58, 157-159.

four weeks vacation in a year. To be truly competitive with industry, a dairy farm will have to find ways of allowing week-ends off, time for personal and family affairs, as well as time for vacation periods.

The foregoing suggestions are hard to put into practice on a dairy farm. However, if not more than one-half of the labor force is needed for chores, time off can be provided. Budgets to be presented later indicate that enough milk can be produced per man to permit paying wages and bonuses which are comparable to industry. If this production is obtained from a working day averaging nine hours' working time per day would be similar to the working day of industry if travel time is considered. During the spring, early summer, August and September crop production may require a longer day. If so, arrangements can probably be made for additional time off at other times, say, during deer hunting to compensate for this. Vacation schedules can be worked into slack periods.

There are other non-wage aspects of farm work which must be considered. The social security law serves as a retirement program to some extent. By itself it may or may not be adequate. The fact that most industrial employment is now covered by unemployment compensation and employer liability acts suggests another area where farms have to compete. Prerequisites and housing have a value to the employee and are a cost to the operator. Cheaper rates on fuel, gasoline, and electricity may actually benefit both because of quantity discounts. Group insurance of various kinds may offer additional benefits. So can the provision of repair and maintenance services by farm employees to the farm households. The fact that these same features may be provided in a manner which reduces income taxes should not be forgotten. It is the aggerate of these items which must offer a competing level of living as compared to industry--not the wages per day.

The prerequisites and housing furnished hired help will have to change from what is common today if high quality labor, earning competitive wage rates, is to be acquired and retained. With rapid transportation, better knowledge of alternative employments and a desired higher level of living, prerequisites and housing capable of keeping employees and their families satisfied must be available.

Housing must be comparable to urban housing, comfortable and supplied with modern conveniences. If good employees are to stay indefinitely, they are likely to want to own their own homes. As home-owners, they may find some of the security, pride and human dignity they as permanent members of the community may seek.

The building, remodeling and maintaining of such homes offers one more way of evening out seasonal labor peaks. At the same time, another form of compensation to the employee is offered. If farm tools and equipment are used, justification for additional investment in these items is provided.

An employee owned home should be built where its resale

value, separate from the farm, can be maintained. A land contract held by the farm would offer ideal financing. At the same time the farm could guarantee the resale value at cost less depreciation as a further incentive to the employee. Such arrangements would provide unemployment insurance and retirement benefits as well. Urban living offers these things. Dairy farms could. Even partnership organizations might consider similar arrangements.

The production of meat, eggs, and garden produce might serve as further sources of income to the farm families. This is particularly true if this production can be gained without interfering with the overall operation of the farm. One way this might be done is to allow an employee's family to produce these things in buildings or on land provided by the farm. Rent and machinery charges could be paid in kind in many cases.

One of the interviewed farmers rented farm machinery to his hired man so that the employee might crop his own farm on his days off and evenings. When needed additional time off was granted.

The non-monetary rewards to farm labor are often of major importance to farm workers.[2] Relations with the employer, good housing, pleasant working conditions all have a part in

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2 Varden Fuller and George L. Viles, "Labor-Management Relationships and Personnel Practices," California Ag. Exp. Sta., Giannini Foundation of Ag. Econ. Mimeo Report No. 140, January 1953, pp. 2 ff.

gaining high labor productivity. A considerate employer is the first step toward satisfied employees. A basic written statement of working arrangements is often advocated but seldom adopted. Perhaps it should be.

Security for Employee and Employer

In the contractual arrangement of hiring help both sides require security. Employees desire security from unjust discharge. An agreement for severance pay may help in this respect. Coverage under workmen's compensation and unemployment security laws may be a better answer. They deserve safety from accident and health hazards. Many employees carry the goal of farming on their own and they want to work toward this end. A good employer cannot discourage this goal. Some look forward to the need for old age security for which the federal insurance plan is hardly adequate. This is where housing may help. Many desire a certain freedom from adjustment to change in working conditions. An employer must handle this aspect with care.

On the other hand, the employer wants reliable, steady responsible help. He wants security that the time spent in training new personnel will not be wasted. He wants sufficient security in his production to insure profits. He wants to know that his capital investments are in safe hands. He wants a maximum of freedom and flexibility for action. He needs to consider insurance and other schemes for protection from legal action. But another way to help gain this security is a willingness on the part of both to maintain an open and ethical relationship over time. By so doing, a middle ground of incentives and compensation can be found for the mutual good of both parties. The farm manager should do whatever is necessary to encourage two way communication between employer and employee. Grievances, ideas, opinions and beliefs should flow freely if workers are going to feel that they belong on the farm.[3]

Farm workers have a right to know what is expected of them. Work should be planned far enough in advance so that a worker can be given a preview of the next few days requirements. A list of rainy day alternatives can then be used to keep things going smoothly.

Instructions should be clear and definite. Giving good instructions is harder to do than many people realize. By using time and motion study and materials handling principles it is possible to "routinize" tasks to simplify the instructions necessary. No two people work exactly alike, yet the development of a suitable work environment to reduce waste time and motion and to promote circular travel will ease the need for time spent teaching others how jobs should be done.

The need for building the attitudes of groups as well as individuals is another consideration. Each worker should feel that he is an important part of a team if high production is to be gained. The responsibilities for these things lie

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[3] Ibid., p. 23.

with supervisors and managers. The tools for implementing these actions are common sense and an understanding of human behavior. Farm managers will find the study of psychology and human behavior helpful in dealing with the farm's labor force because of these and similar considerations.

Some Additional Aspects of Supervision

An employee has a right to know what is expected of him. Starting and quitting times should be definite and areas of responsibility defined. Built-in safeguards against human error and negligence should be workable but not obtuse to the employee. A supervisor must watch for health and safety hazards. There are times when a slower but safer way of operation can save expensive hospital bills, lost time and even legal damage suits.

Generally speaking methods which save human energy in farm work will improve productivity and lessen fatigue. Radios, seat belts, cabs, cooling fans and sun-shades on tractors can be justified from this stand point on many farms. There is a limit to saving human energy, however, sometimes methods which offer a certain amount of variety and challenge reduce boredom and keep a man more alert. Judgement and an understanding of people are important here.

The methods of supervision are important also. An understanding of how people respond when criticized, praised or given instructions is something a supervisor should acquire. The judicious use of praise can often aid in increasing

worker productivity. Self-criticism coming from an employer may do more to correct mistakes than for a supervisor to point out his misdoings.

People should be allowed some latitude in developing their own work methods. At the same time a worker should first be taught an approved method and given a clear understanding of the rate and quality of performance expected.

While coordination of individuals into work teams may produce gains in productivity, many farm tasks can best be done alone. Among the factors to consider in organizing a given task is the likely interaction of the personalities involved.

There are times when making a man aware of how the product he helps produce with his labor pays his wages is necessary. It has been the author's observation that many farm workers are unaware of this. This idea along with status building and a feeling of importance are necessary to give people a feeling of accomplishment over time. Salary increases can serve the same end.

Conclusions

If dairying is to offer a truly competitive alternative for labor, both wages and working conditions, must be comparable. Or perhaps more accurately, the "sum total" of these things must be competitive with other labor alternatives.

As farms become larger, personnel problems increase.

Within the objectives of this thesis, it is hoped that they can be solved by maintaining or even raising the level of satisfactions to the people involved. By providing competitive wages, housing and other fringe benefits and discreetly letting it be known how these things come about, the farm workers should better appreciate their position in the business. At the same time services to the households can supply additional benefits. Good business arrangements can give financial and social protection to both employer and employee. Incentives built through strategies can aid in gaining productivity.

Incentive pay plans can gain the same end. In short, an understanding of human behavior is a necessary factor in good personnel management.

This chapter points out some, but not all, of the aspects of good personnel management. Too much is involved in the problems arising from size and organization to be more specific in so short a discussion.

CHAPTER VII

THE FUNCTIONS OF MANAGEMENT

A labor efficient system of production does not just happen. Management must build that system. Once it is built it is still up to management to organize and operate it. This requires efficient performance of the managerial functions. When the man who manages also labors, the time spent at one conflicts with the other. This chapter first discusses ways of reducing this conflict and then discusses how to perform the functions of management more effectively.

At any given time and with any given farm, the application of the recommendations contained in this thesis must be considered relative to the people involved. Their abilities, values, beliefs and goals have much to do with the manner in which the system should be built. The whole discussion is built on the premise that, by willful action, the abilities of management and the skill of labor can be improved to the benefit of both.

Reducing the Conflict between Management and Labor Functions for Time

Reduction of the time conflict between managing and laboring has several aspects. Supervisory responsibilities can be delegated to others. Information collecting and decision making can be made more efficient. Methodical labor tasks can be done while future plans are being made. The production system can be designed to contain checks and double checks on labor and management in order to ease the responsibilities of action on both. At the same time this same system can serve to minimize the number of decisions which management must make and the labor which has to be performed.

Supervisory Responsibilities

Even on the one man farm, the operator must occasionally direct the work of others. On larger farms, supervision assumes major importance. The task of giving clear, concise instructions to others is harder than most people realize. There is an art in leading and commanding. Doing the job well saves both time and other resources.

An environment which promotes efficient work habits simplifies supervision. The hiring and training of skilled personnel also serves this end. Judiously done, the delegation of responsibilities and even some part of the supervision itself may free management for more important tasks. The type of buildings, equipment and procedures discussed in the preceding chapters create environments in which work habits can be simplified and responsibilities spread as compared to most existing operations.

Specialized production systems require fewer kinds of supervision.

The timing of field work and other crop practices requires close attention if the economies of large scale crop operations are to be secured.

To gain these ends the interviewed farmers had done various things. It was evident in most partnership arrangements that either each partner assumed the supervision of certain parts of the business or that, if jointly done, the division of labor was such as to serve as a double check on the actions of each partner. The operators who worked with hired help either were forced to spend a good deal of their time supervising and making decisions or they had been successful in delegating some supervision to skilled workers.

In any case, when more units of production come under the control of a given fully employed manager, he must find ways of spreading management over these additional units. If these responsibilities are delegated to others they must be done under incentives and by methods capable of maintaining satisfactory production rates if profits are to be secured. With animal and crop husbandry this is often hard to do.

Business Transactions and Record Keeping

There are many types of information which must be gathered in managing a specialized dairy farm. Keeping breeding and health records for a large number of cows is a major one which cannot be neglected without financial loss. Most of the time consuming job of keeping records and conducting business transactions falls to the man who manages the farm. Though most farmers feel that the value of records exceeds the cost of keeping them when time is figured at average value, record systems tend to breakdown when time has a high opportunity cost during rush seasons.

On the other hand, records over the years are valuable to the farm business. If properly kept, they indicate weak and strong points. They serve as a basis for reducing costs and increasing production by aiding in herd selection, market choices and crop rotations.

This section's primary concern is in how to save time in these tasks while still maintaining sufficient accuracy and completeness in dealing with records. One of the simplest things which can be done is to pay all expenses by check, noting on each the purpose of the payment. As a double check, itemized receipts can also be filed by group until the purchased items are listed in the account book. These habits along with one of keeping a note book on one's person while at work contain the essential ideas presented here.

The latter idea is suggested so that memory need not be relied upon to list fertilizer and planting rates or to specify dates and quantities of various crops handled. From this data, a reliable field diary can be developed. Rainy day jobs can also be noted in this book. It will also aid in recording price information on occasion.

The farm shop should also contain a set of records to account for gasoline and oil usage, maintenance scheduling and needed repairs. Special forms will simplify this task.

Herd records have been mentioned previously. Time is required to analyze the daily herdsman report and other records. A complete but simple system which does this well consists of individual cow records, a herd testing report, a herd breeding record and a daily herdsman report.

With the volume of business transacted on the modern large dairy farm, it is likely that a small adding machine would soon pay for itself. By simply making the record keeping task easier, a better job is likely to be done. The job that is tedious is the notation and adding of columns of figures. Analysis through charts or graphs or similar methods may usually be viewed with more pleasure.

Another thing some farmers are doing to aid in making record keeping more pleasant is to include photographs of the historical sequence of events. This includes pictures of calves for identification. A color slide record of crop and field history can be a learning tool as well as a source of pleasure in accomplishment.

Both labor and management time are expended making business transactions. When items must be delivered labor is involved. The use of farm labor here is another way of increasing earning power if fuller employment of resources result. This is particularly true in off seasons of the year. Dairy farmers report that hauling lime, fertilizer, livestock and feed are the main uses of labor in business transactions on their farms. Larger farmers may eventually get involved in delivering their milk to processors.

Management time can be saved too in business transactions. By the use of the telephone, newspapers, trade papers, radio and mail order catalogues much comparative shopping for both price and features can be made right in the farm office. It takes very few truck loads of fertilizer or grain bought at a five percent discount to pay for up-to-date trade journal price information.

A buyer informed on prices and features stands a better chance than an uninformed one in dealing with tradesmen. Catalogues are often an excellent source of these kinds of information. The people with whom a farmer deals usually spend their full time working with prices and features. It is self-evident that a farmer should inform himself well in dealing with such people.

An environment for efficient management includes a well equipped office, pleasant to work in and containing efficient tools. These tools should include an intrafarm communication system. On large farms this may even require two-way radio as well as a telephone.

Good reference sources, orderly kept, are also needed. In fact a whole filing system is needed. This is another center of operation from which a view of as much of the total enterprise as possible would be helpful. It should be easily accessible in order to promote its use. How much should be invested in office equipment depends largely on the size of business.

Collecting and Analyzing Other Types of Information

In order to make good decisions rapidly, the farm manager requires information on things other than prices and the existing state of affairs on his farm. In a changing world, many problems must be faced. The behavior of institutions, governmental and otherwise can greatly effect the farm business. It may be in the managers' best interest to take time to take an active part in these institutions in order to remain better informed relative to their actions.

The activities of the people involved in the farm business may also require a certain proportion of the managers' time. Social activities of business groups is one example. Health and welfare aspects of dealing with employees is another. Strategic parlance may offer a third example. Little can be said about such time requirements except that they do exist.

Ever changing technology requires a proportion of the time of managers. One interviewed farmer said, "We always have to learn. This thing (farming) is changing so fast you just can't hardly keep up." An efficient filing system of material having to do with new ideas is one method of saving time and remaining informed. At least one publication is on the market which digests current farm articles. This approach also has merit.

In some cases, perhaps the time saving way is not the best way. Oftentimes a manager will find it helpful to investigate new information at its source. For this reason alone, a manager might well consider the building of a system where he is not indispensable and can get away when need be.

For problem solving, a manager has a whole array of analytical tools at his disposal. The judgement he uses in selecting particular ones for use on a specific problem, the proficiency with which a solution is derived, and the "correctness" of the solution greatly effect his success as a manager. Thought processes all the way from inductive to deductive are involved in handling these tools. Budgeting, marginal analysis, and other economic analysis tend to be deductive. So does the use of logic and the theories of the physical sciences. The application of formal or informal statistical procedures for choosing between alternatives tends to be inductive. No matter what the source, judgement is needed to sort and evaluate and make meaningful the information in question.

Regardless of how it is performed, time must be allotted for management, even though many of the managerial processes require no time in themselves. A farmer can learn to do much of his analyzing when engaged in routine tasks such as driving a tractor. This is another way a man can become more efficient at management.

Conclusions

Inasmuch as management and labor may compete for time, ways of saving the time of both were discussed. Delegating responsibilities appears promising. Simplifying and systematizing records also saves the time of both. Making record keeping easier and more pleasant serves the same purpose. Using labor to substitute for the manager's transaction time can also be used. Keeping informed in the farm office is a time saver.

Most important of all however, is the systematizing of the functions of management to save time and do a better job. To the extent that management time can be saved, time for other activities can be gained.

CHAPTER VIII

THE COMPLETED SYSTEMS

This chapter combines the preceding recommendations into a workable system through planning and budgeting. While budgets do not give exact answers, they provide an excellent way of doing forward farm planning.

Budgets are limited in many ways. To plan for the future, prices must be projected. Input-output relationships must be found. Before the profits can be earned, management must put the plan into action. To go from general budgets, such as developed here, to specific farms requires adjustment for prices, input-output ratios, and the fixed conditions on particular farms. The larger the required modifications, the more limited the usefulness of budgets.

The author would argue that managerial limitations are not particularly important for the budgets and plans to be developed. For superior management today and for the "typical" Michigan dairy farm of the future, the performance rates used may be unduly conservative. Though it is difficult to prove it, if all the suggestions incorporated in the budgets were put into practice, greater labor productivity than reflected in these budgets should be attainable.

General Assumptions

The budgets presented herein were developed for specialized dairy farms, varying in size from 30 cows and one man to 360 cows and nine men. Land varies from 114 to 1368 tillable acres. Though they are actually complete farm business budgets they are partial in the sense that no allowances are made for family living. All labor is paid as if hired. Machinery and building inventories do not cover the home or automobile. Car services are assumed purchased from the home at seven cents per mile. Thus the estimates of total returns probably tend to be conservative as services to the home in the form of milk, poultry products, garden produce, fuel, electricity, maintenance and repair will be available either at low cost or from the expenditure of small amounts of additional time.

Furthermore, on many fairly specialized dairy farms, additional enterprises would supplement dairy. No budget presented herein uses labor completely uniformly throughout the year even after vacation time, repair work and maintenance tasks are used to fill the gaps; the opportunity may still exist to produce such things as wheat or possibly even hogs and poultry, especially if family labor is available to help with chores. To incorporate such enterprises only additional direct costs, investments and returns would need to be considered so long as land, labor, buildings and machinery were not increased but simply used more fully. In fact the corn silage yields were discounted so that early corn might be used for this proportion of the crop and the same land seeded to wheat, rye for pasture or oats for silage in order to intensify land use further. This aspect of the budget then allows for additional possibilities for spreading the labor load, insuring against drought and increasing net returns. However, in none of these cases are the additional expected gains specified nor the additional difficulties in managing or supervising discussed.

A more static situation is assumed than probably exists on most farms today. Essentially, present prices are used. Inventory values are held relatively stable. Depreciation allowances are assumed to cover replacement, the exceptions being those cases where small amounts of feed are carried over and valued as an increase in inventory. With the high rate of herd replacements used, it is assumed that average production is increasing or that some animals may be sold for dairy purposes; this additional value is included as income.

The budgets are for a one year period <u>after the system is established</u>. Account is not taken of the time and money consuming difficulties involved in setting up and operating a farm at the same time.

Of the performance rates specified, two are likely to create argument. The others are essentially those specified in recent studies. The two in issue are probably the most important of all on a specialized dairy farm. The first is the rates specified for forage chopping. The specified 10 to 20 tons of silage per hour is faster than most farmers are chopping at present yet easily within the capacity of a large chopper, adequately powered, equipped with automatic couplers and serviced by large hauling units even after allowing for such minor repairs as are likely to occur with machinery overhauled each winter. The second is milking time. The technology of milking has not progressed nearly as far as it can go. New machines, milking rooms and techniques need to be found. A cow with a less sensitive udder and nervous system needs to be bred. The author does not wish to argue that herds should be milked faster than the maintenance of herd health allows; however, it appears that a milking room designed for milking 40 cows an hour should be built if plans call for keeping this large of a herd.

The people involved in the system are assumed to have better than average managerial ability. Someone must be a good mechanic and someone a good herdsman. They are assumed to be willing to work a fifty hour week on the average, with longer hours during the rush times of the cropping season being compensated by shorter work days in the winter. The basic pay rate is assumed to be $4800 a year gross. Seasonal help is paid $16.00 per 8 hour day when used. These hours and wages are felt to be competitive for equal quality labor used in alternative employments. This work week is adequate for all business transactions and record keeping, as well as some time lost between jobs. If Michigan dairymen must compete eventually with the proposed 32 hour industrial work week, further adjustment will be required. Though the "best" procedures presented in this thesis might permit this, is not demonstrated to be attainable.

Seasonal hired labor is included in the budgets for several reasons. First of all one man and, often, even two men do not make up an efficient forage harvesting crew. Seasonal labor is assumed to cost $16 per 8 hour day. Another reason for employing seasonal labor is that if a dairy farmer takes a vacation, someone must be available to milk the cows. Also, sickness may require temporary help. Further, there are always some jobs which require skills not found on the farm. As most farms provide additional help in the form of family labor, this is another way of filling the need for seasonal labor.

Michigan farms in area five showed an average investment of $67,187 in the account summary for 1955.[1] This is higher than in the 40 cow budget. The difference is accounted for primarily in size, there being 201 tillable acres in the average account farm as compared to 150 tillable acres in the budgeted farm. All larger budgets presented show higher

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[1] Leonard R. Kyle and Warren H. Vincent, Farming Today, Michigan State University Cooperative Extension Service, Ag. Econ., No. 637 for Area 5, 1956, p. 9 with the farm valued at sale value.

investments. In fact, the budgets involving 100 or more cows have investments large enough to produce a comfortable living from interest alone.

Such investments appear to be profitable now and in the future. But until lenders are willing to loan substantial sums on potential earning power rather than on established security, owner-operators will have difficulty attaining the benefits of such large investments.[2]

Assumptions Relative to Dairy Husbandry

The plans assume considerable emphasis on improving production per cow and the management necessary to handle a better herd. The buildings are laid out as recommended in Chapter III. All areas are observable from the milk house. Circular travel is promoted. Roughages are self fed outdoors. Materials are used to reduce maintenance, repair and cleaning time. A tractor, scraper, manure loader, spreader and hammer mill are stored close to the milk house. Maternity cows and calves are housed in the same building with the milking plant. A records desk and telephone are in the milk house. A treadle fly sprayer and shunt pen are at the exit to the milking room.

Grain is simply corn and cob meal with added salt and bone meal. Heifers are allotted grain although with excellent roughage it may not be needed; if not fed, the allotted corn

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[2] Sydney D. Staniforth, "Institutional Considerations in Farm Management in the Decade Ahead," Journal of Farm Economics, Volume 38, No. 5, Dec. 1956, p. 1297.

becomes added feed insurance or a saleable item. Sufficient excellent quality roughage is produced so that no protein supplement is required.[3] Replacements are determined by multiplying cow numbers by .35 for yearling heifers and .40 for calves less than one year. With these high rates of replacement, it is assumed that each cow equivalent requires 52 bushels of corn and 8.4 tons of hay equivalent under dry lot conditions. The herd is fed entirely out of storage. It was hoped that pasturing for three month equivalents would further lower costs and lessen labor requirements. However, examination of this alternative did not offer sufficient possibilities to suggest its use under the assumed conditions.[4] With more land available relative to labor and cow numbers, this conclusion could easily change.

Under the four dollar milk price assumptions, it is assumed that the herd is artifically bred to freshen throughout the year. The 12,000 pounds of milk per cow modification and the four dollar and twenty-five cent milk price modification illustrate the obtainable gains from improved prices,

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[3] C. R. Hoglund, <u>et</u>. <u>al</u>., "Forage Quality and Protein Feeding of Dairy Cows," <u>op</u>. <u>cit</u>., p. 426.

[4] For a discussion of various forage alternatives see: C. R. Hoglund, <u>The Economics of Alternative Forage Systems</u>, Department of Agricultural Economics, Michigan State University, Ag. Econ. No. 674, Apr. 2, 1957. In his conclusions (p.9) he says, "A combination of different pasture systems may be more desirable than a single system for some dairymen. It may be desirable to graze pastures early when they are succulent and when a farmer's labor load is heavy. Storage-feeding or green-chopping are often used the balance of the pasture season. Dairymen need a certain amount of flexibility in their feeding practices in order to meet year-to-year changes in climatic conditions."

cow quality, or possibly from seasonal freshening in order to sell 90 percent of all milk as base. Ten bushels of additional grain is calculated for the higher rate of production but not for higher prices. Seasonal freshening would serve to lessen chore requirements during June and July when forage harvest is pressing and a summer lull suitable for vacation time occurs.

Bedding and feeding chores are assumed to be arranged in order to give a certain time flexibility to their completion. Milking and related chores are assumed to be done on time regularly, but at intervals which vary with the season of the year. Individual animals carry recommended identification. A milker washer is available to save chore time.

Miscellaneous livestock expenses are calculated to include commercial artificial breeding and owner-sampler dairy testing. With the larger herd a farmer might consider dairy herd improvement testing and farm use of frozen semen instead at about the same cash cost. The major considerations here are the required time and record keeping involved with the various alternatives. If a pure-bred herd were maintained instead of grades to secure additional income from the sale of breeding stock, official dairy herd improvement records should be kept. Likewise, additional depreciation expense would have to be considered along with higher investments as costs. Purebred modifications are not included. Veterinary expenses are considered to be high enough to carry on a calfhood vaccination and other possible disease preventive programs.

Assumptions Relative to Crop Production

Crop yields used are those anticipated by the extension service for recommended use of fertilizer and production practices on moderately productive soils in southern Michigan.[5] The basic yields assumed are 65 bushel corn, 55 bushel oats, and three ton hay, 10 ton corn silage, 7.5 ton oat silage and six ton alfalfa brome silage (first cutting) plus one ton dry hay (second cutting). Corn stover provides one ton of bedding per acre.

Minimum tillage procedures are practiced but sufficient equipment is kept so that traditional methods may be followed under adverse moisture conditions. Field operations are done on time. The production of only three crops reduces the problem of managing field operations.

The crop rotation is two years corn, oats seeded to alfalfa-brome and three years meadow. Various other good alternative rotations might have been assumed for a more specific case. Rough land could be seeded to oats and alfalfa brome in late August. The oats could then be harvested as pasture, or silage, in November. Rye could provide late fall and early spring pasture. In practice some farmers might find

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[5] These are quantities close to those established in C. R. Hoglund and R. L. Cook, Higher Profits from Fertilizer and Improved Practices, Department of Agricultural Economics, Michigan State University, Ag. Econ. 545, Oct. 1956.

modification of this forage program justifiable. They might seed ladino clover as it makes excellent pasture or silage on lowland fields. Also sudan grass can provide large tonnages of pasture, silage or green chopping material in late July. On heavier soils, some farmers have had success seeding in Sudan. Furthermore with well located fields, good fences and water, pasturing of good forage stands should not be discounted. Getting cows to and from fields takes time just as dry lot feeding does. Some farmers might consider splitting the herd and pasturing just the young cattle. A bull may be necessary to pasture breed the yearlings under this system. This is especially true if good pastures with water are located some distance from the main buildings.

In addition to corn stover, additional bedding up to a total of eight pounds per cow per day must be purchased. This may include other corn stover, crushed corn cobs, straw, old hay, shavings or, preferably, saw dust. It is assumed that this bedding will cost 12 dollars per ton.

The budgets based on cows capable of producing 12,000 pounds of 3.5 percent milk assume that an additional ten bushels of corn are purchased. This was done in order to make the budgets more nearly comparable. Roughage consumption is assumed to remain the same.

Lime and nitrogen side dressing are assumed to be applied by custom rig at the prices used in the budgets except for the 360 cow budget which assumes that the equipment is owned.

After minimum tillage preparation, corn is assumed to require one cultivation and spraying in mid-June. Oats are seeded on disked corn land using a drill equipped for band seeding and followed by a cultipacker. The land is worked level to insure smooth hay fields.

Forage and bedding are chopped. Rates vary with machine capacity and the size of crew as shown on Appendix Table six. It is assumed that work schedules are varied to adjust for silage moisture content. No major breakdowns are accounted for. Rather, slack season overhaul and the correct operation of machines minimize this risk. Time for greasing, fueling and sharpening is included in the hourly rates. A minimum amount of time is allotted to change from one task to another.

Early season scheduling delays due to high moisture content are made up later by direct chopping or by mowing, withdrowing and chopping in one operation, or simply by good scheduling. With the smaller crews, jobs are interchangeable so that a delay by one individual does not stop the whole operation. Fast hitches, hydraulic or other equally fast unloading devices and horizontal silos are used. If a tractor pulls the chopper, a hook and eye automatic hitch is used in order not to tie up that tractor. All units are assumed to be selected for rapid interchangeability from one task to another.

All first cutting forage is mowed with an attached windrower. If it is necessary to use the type which lays the forage in the center of the swaths because of bunching, two swaths are thrown together to operate the chopper at maximum efficiency. Time requirements assume this is done.

When hauling is done by wagons, the farm truck stands by as an additional hauling vehicle. In the larger budgets, trucks are used for hauling and the wagons are held in reserve. All hauling units hold at least four tons of grass silage.

Some manure hauling must be done every month of the year. However, the greatest bulk of the job is assumed to be done in the fall and early spring. With either two tractors or one which can pick up a loaded spreader without having the operator leave the tractor seat, one man can work alone as efficiently as with another; therefore, no problem of task integration need exist with any size operation.

Field improvement work and fence maintenance are fitted in when time is available.

Machinery

Farmers do not operate with new equipment all of the time. Over time, it wears out and is replaced. The inventory values of machinery used in the budgets are for used equipment in good condition.

The machinery inventory may be looked upon as a complete, integrated unit adequate to handle the crop and livestock enterprises on the farm. It is interesting to note that the equipment is not fully employed on the 120 cow unit but can still be spread over larger units. Accomplishment rates as specified allow for minor adjustments and repair as well as lost time on corners and other similar delays.

Bulk milk tanks and pipeline milkers are assumed in all budgets. At least one old dump truck is included for general farm service and possibly for forage hauling. The items carried on inventory are listed in Appendix Table Three.

Maintenance and Repair

A farm shop equipped with a power saw, power drill, welder, and most of the items discussed in Chapter V is assumed. A mobile unit for work in other buildings and in the fields is also assumed. Repair expenses are principally material and parts costs with farm labor used for all except major overhauls or tasks requiring special equipment such as magneto repairs. Adequate time is budgeted for repair and maintenance work during slack seasons and a certain amount is budgeted for busy periods also. Wage rates paid are high enough to attract competent help to perform these tasks.

Land and Buildings

The inventory value on land is $200 per acre with total acres running some 10 percent in excess of tillable. This value is considered adequate to cover all buildings except houses. Houses are not included in any budget except in the last series discussed where an additional $60,000 is included to cover nine housing units. Real estate taxes are assumed to be one percent of the inventory value.

Building depreciation and repair are calculated at a total of four percent of building values which vary from $9,000 for the smallest series to $110,000 for the largest series budgets. Fire and extended coverage insurance is computed at $4.50 per $1,000 per year.

Other Expenses

Because of the variance in possible costs some expense items may appear arbitrary. Truck taxes, licenses, and insurance vary with location, use and size of operation. So does fuel and electricity. Because of these difficulties, values close to those found on similar farms in the Michigan farm account project were used with 15 percent added to total expenses for other miscellaneous items. This gave figures ranging from $2906 for the smallest to $23,398 for the largest budgets presented to cover these items.

The Individual Budgets Examined and Explained

At this point the tables showing the investments, inventorys, expenses and balance sheets of thirty different situations are presented. These situations include ten different combinations of men and investments. Each table will carry in its column headings the combinations of men, cows, and tillable acres in the ten situations. Henceforth these ten situations will be referred to as the I through X series of budgets respectively, with I series assuming 30 cows and

IX and X series assuming 360 cows.

Each series then has three <u>modifications</u>, (a), (b) and (c). The (a) modification assumes an average of 10,000 pounds of 3.5 percent milk per cow with milk selling for $4.00 per hundred weight at the farm. Cows are valued at $200 per head and each cow equivalent requires 65 bushels of corn and 8.4 tons hay equivalent as feed.

The (b) modifications assume the same feeding level, production level and inventory value but milk sells for $4.25 through either a better market or a better freshening program.

The (c) modifications return to the original milk price but a better cow is involved. Production is assumed to be 12,000 pounds of 3.5 percent milk which necessitates purchasing an additional 10 bushels of corn to maintain this productive level.

After these tables are presented, the discussion takes up each of the series in turn. The peculiarities and assumptions of each are explained and the results discussed. Particular emphasis is placed upon the requirements and returns which can be expected for both labor and management in each case.

Assumptions and Results of the Thirty Cow Budget

In budget I, modification (a), a situation is illustrated which is near the immediate goal of many of Michigan's commercial

TABLE 1. - Description of Budget Series; Series Designation, Number of Men, Number of Cows, and Tillable Acres for Each

Item	Series Designation									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Number of men	1	1	1	1	2	2	2	3	9	9
Number of cows	30	40	60	60	80	100	120	120	360	360
Tillable acres	114	150	114	228	300	375	228	456	1368	1368

TABLE 2. - Principle Assumptions for the Budget Series Modifications, (a), (b), and (c)

Item	Unit	Modification Designation		
		(a)	(b)	(c)
Production per cow	lb. milk	10,000	10,000	12,000
Milk price (f.o.b.)	dollars	4.00	4.25	4.00
Inventory value per head	dollars	200.	200.	250.
Grain requirements (per cow equivalent)	bu. corn	65	65	75

TABLE 3.—Investments and Inventories for 30 Presented Budgets, by Series (I-X) and by Modification (a,b,c)

PART A: Applicable to modifications (a) and (b) 10,000 pounds of milk, average

Series	I	II	III	IV	V	VI	VII	VIII	IX	X
No. full-time men	1	1	1	1	1	1	1	1	1	1
No. of cows	30	40	60	60	80	100	120	120	360	360
No. tillable acres	114	150	114a/	228	300	375	228a/	456	1368	1368
					-- Dollars --					
Land & improvements b/	24,000	32,000	30,000	48,000	64,000	80,000	60,000	96,000	310,000	370,000
Dairy cattle c/	8,090	10,870	16,305	16,305	21,740	27,370	32,610	32,610	97,830	97,830
Machines & equipment d/	11,855	13,540	12,705	15,315	17,255	17,655	30,505	20,505	49,175	49,175
Av. feed inventory e/	4,141	5,268	8,282	8,282	10,931	13,330	16,563	16,563	49,868	49,868
Cash & liquid assets f/	750	1,000	1,500	1,500	2,000	2,500	3,000	3,000	9,000	9,000
TOTAL INVESTMENT	48,836	62,678	68,792	89,402	115,926	140,855	132,678	168,678	515,873	575,873
5% interest charge	2,442	3,134	3,440	4,470	5,796	7,043	6,634	8,434	25,794	28,794

PART B: Applicable to modification (c) 12,000 pounds of milk, average

	I	II	III	IV	V	VI	VII	VIII	IX	X
					-- Dollars --					
TOTAL INVESTMENT g/	50,866	65,408	72,887	93,497	121,386	147,485	140,868	176,868	540,443	600,443
5% interest charge	2,544	3,271	3,545	4,675	6,069	7,375	7,043	8,844	27,022	30,022

a/ Because of limited land, series III and VII require the purchase of all grain and some roughage.
b/ Total land is valued as $200 per acre including all buildings except houses.
c/ See Table 1 for prices and quantities.
d/ See appendix Table 3 for values, kinds and numbers used.
e/ Equals one-half of total feed produced and purchased.
f/ Considered sufficient for an operating fund, checking account, etc.
g/ Increase due to increased value of the herd.

TABLE 4.— Expenses for 30 Presented Budgets, by Series (I-X) and by Modification (a,b,c)

PART A: Applicable to modifications (a) and (b) 10,000 pounds of milk, average

Series	I	II	III	IV	V	VI	VII	VIII	IX	X
No. full-time men	1	1	1	1	2	2	2	3	9	9
No. of cows	30	40	60	60	80	100	120	120	360	360
Tillable acres	114	150	114a/	228	300	375	228a/	456	1368	1368
					-- Dollars --					
Cash exp. on crops b/	1,591	2,157	1,591	3,182	4,322	5,441	3,182	6,364	17,290	17,290
Feed & bedding purchase b/	378	507	8,545	756	1,014	1,261	17,352	1,512	3,978	3,978
Misc. livestock exp. b/	1,118	1,490	2,235	2,235	2,980	3,725	4,470	4,470	13,410	13,410
Seasonal labor c/	320	480	320	920	480	672		2,160	2,000	2,000
Mach. repair & deprec. d/	1,650	1,966	1,865	2,480	3,030	3,130	2,380	3,130	7,188	7,188
Bldg. repair & deprec. e/	360	400	600	600	800	960	1,120	1,120	2,800	5,600
Auto, truck & tractor operating costs	1,000	1,225	1,175	1,650	2,000	2,275	1,950	2,575	6,600	6,600
Misc. taxes, ins., elec. c/	1,906	2,413	4,014	3,562	4,379	5,144	6,995	6,086	16,569	17,688
TOTAL EXPENSES (excluding salaries & benefits)	8,323	10,638	20,345	15,385	19,005	22,608	37,449	27,417	69,835	73,754

PART B: Applicable to modification (a) 12,000 pounds of milk, average

	I	II	III	IV	V	VI	VII	VIII	IX	X
					-- Dollars --					
TOTAL EXPENSES f/	9,638	11,788	22,070	17,110	21,305	25,483	40,899	30,867	80,185	83,604

a/ Because of limited land, series III and VII require the purchase of all grain and some roughage.
b/ Prices and qualities of items shown in appendix Table 1 and 4.
c/ Explanation found in text of Chapter VIII.
d/ Explanation found in appendix Table 3.
e/ Calculated at 4 percent of inventory value.
f/ Explanation in appendix Tables 1, 4 and in the text of Chapter VIII.

TABLE 5.— Final Budget Balance Sheet; Total Income, Total Expenses, Net Farm Income and Labor-Management Residuals, by Series

PART A: Applicable to Modification (a), $4.00 Milk and 10,000 pounds of Milk Average

Series	Ia	IIa	IIIa	IVa	Va	VIa	VIIa	VIIIa	IXa	Xa
No. full-time men	1	1	1	1	2	2	2	3	9	9
No. of cows	30	40	60	60	80	100	120	120	360	360
Tillable acres	114	150	114	228	300	375	228	456	1368	1368
					-- Dollars --					
Inc. in crop inventory a/	251	287		450	442	663		650	2,241	2,241
Inc. in livestock value b/	300	400	600	600	800	1,000	1,200	1,200	3,600	3,600
Receipts from milk sold	11,832	15,776	23,664	23,664	31,552	39,840	47,328	47,328	141,984	141,984
Receipts from stock sold	1,810	1,750	2,620	2,620	3,500	4,380	5,240	5,240	15,720	15,720
Receipts from house rent										7,500
TOTAL RECEIPTS	14,193	18,213	26,884	27,334	36,294	45,883	53,768	54,418	163,551	171,051
TOTAL EXPENSES c/	8,323	10,638	20,345	15,385	19,005	22,608	37,449	27,417	69,835	73,354
Net farm income	5,770	7,575	6,539	11,949	17,289	23,275	16,319	26,001	93,716	97,697
Interest at 5%	2,442	3,134	3,440	4,470	5,796	7,043	6,634	8,434	25,794	28,794
Labor and mgt. earnings	3,328	4,441	3,090	7,549	11,493	16,232	9,685	17,567	67,922	68,903
Workers' salaries	4,800	4,800	4,800	4,800	9,600	9,600	9,600	14,400	53,685	53,685
Business profits	Neg.	Neg.	Neg.	2,749	1,893	6,632	85	3,167	14,237	15,218

PART B: Applicable to Modification (b), $4.25 Milk and 10,000 Pounds of Milk Average

	Ib	IIb	IIIb	IVb	Vb	VIb	VIIb	VIIIb	IXb	Xb
					-- Dollars --					
TOTAL RECEIPTS	14,933	19,199	28,813	28,813	38,266	47,913	56,726	53,376	172,419	179,919
TOTAL EXPENSES c/	8,323	10,638	20,345	15,385	19,005	22,608	37,449	27,417	69,385	73,354
Net farm income	6,610	8,561	8,468	13,428	19,261	25,305	19,272	29,859	102,584	106,565
Interest at 5%	2,442	3,134	3,440	4,470	5,796	7,043	6,634	8,434	25,794	28,794
Labor and mgt. earnings	4,168	5,427	5,028	9,028	13,465	18,262	12,643	21,425	76,790	77,771
Workers' salaries	4,800	4,800	4,800	4,800	9,600	9,600	9,600	14,400	53,685	53,685
Business profits	Neg.	627	228	4,228	3,865	8,662	3,043	7,025	23,105	24,086

PART C: Applicable to Modification (c), $4.00 Milk and 12,000 Pounds of Milk Average

	Ic	IIc	IIIc	IVc	Vc	VIc	VIIc	VIIIc	IXc	Xc
					-- Dollars --					
TOTAL RECEIPTS	16,542	21,293	31,504	31,954	42,454	53,883	63,008	63,658	190,185	197,685
TOTAL EXPENSES c/	9,638	11,788	22,070	17,110	21,305	25,483	40,899	30,867	80,185	83,604
Net farm income	6,904	9,505	9,434	14,844	21,149	28,400	22,109	32,991	110,000	114,081
Interest at 5%	2,544	3,271	3,645	4,675	6,069	7,375	7,043	8,844	27,022	30,022
Labor and mgt. earnings	4,360	6,234	5,789	10,169	15,080	21,025	15,066	24,147	82,978	84,059
Workers' salaries	4,800	4,800	4,800	4,800	9,600	9,600	9,600	14,400	53,685	53,685
Business profits	Neg.	1,434	989	5,369	5,480	11,425	5,466	9,747	29,393	30,374

a/ Explanation in the text Chapter VIII and appendix Table 4.
b/ Explanation in the text Chapter VIII and appendix Table 1.
c/ Carried from Table 4.

dairy farmers today. This plan grossing \$14,193, with an investment of \$48,836, can be expected to return \$5490 for the use of capital, entrepreneurship and the labor of the farm operator. This is adequate for a comfortable living provided the debt load of the operator is not excessive and he is not renting or otherwise paying some of these returns to others.

There are chores to be done seven days a week with an expected 4.6 hours per day spent doing them. Time off would be difficult to arrange. This budget is calculated to have a milking room capable of operation with two units at thirty cows per hour. Additional time is allowed for milking maternity cows.

Perhaps a more complete line of machinery is specified than is economical. Yet one man working largely alone must have a rather complete line unless custom operators are readily available. Twenty days of hired labor is included to do special jobs and for two weeks at grass silage time. At other times the farm operator should have no difficulty in accomplishing all tasks alone. This is the only budget series where corn picking is hired done.

With \$4.25 per hundred weight for milk in modification (b) it is interesting to note that net farm income[6] increased

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[6] Net farm income as used in these budgets is defined somewhat differently than as used in the Michigan Farm Account Project. It is calculated here before any deduction of wages for full time workers. This was done on the assumption that two and three men farms might be partnerships or similar arrangements where this amount is available for distribution to the several owner-operators.

by $840. Certainly movement in this direction by seasonal freshening and under dry lot conditions would be advantageous.

With an increase of 2,000 pounds of milk per cow in modification (c) even higher gains can be expected. While investments and expenses also increase, net farm income is now $6,904.

In no case, can net farm income pay $4,800 for labor to the operator, a 5 percent return on investment and an additional business profit. Provided management skill permits, probably still higher production per cow would return a profit.

The Forty Cow Alternative

In budget II, modification (a) net returns are higher as is the required investment. With $62,678 invested, returns of $7,575 can be expected for capital, labor and entrepreneurship. This still falls short of a 5 percent return on investment and $4,800 per years work.

This again is a confining alternative requiring some 5 hours of chore time daily, calculated at a milking rate of 35 cows per hour. However, it is unlikely that there would be over twenty weeks during the year when the operator would need to work over 50 hours.

It is interesting to note that even though this budget provides for twice the cows found on most one-man dairy farms in Michigan and some 373,000 pounds of milk are produced per man, no business profit exists after labor is charged at $4800 per year. It should also be pointed out that some operators can produce this much milk from 30 or less cows. Yet in neither case can the fringe benefits of industry be provided. While the latter requires less feed inputs, it may actually be easier to operate the 40 cow budget. From the experiences of the interviewed farmers, actual chore time would likely remain about the same with more skill required with the smaller herd. Also from their experience, a man is more likely to be tied to the farm with the smaller herd of this quality.

Machinery investment is increased over the thirty cow budget by a three unit milker, a larger motor-mounted forage harvester, and a one row corn picker. All three of these machines save labor and accomplish more work per hour. Machine overhead costs are still high. Yet 30 days of extra labor are all that need be hired and, perhaps, under different assumptions even this could be reduced. Second cutting hay and corn silage operations are assumed to be done by the farm operator alone. With automatic hitches, two tractors and hauling two loads at once on long trips, the specified rates are not excessive.

With the (b) assumptions an entrepreneurial or business profit of $627 is made. This again illustrates an adjustment many farmers might make. In series (c) a profit of $1,434 is shown as an attainable worthwhile goal.

Again the budgets point to the benefits of developing an environment where labor produces more product or a higher valued product.

A Sixty Cow Limited Land Alternative

Budget III (a) illustrates what could be expected by turning to an all forage alternative on limited land, purchasing some additional forage and all grain. At the level of productive capacity specified, it does not appear to be a particularly good alternative for anyone except a man who may expect to acquire additional land in the near future. Investment is higher ($68,792) and net farm income is lower ($6,539) than in budget II.

Chores alone require 6.5 hours per day every day, and when combined with necessary odd jobs, maintenance, repair and business transactions, become a full time job. The field time on 114 tillable acres, even with 20 days of hired labor, is likely to necessitate many 12 hour days for the operator in the spring and summer months. Even so, under adverse weather hazards, field work might easily get delayed.

The (b) and (c) modifications add to profitability, but even so, budget II alternatives are superior.

Budget IV: Assuming One Full Time "Extra Efficient" Operator, Hiring Over Seven Weeks of Labor and Milking Sixty Cows

This budget illustrates about what one man could accomplish provided that he is willing to work what today is considered excessive hours and has adequate capital for a sixty cow unit. With an investment of $89,402, a net farm income of

$11,949 is obtained. If this return accrued to one family it would show quite an adequate income or, as is more likely to be the case of anyone ambitious enough to operate in this fashion, a rather substantial debt paying capacity.

Even milking 40 cows per hour, 6.5 hours of chore time are required each day. When totalled, this amounts to some 42 hours per cow per year. Field work and all other jobs are likely to create steady summer employment, assuming good scheduling, of some 70 to 75 hours per week. Certainly this is not what a man would want to do for a life time, yet perhaps through the use of better alternatives, more time might be cut off of these totals. If a man were trying to build to this size and operate at the same time, he almost certainly would have to count on more labor than specified here.

Some young operators could build this system, but unless they develop it into a larger two-man business, a few years of this kind of work would probably make them reduce herd size or quit dairying entirely. Even though profitable, this alternative has all the problems of the one-man dairy farm plus the risk of greater absolute loss if sickness or other misfortune should occur. The problems created by the life cycle for family farms are likely to be intensified in this situation.

The four row corn equipment and the three man crew specified for grass silage operations will help get work done on time. Even so, careful scheduling and planning to avoid

weather hazards must be done if the field work is to be completed on time and excellent quality forage is harvested.

Under series (b) and (c) this type operation becomes even more favorable. Still a word of caution is needed. With 60 cows to milk and feed, as well as caring for considerable young stock, a man may find difficulty in finding time to see that breeding schedules are maintained. Sixty cows to calf, breed and keep records on is no easy matter; yet under assumptions of seasonal freshening or for caring for 12,000 pound production animals, these jobs must be done carefully.

By seasonal freshening, most of the herd would be dry in June right when this tremendous quantity of forage must be harvested. Certainly, this possibility could aid in evening out the labor load a great deal. For this reason, it makes a worth while alternative not considered in these budgets.

Budget V: Two Men, Eighty Cows and Three Hundred Acres

Budget V, in many respects, is similar to Budget II doubled in quantities. Yet certain advantages to scale are evident. Chores are more efficient. Week-ends and vacations off are no problem, nor would sickness be such a catastrophe as on the smaller farm. With a two-man operation working conditions can begin to compete with industry. It is still hard to develop fringe benefits similar to industry though social security, health and workmen's compensation insurance help. Other benefits common to farm workers can aid in making

this alternative competitive for labor. Certain savings also develop in the investments, particularly in machinery.

Sufficient land is being farmed to justify a four plow tractor. The thirty days of seasonal help might even be eliminated. The net results of moving to the two-man farm of this size are shorter working hours, a net income figure of $17,289, of which $1,893 could be accounted as a residual profit for entrepreneurship after a 5 percent return on the $115,926 investment and $9,600 is deducted for wages.

There are several ways that two men could operate this farm. Perhaps one of the best for attaining this labor efficiency and creating a productive pleasant work environment is to have one man do chores in the morning and the other at night. Various modifications could be made to get both men in the field when need be. In off seasons, the workday could be shortened for both this way. In this way, no man becomes indispensable, as both tend to be reasonably familiar with all jobs.

The increased rate of forage harvest in this plan results from a three-man crew and the use of old used dump trucks specifically to haul forage. Wagons are also retained for emergency use. Two mowers provide a reserve of cutting capacity.

The (b) and (c) series budgets point the way to further profitability. There is sufficient help in this plan to gain this profitability rather easily as compared to the smaller operations. June and August are the only months where field work is really pressing.

Budget VI: Two Men and One-hundred Cows

Under the same general assumptions as Budget V, the caring for 20 additional cows and raising feed for them increases net farm income to $23,275. Even after deducting interest and labor charges, $6,632 remains under the (a) series assumptions. While the labor load is increased, it is still considerably lighter per man than under Budget IV. Chores now take nine hours per day. This in itself accounts for one full time man. The necessary hours of work in this alternative are likely to exceed what might be considered competitive with industry.

Budget VII: Two Men and One-hundred and Twenty Cows

This plan is another of the type where all the grain and some hay is purchased. It is relatively unprofitable. More hours of work are required than in Budget VI and farm earnings are less. Perhaps adjustment in cow numbers to decrease the need for purchased hay might compare more favorably with an alternative where all grain is grown on the farm. Under the general assumptions of this chapter this budget can not provide anything near competitive working conditions.

Budget VIII: One-hundred Cows and Three Men

Here again, many factors tend to be multiples of the smaller II and V budgets. Cost savings do exist in machinery

investment and services. Entrepreneurship returns are rather favorable. A total investment of $168,678 is involved.

Forage harvest is a busy time in this plan. Three men are required. Milking a hundred or more cows at one milking tends to produce another problem. For purposes of illustration a two-man milking system is used where one unskilled man prepares cows and a more skilled one milks. Though there are several disadvantages to operating this way, some farmers are doing it. From a strict labor efficiency standpoint a one-man, 40 cow per hour system is better. If the two-man system is used, then some part time or family help must be used for week-ends and at other times. Thirteen hours of labor are required for chores each day with this system, considering 60 cows milked per hour in a two preparation--four milking stall room. Because of this heavy chore load, additional summer help is also needed. A total allowance of 135 days help is made. If a more efficient milking system could be used, eliminating most of this extra labor, profits would increase by about $1,000.

With an operation of this size, a great deal of maintenance and repair work will have to be done. For this reason, the shop inventory is increased $100 over series VI. A larger bulk tank and an additional tractor and plow are also included.

The profit incentives for striving for the (b) and (c) alternatives are particularly strong at this level of output, providing management is not taxed too severely. When operating with hired labor, management might be taxed too severely depending upon the individuals involved.

With a three man operation even more nearly competitive working conditions and fringe benefits can be obtained. Under the assumptions of this budget, every other Sunday could be free. For most of the year this could be stretched to whole weekends off. There is sufficient time available to allow a months vacation per man in this budget. While July is a rather slack month, most of the potential vacation time occurs during the winter.

At least half of the year could be worked on the basis of a forty hour week though longer hours are still required in the spring and during forage harvest. At this level of operation outside social security, health and compensation insurance will still have to be relied upon for retirement, sickness and accident programs. If hired help is used either housing must be provided or some other housing provisions made. Neither are provided in the budget.

A Three-hundred and Sixty Cow Farm: Budgets IX and X

As the farm operations are identical in series IX and X, one discussion covers both. Both are essentially built out of three farm units similar to those discussed in Budget VIII. The difference between the IX and X series is that the latter includes nine housing units for employees, valued at

$60,000, as part of the inventory. To operate these units requires collecting $7,500 yearly in rents. This figure is roughly equivalent to the repairs, depreciation, taxes and interest on investment necessary plus an additional $600 for bearing the risk involved. No profits are made on this additional investment; rather it is regarded as an added investment which might be needed to organize such a farm.

No farm this large was observed in the study. These farms are extensions developed because of the advantages evidenced in Budget VIII with regards to profits, level of satisfactions attainable by the workers and economies in machine use. There are serious problems in establishment. An experienced and trained manager is required whose full time would be spent supervising, coordinating, transacting business and in making management decisions. Skilled responsible workmen secure in their jobs and working under adequate incentives would also be required. The salaries and fringe benefits specified are adequate to compete for this type of personnel. 1368 relatively contiguous tillable acres are needed. With the present land institutions of Michigan this much contiguous land is hard to find. This problem is partially solved by using three dairy units of 456 acres each. This also shortens hauling distances, a problem which arises on large livestock farms. Over a half million dollars are required to finance the operation. It is likely that it would take corporate structure and financing to acquire this many assets. Once acquired, interest on investment may have to

be considered as a perpetual payment for the use of those assets and most business profits used for dividends, investment or adjustment and growth rather than as money to retire a capital debt.

As noted in the Appendix, some operating cost advantages are secured. None are noted with the dairy herd although some minor adjustment might be made in veterinary, breeding, and testing charges. Most advantages would occur in the flexibility of labor use or in fuller employment of machinery.

As previously noted, three units each the size of the discussed 120 cow farms (series VIII) are incorporated into one farm. Two men are assigned directly to each unit with the three remaining men assuming the roles of (1) general tractor driver, (2) crops and maintenance supervisor, and (3) farm manager.

Under this system, the overall farm manager would likely be fully employed even with a herdsman at each unit assuming considerable responsibility for the performance of the dairy husbandry tasks. Chores require nearly 12 hours per day per unit. This means that each unit requires the services of one and one half men each day leaving two and one half men for other general assignments. During most seasons this should be sufficient, even with week days off to make up for week-ends worked. Vacations would follow the pattern of Budget VIII.

No man would become indispensable. Every man would be required to be able to milk if needed. At least two men would be familiar with each herd. Management would retain the right to shift assignments at will to make sure that worker frictions could be taken care of. A one man, 40 cow per hour milking system is used. Sunday chores are done in eight to ten hours.

Chore routines are designed to make it possible for six men to be in the field for eight hours a day during forage operations. In general, hours worked per day are kept flexible enough to allow at least a ten hour day during June and August even if only eight hours are worked during most other months.

Because of greater labor efficiency than in the other previous plans and a greater need to compete for skilled reliable labor, it was felt necessary to raise salaries to the employees. $4,800 is still the basic wage for the four general farm workers but it is no longer gross. They, as well as the other employees, will require an additional two percent of $4,200 for social security and 2.7 percent of $3,000 as an unemployment insurance fee as specified in the laws of the United States and of Michigan. The three herdsman receive $5,400, the farm manager $9,600 and his assistant $7,200. This makes a total wages and salaries bill to the firm of $53,685 per year. In addition, $2,000 is allocated for extra clerical help and because of possible increased labor needs arising from personnel turn over or similar emergencies.

The machinery program requires considerable discussion. Three two-plow tractors are each equipped with manure loaders to serve as yard tractors. Two three-plow ones are equipped

with four row tools for general field work. A six-plow diesel crawler is used for land preparation, bulldozing, heavy loading and forage chopping. It can go where other tractors can not and is a versatile tool on large farms. However, the assumption of a wheeled tractor would have also been workable. A small garden tractor is used to mow grass and weeds, operate power elevators and other tools and for many other tasks.

A multiple hitch is provided to allow the crawler to use tools of a size ordinarily designed for the three-plow tractors. Two sprayers are provided, one for weeds and one for insect work. The chopper has a rated capacity of 35 tons per hour and is a power take-off model. In order to benefit by that capacity, a 14 foot mower (Kosh) is provided with three or four windrows being thrown together. Hay yields are not heavy enough to make the use of a direct cut unit practical.

A rotary chopper is also provided. With a unit this large green chopping through the summer is both practical and necessary in order to handle the regular silage and hay harvest on time. Two men using a dump truck and a wagon can cut and haul three loads in an hour which is about what is needed per day. It is assumed that one third of the hay land can be harvested in this fashion. This procedure will also aid in spreading out the normal grass silage harvest time to one month. This chopper can also be used to open fields for silage, serve as an auxiliary or supplementary chopper if need be, and to harvest corn stalk bedding.

In addition, a small baler is included for use in harvesting first cutting hay which may become too dry for silage, for harvesting calf and maternity cow hay and as an emergency machine.

Eight thousand dollars worth of trucks are inventoried. One is a $600 pick-up for the use of the manager and foreman. Another is an old used $600 gravel dump truck. The other two are $3,000 long-wheel base, tandem dumps with 8 x 14 combination grain and stock racks each capble of hauling 5.5 tons of silage per load. With a chopper of the size specified, it will take units of this size to handle forage at the specified average rate of 22 tons per hour. During part of the year one rack is replaced with a lime box. Lime and bulk fertilizer are hauled and spread direct.

The other truck is likely to see daily use hauling grain in bulk from a small, automatic 5 horse power, feed mill located at the farm grain center. It also can be used for livestock hauling, a common activity on a farm with 360 dairy cows. The small dump truck is adequate for hauling daily green chop.

The shop and small tool inventory is expanded because of a need for various duplicated items. It is also now adequate for virtually all repairs and overhauls.

A three row anhydrous nitrogen applicator and supply tank is included so that this job can be done with farm labor.

Comparison of the balance sheets for these budgets with those for the VIII series discloses several things. Profits are about three and one half times as much as for the smaller budget. Wages and salaries are proportionally more and other expenses less. The higher salaries of the former about offsets the economies in the latter. Fewer services are hired and farm labor is more productive. In sum then, it is possible for employees to get a greater share of gross returns in this larger farm but it is likely that this increased share is necessary in order to get high enough quality labor.

The absolute magnitude of profit levels when the (a) modification is compared with (b) and (c) ones again point out the profitability of increased production per cow or prices and point out the danger of movements in the opposite direction. In the (a) series for instance, it would appear that without drastic production modifications, the business could not maintain itself at a milk price below $3.50.

Poor management could produce great absolute losses in a hurry. So could disease or unfavorable prices. It is possible that before a farm would get this big under Michigan conditions, it might diversify into other livestock rather than stick strictly with dairy. If advantages of less risk, and a possible fuller use of some fixed assets were found which could outweigh the cost and economic advantages of specialization and simplier management, this could happen. So little is known of such farms that it is hard to say.

Perhaps the future will indicate that the California type dry lot operation is superior. However, better hay will have to be available for purchase before the industry can profitably move in this direction in Michigan. The author does not know what the answer is. He does feel that the larger operation does tend to be relatively more profitable and that management sufficient to operate it is being developed. Yet just how it will be developed or how big it will get is still unanswered.

The Conclusions of, and Results Obtained From The Budgets

In a sense, each budget illustrates the limitations and benefits of a different allocation of labor and capital investment. They tend to point out, assuming management ability capable of handling each unit as specified, that added units of livestock and land show constant rates of return, whereas investments in machinery, show increasing returns.

Among the assumptions is one that management can be spread over more units by simplifying its tasks. Concurrently, labor is spread over more units by creating a simplified working environment. The accomplishment rates specified are, for the most part, similar to those reported in recent studies. Perhaps the most important conclusion of all is that an environment can be built for dairying where labor can earn sufficient product to make its use competitive with industry from both a monetary and a non-monetary standpoint.

CHAPTER IX

A PROPOSED BULLETIN AND OTHER CONCLUSIONS

If the information contained in this thesis is to aid Michigan's dairy farmers it must be presented to them. One way to do this is to publish a bulletin.

Such a bulletin should present dairying as only one of several alternatives farmers face. Furthermore, it should present it as fairly and concisely as is consistent with adequate explanation. The presentation should be directed toward persons considering major changes in their dairy operations. It should point out alternatives, answer questions about dairy farm organizations and, finally, discuss the pit-falls to be guarded against.

A question and answer format has been selected to fulfill these requirements. This method has impact to incite action. At the same time, it can present the analysis developed herein.

The conclusions to this thesis take the form of this bulletin and are herewith presented:

Cover Page

It is suggested that the title be: Is LARGE SCALE DAIRYING The Answer FOR YOU?; that it be superimposed and centered over a "?" mark with small cuts of such items as a bulk milk tank, a time clock, feeder cattle, workers entering a factory, and similar "picture stories" of a farm operator's alternatives bordering the page.

The Bulletin Format

The purpose of this bulletin is to give you, the farmer, some idea of the possible requirements and rewards of large scale dairying.

BUT WHY IS LARGE SCALE DAIRYING IMPORTANT TO ME RIGHT NOW?

Because this is an age of rapid change and;

(1) It appears that farming is entering an era of specialization; an era which demands an increase in worker productivity to remain competitive.

(2) Michigan farms require $40,000 or more capital per man to be profitable.
That is a lot of money, it should be used wisely.
Common stocks paid well in 1956. So did many non-farm business opportunities!
The people with money to loan know this.

(3) You have other alternatives for your time;
Feeder cattle, hogs, cash crops,--
Part-time farming or off the farm work,--
and none of these require milking cows 14 times a week.

(4) Labor is talking of a 32 hour week. Many dairy farmers today work 64 hours per week - and that is 7 days a week - every week - even when they're sick, or when they want a holiday.

IF IT'S THIS BAD WHY DOES ANY ONE WANT TO DAIRY FARM?

Well, first of all some people like dairying and dairy cows. But let's try to be practical. Let's look at some budgets as to how you, as a dairyman, might allocate your time and money. Budgets let you try an alternative out on paper. They aren't infallible. But they do present an orderly and organized way of looking at the alternatives you face.

At this point in the bulletin the results obtained in Chapter VIII by budgeting a one, two and three man operation should be presented. If additional scope is considered advisable, a nine man operation could be included in this section. A discussion of the required investments, expenses and receipts would be necessary. Important points of comparison such as net returns and fringe benefits would need to be included. The basic assumptions of the budgets must be mentioned. As doubts would naturally arise and interest must be maintained the bulletin would continue;

YES BUT --

Hold it before you say anything; let's look at the assumptions and conditions more closely:

(1) 10,000 lbs. milk per cow and lots of cows -- in a moment we'll discuss some things which will allow a man to take good care of that many cows.

(2) $4.00 a hundred weight for 3.5 percent milk -- $4.25 would be lots nicer -- if you can get it by seasonal freshening or through supply-demand relationships. A quarter of a dollar in the other direction doesn't look nearly so good but you would still be better off than most dairy men are now.

(3) Forty hours per cow per year chore time -- its possible and probable. Excellent quality forage -- there are several methods. Yields of 60 bu. corn and three ton hay aren't really high today.

(4) We tried to leave time for sick cows, broken mower blades and talking with farm visitors -- provided they are taken care of efficiently.

Additional expansion may be necessary here depending upon the exact way the budgets and their expressed assumptions are dealt with earlier. To maintain interest the discussion would continue:

IF YOU SAY I CAN DO THIS MUCH WORK, THEN SHOW ME HOW!

O.K. let's look at one method for doing each of the critical tasks in operating this business. There are several other good ways of doing many of these things. But before you decide which method to use ask yourself:

(1) Which way requires the highest investment?

(2) Which costs the most to operate?

(3) What can I do with the time I might save?

(4) Which will work best for me on my farm under the conditions I can't change?

(5) Which is the most foolproof and simple for me and the hired man to operate?

(6) Can I trust someone else to do it right?

(7) Which offers the most chance of success or the least of failure?

(8) Which gives me flexibility in timing or allows me to take off if I want to?

By the way, the farmers visited in this study said that the best way to find better methods of getting "the job done" was to go see how your neighbors and other good farmers were doing. You have to have a dairy farm which allows you to get away to do this - most don't. If yours doesn't read this, it is the result of visiting 46 good dairy farms from which most of the presented ideas were acquired.

HOW CAN YOU DO THE DAIRY CHORES FOR THESE HERDS?

Here are some rules:

(1) Design a system that the hired man can handle.

(2) Reduce cleaning, bedding and feeding to the "bone."

(3) Reduce milking and individual attention only so far as production and health can be maintained.

(4) Build in as much flexibility as you can.

(5) Build it to "force" you to run it right.

HOW CAN I DO ALL THESE THINGS?

Here is one way of doing some of them:

(1) Design a building layout so that all of the six housing areas (feeding, loafing, milking, young stock, and calves) are observable from the milk house, the "nerve center" of the operation. Design it to promote circular travel when doing chores.

Design it to eliminate as much travel as possible by keeping maternity cows and calves in the same building as the milking plant. Further, use cattle guards, remote controls, catwalks and easy observation to eliminate work travel when possible.

(2) Try to eliminate as many job elements in cleaning, feeding and bedding as possible. Use concrete yards and feed outdoors. A tractor with a scraper blade and a manure loader parked right next to the milk house in what might be a grain handling area should be available for dairy yard cleaning and other chores. Use self feeding structures or automatic mechanical ones for forages. With self feeding structures perhaps you can eliminate Sunday feeding. With high quality forage many farmers aren't feeding grain to dry cows and heifers. Sawdust, for instance, may require attention only two or three times monthly and then only when you aren't busy with other tasks. Design loafing areas to speed bedding and cleaning, to eliminate traffic lanes and to stay dry.

(3) Design a milking room which will <u>allow</u> you to milk at least 40 cows per hour - others have. <u>Then learn how</u>. Of those observed in the study, the three on a side lane type seemed the one most practical for adoption today. Design it so the hired man can operate it too. Don't forget mastitis problems, high production requirements and that you are sleepy in the morning and tired at night. Put in a shunt pen at the exit to hold animals requiring special care. Plan it to serve heifers as well. Keep maternity cows and small calves in the same building where you milk so you can speed the care of them as well.

(4) Make the whole operation such that you will be proud of your cows and buildings when the chores are done and so <u>you can't forget them</u> when they aren't !

(5) Select cows who are at home in your system.

If needed, further details may be introduced at this point.

<u>BUT WHAT ABOUT THE FIELD WORK?</u>

Here Are The Important Factors:

(1) A man must be fully equipped if he is to be efficient.

(2) Fewer crops mean few problems and fewer machines to make him fully equipped.

(3) With four row corn equipment, crop sprayers, minimum tillage and multiple hitches, spring work and fall work are already "licked" on most dairy farms.

(4) It takes a lot of excellent quality forage to operate a large scale dairy. Harvesting this large quantity is the real problem.

(5) Crops require labor seasonally, and each task must be done on time.

For the purpose of this bulletin, the first three factors listed above can take care of themselves, provided you learn what the latest approved crop practices are and equip yourself with the machinery to get the job done on time. The fourth factor is the one to worry about. Let's talk about grass silage for first cutting and oat silage, hay for second cutting, corn silage for at least part of that crop and corn stalks chopped for bedding as well.

This makes the forage harvester a pretty big key to the business. But let's start at the beginning to describe one way of doing a big task. There are other ways which may work just as well for you, but ask yourself which is best when you consider:

(1) Quality of product,

(2) Speed and simplicity of operation,

(3) Investment, overhead and operating cost,

(4) Amount and kind of labor needed.

At this point a discussion of devices and methods of task integration in forage harvest should appear in the bulletin.

YES, BUT WHAT ABOUT ALL THE MAINTENANCE AND REPAIR WORK YOU HAVE TO DO?

These are important, too, and a place to even out employment while lowering production costs. To get the job done you need to:

(1) Learn how,

(2) Supply a good shop and tools,

(3) Plan ahead; be prepared for emergenies,

(4) Be sure that you allow time for these tasks.

Here a short discussion of the importance of this area and therefore certain listed procedures are needed.

THIS SOUNDS GOOD, BUT HOW CAN A MAN KEEP TRACK OF THIS MANY COWS, AND ACRES AND MACHINES?

It isn't easy! Farming is a rapidly changing business, what was best yesterday often isn't nearly good enough tomorrow. But to be forewarned is the first step to being prepared. So let's look at what can go wrong and what you will need to do about it.

Your problem is to take care of each acre and each cow just about as well as a good manager does now with 20 cows. If you go from 20 to 40 cows, you don't just double the job, in some ways you quadruple it! This won't do. To make a wrong guess might be pretty serious.

Let's list some ways we have to solve this problem:

(1) Continue approved production practices,

(2) Simplify or even eliminate tasks needed to maintain these production practices,

(3) Substitute machines for labor - sometimes. There are times when you can make the machinery you now have do more work instead,

(4) Improve the efficiency with which you work.

(5) THIS IS THE KEY ONE: Improve the efficiency with which you manage.

We have talked about (1) through (4) before so let's look at number (5). There are five steps to management. Given a problem, you gather ideas for its solution (observation). Then you examine it and its alternative solutions (analysis). Then you decide what to do (decision). Then you do it (action). And before you are done, you (not people who tell you how in bulletins) must take the responsibility for that action. Now anything you can do to improve your abilities to observe, analyze and decide, will help you to take the correct action and ease the responsibilities. It takes time to manage -- allow yourself that time.

This means making up your mind that you can improve; that you can do it. It means being prepared to expect difficulties and being prepared to meet them. In fact, that is what you are doing right now as you read this. It also means that you must clearly understand the problems and pitfalls you face. You need to see your other alternatives just as much as you need to see large scale dairying as one of them.

It means that if you decide on this alternative, then you need to build a system of cow numbers and qualities, of crops and machinery, which will be the best for <u>you</u> and the other people with whose welfare you are concerned.

WHAT ARE THE THINGS WHICH ARE LIKELY TO GO WRONG?

We can't name them all, but we can mention some of the most important.

(1) Changes in relative prices,

Requires a minimum of discussion.

(2) Poor crop years
  Less grass silage
  Wrong cultural decisions
  It is possible to build in certain insurance schemes,

Requires a minimum of discussion.

(3) General price level
  Depression or recession effects
  Demand -- substitutes for milk,

Requires a minimum of discussion.

(4) People
  Problems to be faced with hired help
  Problems to be faced with partners
  Problems to be faced with other people
  Farming and the life cycle
  Health and well being
  Motivations and goals,

This section also requires further discussion to point out that a modern farm manager has to learn to deal with people as well as crops and livestock.

(5) Credit,

Requires discussion to point out today's problem. The analogy of what happened to the family grocery store could be used here. To continue:

Some of these problems are more important than others. But any successful businessman has to expect to face, overcome or circumvent these kinds of problems continuously.

OK, BUT WHERE DO I GET THE TIME AND THE MONEY TO BUILD THIS SYSTEM?

It's pretty hard to expand a farm business and still keep producing at the same time. Perhaps it's even harder than operating the expanded business! There are so many things you have to learn about. Your management has to keep up with your expansion or vital profits are lost.

Maybe you should consider doing just the planning and purchasing and hire others to do the bulk of the actual building construction. There will be enough small details and actual farm work to keep most people busy.

As for money, credit is a tool of all modern businesses. The kind of money needed to establish an 80 cow dairy farm has to be based on potential earning power just like the credit extended to other businesses is today. It needs to be credit which does not place an excessive burden upon receipts.

Remember that a lender will want to see where repayment will come from. Farm budgets will help show him. Remember that other people have acquired the kind of capital discussed here. It may have to be supervised credit where someone will help you learn to manage.

This discussion could continue in attempting to explain how to get credit.

HAVE YOU REALLY SOLVED THE PROBLEM?

No - It's still your problem.

Just remember that none of us are perfect. This system wasn't built for a perfect man. It was built for the man who is determined to build a successful dairy operation which pays as well as other alternatives can; especially one that is capable of competing for labor with industry in Michigan.

You have still to ask yourself:

(1) Do you really want to run this kind of a business; is this the life <u>you</u> and <u>your family</u> want?

(2) Have you got or can you get the necessary technical knowledge and capital?

And remember this bulletin presents some general material which will need modification to fit your farm and your conditions. Why don't you try to budget it out with your prices and production rates?

There are several additions which could be made at the conclusion of the bulletin. Coefficients for budgeting could be included. So could actual budget forms. A selected bibliography of recent literature might also be considered.

Other Conclusions

The proposed bulletin presented some methods of organizing dairy farms so as to make the earning power of labor competitive with industry.

The study also has other implications. Important ways to simplify the management of dairy farms exist though it is still necessary to account for the art of husbandry so aptly expressed by, "The eye of the master fattens the cattle." Specialization in a few crops and only one type of livestock simplifies management.

Another implication is that dairy farms must be large enough to employ at least two men if working conditions are to be even partially comparable with those in industry. Days off, vacations, illness and a medium length work week are difficult to handle otherwise.

Further, modifications are possible to adjust specific farms for particular comparative advantages or for particular soils and climates. Feed crop production is profitable on Michigan dairy farms. There are at least two reasons for this. One is that feed production tends to make better use of the farms fixed assets over the seasons, especially labor needed by the firm in order to provide time off for dairy workers. The other is that it is difficult to purchase sufficient excellent quality forage in Michigan to supply low cost nutrients to the dairy herd.

The budgets indicate that even higher herd production averages should be the goal of the farm manager if such are attainable without excessive additional cost in feed, managerial effort and husbandry skill. While data are not available to determine how far a manager should go in this direction, it appears that an average of 10,000 pounds of 3.5 percent milk per cow should be set as a minimum standard.

Another implication is that no matter what kind of livestock farm, easier observation should be built into the production system. Circular travel, work simplification and materials handling all have a place. Equally important, that work environment design must consider comfort and physical work load per man if high productivity is to be gained as productivity depends upon motivated conscientious workmen.

Perhaps the most important implication of all concerns the relative advantage of large operations in providing competitive wages, working conditions and fringe benefits as well as increased profitability. While two men budgets permit improved working conditions and the three men budgets begin to appear competitive with industry, it is not until a nine man situation is produced that truly comparable working conditions and wage rates develop. Little is known about such farms in Michigan though such farms are in operation in California and England. It appears that the setting in Michigan is now favorable for their development provided that financing can be arranged. Present credit institutions may not be able to finance their development. Further study in the area of credit seems to be called for if dairy farms where labor can be used competitively with industry are to be organized in Michigan.

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APPENDIX

APPENDIX TABLE 1.- Dairy Cattle Inventory Values, Feed and Product Rates and Prices, per head

Item	Value			Production Per Year			Depreciation Per Year		Misc. Exp. Breeding, Vet., and Testing	Feed Requirements a/ (equivalents)	
	Cull	Inventory	Increase in value per yr.	Milk lb.	Fat lb.	Manure tons	Rate	Amount		Grain b/ bu.	Hay b/ T.
-- Medium Producers --											
Cows	$110	$200	$10 c/	10,000	350	10 d/	0.1250	$25.00	$12.25 d/	65 d/	8.5 d/
Heifers		125									
Calves	10	75									
-- High Producers --											
Cows	$110	$250	$ 7 c/	12,000	420	10 d/	0.1875	$38.50	$12.25 d/	75 d/	8.5 d/
Heifers		160									
Calves	10	85									

a/ Corn valued at $1.25 per bushel and hay at $20.00 per ton.

b/ Feed inputs modified from: C. R. Hoglund, Economics of Producing and Feeding Roughage and Grain To Dairy Cows, Agricultural Economics Department, Michigan State University, Ag. Econ. 620, June 22, 1955, p. 8 and also; C. R. Hoglund, A Budgeting Guide in Estimated Feed Inputs and Milk Production When 1,200 pounds Holstein Cows are Fed Variable Quantities of Grain and Three Qualities of Roughage, Agricultural Economics Department, Michigan State University, Ag. Econ. 670, Jan. 16, 1957, pp. 1, 3-4.

c/ This value is added into receipts as income due to the high level of replacements kept. See Chapter VIII dairy assumptions.

d/ Figured on a cow plus replacement basis.

APPENDIX TABLE 2.- Labor Requirements for Dairy Chores in Hours a/

ITEM	NUMBER OF COWS IN THE HERD 30	40	60	80	100	120	360
				-- Hours --			
Prepare, milk, clean-up, per day	2.6	2.6	3.5	4.0	5.2	8.7	21.0
Care for maternity cows, per day	.4	.4	.5	.5	.6	.6	1.8
Feed calves grain and milk, per day	.3	.4	.4	.4	.5	.5	1.5
Feed silage and hay, per day	.4	.4	.4	.6	.6	.7	2.1
Bed total herd, per day	.3	.4	.5	.6	.7	.8	2.4
Miscellaneous, per day	.3	.5	.8	1.0	1.0	1.3	3.9
Yard scraping, per day	.3	.3	.4	.4	.4	.4	1.2
TOTAL, per day	4.6	5.0	6.5	7.5	9.0	13.0	33.9
Man hours for above items, per year	1679	1825	2373	2738	3285	4745	12374
Feed grinding time, per year	25	35	45	60	70	85	120
Manure clean out time, per year	40	60	80	100	110	120	360
TOTAL MAN HOURS, per year	1744	1920	2498	2898	3465	4950	12854
Hours per cow, per year	58	48	42	37	35	42	35

a/ Data in part developed from farmer experience under conditions similar to those assumed in the thesis, however, the following secondary sources were also used: L. H. Brown, et. al., op. cit., p. 29; George B. Byers, Effect of Work Methods and Building Designs on Building Costs and Labor Efficiency for Dairy Chores, Kentucky Agricultural Experiment Station, Bul. 589, June 1952; C. J. Fenzau and R. N. Van Arsdall, op. cit., p. 22, and Harry C. Woodworth and Kenneth S. Morrow, Efficiency in the Dairy Barn, New Hampshire Agricultural Experiment Station, Bul. 387, June 1951.

APPENDIX TABLE 3.— Machinery Investments and Inventories, Repairs and Depreciation, by Budget Series

Machine	Value a/ per unit	I	II	III	IV	V	VI	VII	VIII	IX&X
						-- Dollars --				
Tractors: 4 plow	2,000					2,000	2,000		2,000	
3 plow	1,800	1,800	1,800	1,800	1,800			1,800		3,600
3-2 plow	1,200					1,200	1,200		2,400	
2 plow	600	600	600	600	1,200	600	600	1,200	600	1,800
6 plow crawler	2,500									2,500b/
Small garden w/attch.	400									400b/
Plows: 6-14"	450									450
4-14"	275					275	275		275	
3-14"	200	200	200	200	200			200	200	400
2-14"	100		100		100	100	100	100	100	
Onceover 56"	175					175	175		175	
42"	100	100	100	100	100			100		200
28"	85		85		85	85	85	85	85	
84"	300									300
Disc 10'	200					200	200		200	
8'	150	150	150	150	150			150		300
Springtooth: 15'	100					100	100		100	
10'	75	75	75	75	75			75		
8'	70									210
Cultipacker: 9'	100									200
8'	100	100	100	100	100	100	100	100	100	
Multiple hitch	75									75b/
Corn planter: 4 row	360				360	360	360	360	360	360
2 row	180	180	180	180						

continued

APPENDIX TABLE 3: Continued

Machine	Value a/ per unit	Budget Series I	II	III	IV	V	VI	VII	VIII	IX&X
						-- Dollars --				
Graindrill: 14x7	300	300	300	300	300	300	300	300	300	
17x7	350									700
Cultivator 4 row	200				200	200	200	200	200	400
2 row	75	75	75	75						
Rotary hoe: 4 row	100		100		100	100	100	100	100	100
Sprayer: 6 row	100	100	100	100	100			100		
8 row	125					125	125		125	250
Cornpicker: 2 row	700								700	700
1 row	400		400		400	400	400			
Chopper (P.T.O.)	1,200	1,200		1,200						
(motor mounted)	2,000		2,000		2,000	2,000	2,000	2,000	2,000	
Mower: 7'	200	200	200	200	200	400	400	200	400	400
Windrower	55	55	55	55	55	110	110	55	110	110
Siderake: 8'	225	225	225	225	225	225	225	225	225	225
Rotary chopper	500									500
Large P.T.O. chopper	2,500									2,500b/
Baler (round bales)	700									700
Pipeline milker: 2 claw	500	500								
(with washer) 3 claw	700		700	700	700	700	700	700	700	2,100

continued

APPENDIX TABLE 3: continued

Machine	Value a/ per unit	I	II	III	IV	V	VI	VII	VIII	IX&X
						Budget Series -- Dollars --				
Bulk tank: 350 gal.	2,200	2,200								
400 gal.	2,500		2,500							
500 gal.	3,000			3,000	3,000					
600 gal.	3,600					3,600				
700 gal.	4,000						4,000			
800 gal.	4,300							4,300	4,300	12,900
Water heater 80 gal.	150	150	150	150	150	150	150	150	150	450
Washtanks	60	60	60	60	60	60	60	60	60	180
Other milkroom	var.	215	365	265	365	445	445	365	445	1,350
Pickup truck	600									600
Dump truck	400	400	400	400	400	800	800	400	800	6,400b/
Manure spreader	275	275	275	275	275	275	275	275	275	550
Elevator 40'	400	400	400	400	400	400	400	400	400	800
Feed grinder 10"	125	125	125	125	125	125	125	125	125	1,500b/
Forage wagons	300	600	600	600	900	600	600	900	900	900
Manure loader	250	250	250	250	250	250	250	250	250	750
Scraper blade	85	85	85	85	85	85	85	85	85	250
Fertilizer spreader 8'	220	220	220	220	220	220	220	220	220	2,500b/
Crawler blade	1,500									1,500
Tools and miscellaneous	var.	590	590	640	690	690	690	690	790	2,200
Total investment		11,855	13,540	12,705	15,315	17,255	17,655	16,615	20,505	49,175
Repairs c/		670	711	725	1,100	1,400	1,500	1,100	1,300	2,500
Depreciation d/		980	1,255	1,140	1,380	1,630	1,630	1,435	1,830	5,175

a/ Prices obtained from central Michigan auctions and dealers for good used equipment.
b/ See the discussion of Budget IX, Chapter VIII.
c/ Repairs are calculated from 2 to 7 percent depending on use and type of machine.
d/ Depreciation is calculated from 7 to 10 percent depending on obsolence, use and type of machine.

APPENDIX TABLE 4.– Crop Yields and Values, Seed and Fertilizer Prices and Rates

Crop	Yield e/		Product Value		Seed		Fertilizer f/			Top Dressing	
	Grain	Silage	Grain	Silage	Rate	Price	Type	Amount	Price	Nitrogen	Price
Corn a/	65 bu.	10T.	$1.25/bu.	$8/T.	$5\frac{1}{2}$A/bu.	$13/bu.	8-16-16	250#/A.	$69/T.	40-60#/A.	12¢/lb.
Oats b/	55 bu.	7T.	75¢/bu.	$8/T.	2bu./A.	$1.80/bu.	8-16-16	400#/A.	$69/T		
Alfalfa Seeding c/					8#/A.	$60/cwt.					
Brome Seeding					4#/A.	$27/cwt.					
Meadows d/	6T. sil. (1st cut)	1T. hay (2nd cut)	$20/T (hay)	$8/T. (silage)			0-20-20	200#/A.	$61/T.		

a/ Corn also requires 6 gal./8A. of 245-T weed spray at $6/gal.

b/ Oats also requires $3.80 seed treatment/50 bu.

c/ Alfalfa also requires $1.05 seed treatment/cwt.

d/ One tenth of the tillable acreage calculated to require 3 tons of lime each year. Lime charged at $4.50/Ton spread in the field.

e/ Corn stover is also harvested for bedding and valued at $12/Ton.

f/ Manure produced at 10 Ton/cow and is spread at the rate of 10 Ton/Acre on corn land and the remainder spread on the oat land.

g/ In the 1368 tillable acre budgets quantity discounts and bulk rates on materials are assumed to be as follows: 8-16-16, $65/Ton; 0-20-20, $57/Ton; Nitrogen, 9¢/lb. not applied; lime, $3.50/Ton applied.

APPENDIX TABLE 5.—Accomplishments Per Man Hour for Various Sized Field Operations; Basic Coefficients Used in Budgeting. a/

CROP	MONTH	TASK	UNIT	Total Tillable Acres in Crops b/						
				114	150	228	300	378	456	1368
Oats	April	disk	Acres	2.5	2.5	2.5	3.5	3.5	3.5	5.0
(for silage)	Apr.,May	drill	do	1.7	1.7	1.7	1.7	1.7	1.7	3.5
	June	mow c/	do	2.5	2.5	2.5	2.5	2.5	2.5	5.0
	do	rake d/	do	2.5	2.5	2.5	2.5	2.5	2.5	5.0
	do	chop	Tons	8	10	10	12	12	14	20
	do	haul	do	8	10	10	12	12	14	10
	do	store	do	*	*	*	12	12	14	10
Corn	May	plow	Acres	1.5	1.5	1.5	2.0	2.0	2.0	3.0
	do	plant	do	1.3	1.3	4.0	4.0	4.0	4.0	4.0
	June	cultivate e/	do	3.0	3.0	4.0	5.0	5.0	5.0	5.0
	do	spray f/	do	5.0	5.0	10.0	10.0	10.0	10.0	10.0
	do	sidedress	do	g/	g/	g/	g/	g/	g/	5.0
(corn for silage)	Sept.	chop	Tons	4	5	10	12	12	16	24
	do	haul	do	*	*	10	12	12	16	12
	do	store	do	*	*	*	*	*	16	12
(corn for grain)	Oct.	pick	do	g/	0.5	0.5	1.0	1.0	1.5	1.5
	do	haul	Bushel	100	*	*	100	100	100	100
	do	store	do	*	*	*	*	*	*	*
(stover bedding)	Nov.	cut	Acres	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	do	rake h/	do	*	*	*	*	*	*	*
	do	chop	Tons	2	2	2	4	4	4	4
	do	haul	do	*	*	*	4	4	4	4
	do	store	do	*	*	*	*	*	*	*
Forage	June,Aug.	mow	Acres	2.5	2.5	2.5	2.5	2.5	2.5	5.0
	June,Aug.	rake c/	do	2.5	2.5	2.5	2.5	2.5	2.5	5.0
	July	fertilize	do	2.5	2.5	2.5	2.5	2.5	2.5	10.0
(grass silage)	Season	chop	Tons	8	10	12	14	14	16	20
	do	haul	do	8	10	12	14	14	16	20
	do	store	do	*	*	12	14	14	16	20
(green chop)	(5 mos.)		do							10
(dry hay)	Aug.	chop	do	2.5	3	4.5	4.5	4.5	4.5	6
	do	do	do	*	*	4.5	4.5	4.5	4.5	3
	do	do	do	*	*	*	*	*	*	*
(lime spreading)	variable		Acres	g/	g/	g/	g/	g/	g/	2

Note: Those coefficients described by an asterisk (*) are considered to be done by the same man and at the same time as specified by the coefficient immediately above.

a/ Crop task accomplishment rates were developed for moderately productive Michigan soils using secondary data. An attempt was made to be reasonably conservative considering the general application of the budgets and the assumptions made relative to people and organization. The data were developed for use in the budgets at hand and are not an "average" of other reports nor a selected "best attainable" rate. Michigan weather conditions especially with respect to rain in April, May, June and October entered into the selection. When possible selected rates were compared against farmer experience. The five major data sources were:

W. Kalbflisch and A. I. Magee, Cost of Operating Farm Machinery (Eastern Canada), Canada Department of Agriculture, Pub. 750, pp. 20-28.

G. E. Frick, S. B. Weeks and I. F. Fellows, Production Efficiency on New England Dairy Farms, IV Adjustments in the Organization of Machinery and Equipment, New Hampshire Agricultural Experiment Station, Sta. Bul. 407, May 1954, pp. 9-10.

James Vivilden, Farm Labor, Power, and Machinery Performance, For Selected Operations Under Dryland and Irrigated Conditions in Central South Dakota, Agricultural Economics Department, South Dakota State College, Pamphlet 43, August 1953.

James Stallings, Cost and Returns in the Production of Major Field Crops in Southwestern Indiana, Unpublished M. S. Thesis, Department of Agricultural Economics, Purdue University, 1956.

R. J. Burdick, A New Technique for Field Crop Labor Analysis, Colorado Agricultural Experiment Station, Tech. Bul. 36, 1949.

b/ In all cases, the rotation is C, C, O, H, H, H; therefore, one-third of the land is in corn, one-sixth is in oats and one-half is in forage crops.

c/ All grass and oat silage mowing includes windrowing.

d/ When windrowed, only half the land area must be raked to throw two windrows together for chopping. For silage making this is assumed to be the common procedure.

e/ Done when the crop is 4-6 inches high.

f/ Done when the crop is 6-8 inches high.

g/ Custom hired done.

h/ In stover harvest, mowing and raking are done in the same operation.

APPENDIX TABLE 6. - Field work labor requirements by crop, acres and months

CROPS and LABOR USED	Number of Acres						
Oats and Seedings	19A	25A	38A	50A	63A	76A	228A
PART A. Man hours required by months.							
April	8	10	15	14	18	22	46
April or May	10	15	23	30	37	44	65
June	46	50	76	120	153	162	297
PART B. Man hours per day estimated to be available for field work							
April	5	5	5	5	6	7	7
April or May	5	5	6	6	6	7	7
June	12	12	12	21	24	28	48
PART C. Days required for oats field work with available labor.							
April	2	2	3	3	3	3	7
April or May	2	3	4	5	6	7	10
June	4	4	7	6	7	6	6

Corn	38A	50A	76A	100A	126A	152A	456A
PART A. Man hours required by months.							
May	57	75	76	75	95	112	266
June	20	26	26	33	38	46	230
September	33	34	52	57	72	98	325
October		66	100	100	150	128	384
November	23	37	56	74	93	110	330
PART B. Man hours per day estimated to be available for field work							
May	5	6	6	6	10	10	20
June	7	7	7	7	7	7	24
September	6	6	12	12	12	18	35
October		5	5	8	8	12	24
November	5	5	5	10	10	10	24
PART C. Days required for corn field work with available labor.							
May	12	13	13	13	10	12	13
June	3	4	4	5	6	7	10
September	6	6	5	5	6	6	10
October		13	20	11	14	11	16
November	5	8	11	8	10	11	14

continued

APPENDIX TABLE 6: Continued

Forage	57A	75A	114A	150A	189A	228A	684A
Part A. Man hours required by months.							
May							45
June	120	135	240	285	360	388	525
July	5	6	10	13	16	19	114
August	69	85	142	186	234	282	522
September							45
October							45
Part B. Man hours per day estimated to be available for field work							
May							2
June	12	12	18	21	24	28	48
July	6	6	6	6	6	6	a/
August	6	6	12	12	12	14	40
September							2
October							2
Part C. Days required for forage field work with available labor.							
May							a/
June	10	11	14	13	15	14	11
July	1	1	2	2	3	3	a/
August	12	15	12	16	20	20	13
September							a/
October							a/

a/ Consists of one hour apiece for two men per day plus fertilizer hauling and spreading.

Date Due

~~SEP 26 1960~~			
~~MAR 10 1961~~			
~~AUG 28 1961~~			
~~OCT 1961~~			