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I am submitting herewith a thesis written by Dick Wayland Smith entitled "Economic Levels of Forage and Grain Production on Dairy Farms in East Tennessee." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

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ECONOMIC LEVELS OF FORAGE AND GRAIN PRODUCTION
ON DAIRY FARMS IN EAST TENNESSEE

A THESIS

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The Graduate Council
of
The University of Tennessee
in
Partial Fulfillment of the Requirements
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by

Dick Wayland Smith

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CHAPTER I

INTRODUCTION

General Introduction and The Problem

Since the mid-twenties, dairying as a major source of income to the farmer has experienced considerable growth especially in Southern states such as Tennessee. Thirty-one percent of the farms in Tennessee reported sales of dairy products in 1951. There has been an increase in Tennessee milk production of 69 percent since 1924. Since this date, there has also been an increase of 40 percent in the number of cows and an increase in production per cow of nearly 25 percent. Even with this increase in production, Tennessee has averaged 341-845 pounds of 4 percent fat corrected milk per cow less than the United States average.¹

The low average production per cow in Tennessee and elsewhere has been attributed to a number of factors one of which is the hereditary capacity of the animal to produce milk. This study, however, was not concerned greatly with the hereditary factor except as related to the managerial ability of the farmer to improve his herd through selective breeding and culling. The study was more concerned with the management problems related to the use of improved feed production and feeding practices.

¹M. L. Downen, The Tennessee Farm Dairy Industry, Rural Research Series, Monograph No. 266 (Department of Agricultural Economics and Rural Sociology. Agricultural Experiment Station, University of Tennessee, Knoxville Tennessee, November 20, 1952), p. 5.

With the many innovations making their appearance in agriculture coupled with the upward trend in prices paid by farmers, dairy farmers need to analyze carefully their decisions relative to the managerial problems faced in the successful operation of the farm unit. They can, through the use of improved feed production methods and feeding practices, increase their net income even if faced with the problem of limited resources. In recent years much has been written on the subjects of feed production methods and feeding practices with the emphasis being placed on the kind and amount of feedstuffs the dairyman should produce and what feedstuffs can best be purchased. These latter factors are certain to influence the number of animals a dairyman could care for on a limited number of acres and with the other limited resources present relative to the operation of a given farm unit.

Along the line of improved practices in the production of feedstuffs for dairy farms is the emphasis now given forage production. With many technological improvements now available for the production and harvesting of forage crops it is evident that larger acreages, increased yields, and higher quality roughage can be produced with the limited resources available on any given farm. The fertilization practices now recommended makes for the higher yields and the harvesting equipment available means that a higher quality roughage can be harvested. The equipment reduces the number of man hours required; however, the additional investment must be given careful consideration.

From the previous discussion it should be evident that there is a problem to be faced by dairymen. To formulate the problems as concise

as possible, yet be all inclusive, it is phrased in the following manner. With limited resources available, there is a need for dairy farmers to analyze more carefully their decisions on how much grain to produce, and how much grain and/or concentrates to purchase in order to make for more efficient farm operation and increase their net income. It is realized that the decisions made on the above problems will determine the number of animal units on individual farms as well as the number of both complementary and competitive enterprises produced.

Objectives

Faced with the aforestated problem there are three definite objectives of the study. The first major objective is to determine as accurately as possible the most economical rate of forage production on dairy farms. Another important objective is to determine the most economical rate of grain production on dairy farms. The third objective which is related to each of the preceeding objectives is to determine how much grain and/or concentrates should be purchased.

Definitions for forage, grain, concentrates, and other terms, as used in this study can be found in Appendix B.

Method of Approach

The decision was made to study thoroughly two Unit Test Demonstration dairy farms in East Tennessee through the budget analysis technique. The analysis was made by taking the present operation of the two farms as

the original plan and budget various levels of operations as alternative plans. The alternative budgets were based on a cropping system with 60 percent, 80 percent, and 100 percent of the available cropland in forage production. The balance of the cropland in the budgets with less than 100 percent in forage production was devoted to grains and/or other crops.

Theoretical Implications Of Budget Analysis

Before proceeding further with details of the study that was made on the dairy farms a brief explanation will be made of some theoretical implications of budget analysis as applied in the field of farm management. Further discussions on the theory of budget analysis can be found in the references hereafter set forth in the footnotes of this particular section.

Budgets as used in this study are often referred to as capital budgets which naturally involve capital expenditures. In Joel Dean's Managerial Economics, capital expenditure is defined in terms of the flexibility of various commitments involved. Those items, therefore, that can be converted into cash relatively easy in the short-run are excluded from the capital budget. The items which are less flexible and require a number of years to return their cash outlay (long-run expenses) are placed in the capital budget.² This is to say that these expenditures involved forecasting and more uncertainty than the short-run expenses of the firm. Certainly this latter statement is applicable to budgeting the farm unit; however, the two preceding statements need modification when

²Joel Dean, Managerial Economics (New York: Prentice-Hall, Inc., 1951), p. 554.

explaining budgets prepared for guidance in the operation of a farm. In the budget for a farm will be such things as number of each livestock, prospective acres of each crop, estimated yield of each crop, facilities necessary to care for and produce the livestock and crops, estimated costs and income, and finally a net income figure. As a general rule more than one budget will be made, and in this case a prediction of the most profitable one will be attempted. The goal then of the budget " ... is to compare alternative plans for prospective profitability."³

In planning the operation of a farm through budget analysis certain basic principles of farm management must be applied. Details of these principles can be found in the many farm management text; therefore, these principles are only enumerated here. They include the principles of diminishing returns, substitution, opportunity costs (also known as the equal marginal return principle), and (for lack of a more concise word) principle of decisions over time. This latter principle has two parts as regards decisions which are important with respect to time. These two include " ... differences in profitability growing out of time alone and difference in the desirability of investments which relate to risk or uncertainties which attach to time."⁴

It should be pointed out here that the theory of the firm has usefulness in the budget method of farm management research. Of use in the theory of the firm are the definitions, concepts, and analytical

³Earl O. Heady and Harold R. Jensen, Farm Management Economics (New York: Prentice-Hall, Inc., 1954), p. 96.

⁴Ibid. p. 87.

tools outlined which provide a framework of logic for specifying conditions and assisting in the analysis of farm management problems. In budgeting economic theory helps the research worker at each step to choose the significant relations for analysis. Actually the budget approach can be looked upon as the extension and adaptation of the analytical methods of economic theory to specific farm situations. In budgeting input-output relations resulting from differences in techniques, combinations of factors, and products produced must be estimated for each operation. Theory can help here by enabling the workers to greatly reduce the number of alternative combinations explored. "The physical relationships together with the expected future prices provide a basis for analyzing the adjustments that will maximize farm earnings in each production."⁵ In both farm management and economic theory "... the input-output relationships are developed separately for relevant enterprises and levels of technology before they are combined into the farm business."⁶

There are also problems in the use of production theory in farm management analysis of empirical data. The relation of economic theory to the analysis of empirical data is more explicit in the budget method, however, than in other analytical methods of farm management research. Although this is true there are relationships which are not always clearly understood. What then are the sources of the problems? One complication

⁵Kenneth L. Bachman, "Relation of Economic Theory to the Analysis of Empirical Data in Farm Management Research," Journal of Farm Economics, XXXIII: 1163, 1951.

⁶Ibid. p. 1164.

arises because economic theory assumes as given the techniques of production. Although we generally assume that the best technique is employed which will maximize the product from a given combination of productive services, it is often more important in maximizing efficiency to choose suitable kinds of inputs in our changing economy than to choose specific quantities of inputs. In economic terms this will result in the shifting of production functions and cost curves which will enable greater production with the same or less input. Thus it is easy to see that with the ". . . infinite variety of possible input-output relationships arising from differences in combinations poses important problems in selecting for study the relationships that are believed to affect significantly the efficiency of farms."⁷ It has been said that the use of marginal analysis must be made in budgeting. Just how appropriate is the use of marginal analysis for budgeting in farm management? Marginal analysis assumes production practices where it is possible to vary by small amounts the various inputs and outputs individually. There are some production practices or situations in agriculture where this can be done to some extent such as in rate of seeding or fertilizer application. There are, however, more cases in agriculture where "lumpiness" and inflexibility predominate. An example of these situations would be farm buildings or most of the farm implements. Although the marginal analysis model cannot be carried out completely for many managerial situations found on the farms, it is still useful for some purposes. For one thing it provides a conceptual

⁷Ibid. p. 1166.

framework for viewing the more important relationships in solving farm management problems. Then too, the equilibrium conditions found in the model serve as indicators of optimal resource use, and the model also specifies meaningful hypotheses for testing.

Can we now apply the principles of theory in determining optimum solution of farm management problems by the use of budgeting? Budgeting is actually composed of predictions as to the outcome of one or of many different systems of operation by estimating the physical outputs on the basis of given resource inputs and by applying prices to these products and factors.

Complete budgets are generally required where problems in farm management involve such questions as: What is the best scale of operation? How should income flow over time be adjusted? In what manner should the farm business be arranged to take account of the operator's ability and willingness to assume risk? What are the various resources worth in terms of their prospective earning capacity? Other problems will arise in farm management which can be answered by the use of the partial budget. In general we can say that four steps are followed in calculating the complete budget. They are: the selection of the systems to be budgeted, specification of the technical coefficients of production, specification of prices for factors and products, and calculation of costs and returns. The problem under consideration will to a great extent determine the selection of the system or systems to be budgeted. The system selected to be budgeted will generally be based on the farmer's managerial ability, his resources, and market opportunities. However,

since most of the problems with which we are concerned involve a choice between plans, budgeting usually involves the selection of alternative plans so that comparisons can be made. Some objective is usually involved in the selection of the alternatives to be budgeted, such as maximization of net income. To accomplish the above an hypothesis is formulated which is relative to the values of the alternatives in meeting the objective. In formulating this hypothesis a certain amount of knowledge will be required concerning the technical and economic relationships involved in the problem.⁸

Generally it will not be possible to determine the most profitable system from a comparison of only two alternatives. The direction of further changes will be indicated by laws of production and familiarity with the technical relationships between the variables. An indication of when the most profitable system is approached can be made by the use of the conditions for equilibrium given by economic theory.⁹

After the selection of the system or systems to be budgeted the input and output of resources and products respectively must be specified. Actually the set-up of inputs of each resource are given when the system to be budgeted is selected. Only output of products are yet to be determined. In applying budgeting to a research problem the agricultural

⁸P. E. Johnson, Carroll V. Hess, and others, Budgeting in Farm Management Research (Memo-North Central Farm Management Research Committee; December, 1954), pp. 9-10.

⁹Ibid. p. 10.

economist has the job of selecting the set of technical data that applies to the particular set of resources and conditions involved. Much of this data can be acquired from the agronomist, animal scientists and engineers.

Another objective in budgeting may be to estimate the effect of major changes in the organization of resources of the farm, such as a shift from beef production to dairy production. The usual practice in farm budgeting is to assume that competing enterprises on a farm substitute for each other at constant rates. Here the equilibrium conditions of economic theory say that only one of the competing products should be produced if products do substitute at constant rates. An exception to this statement would be the case where the inverse price ratio happens to be substitution rate. Actually we do find substitution at constant rates as shown by the fact that different varieties of a crop will usually substitute in this manner. Some times even different crops will substitute at constant rates when they use similar resources at about the same season and provide no by-products beneficial to the other crops. Oats and barley can be cited as examples. This will not be true for crops or enterprises that are so interrelated that the yields of one are influenced by the amount of the other crops grown or enterprises present.

The specification of prices is a major decision in developing a budget. The validity of our examined alternatives in budgeting will certainly be influenced by the choice of prices used, regardless of how accurate our physical coefficients used. Since the purpose of budgeting is usually to help in making decisions for the future, the prices applied are estimates of future prices. There are some three or four methods used

in selecting the estimates to be used. First we generally think of historical prices and assume the future to resemble these. We might also project each price on the basis of trends, production cycles, and in technology, or it may be purely an arbitrary decision, or perhaps some combination of these methods. It is recognized here that none of these methods can lead to price expectations that are sure to materialize. Perhaps historical prices are used most often although the general level of prices in the future may turn out to be much different. We can justify the use of historical prices to some extent by further stating that while prices usually differ in the future, relative prices will generally be quite similar. We need to recognize, however, that in periods of changing price levels, prices of various factors and products do not move in unison; therefore, price relationships may deviate greatly from the normal for short periods. We are confronted here with the uncertainties of price just as we were by the problem of uncertainties in the production coefficients.

The final step in the budget is the calculation of costs and returns. Usually the calculations can be facilitated by grouping the data to be used in convenient tables arranging the procedure into orderly steps. The calculations required will depend upon the problems to which the budgets are being applied. When the next income figure is desired, all of the items of cost and return are needed. If working on variations in the organization of resources, only those items of cost and return which are affected by the proposed shifts will be needed. This would be the case most generally found in partial budgeting.

When using the budget analysis in farm management, one must recognize the limitations of the analysis. One of the most often heard criticisms

of the budgeting procedure as a research method is the fact that estimates of costs and returns are often not verified in actual farm operations. Too often this criticism rises from erroneous inferences drawn from budgets and not because of deficiencies in budgeting techniques. Perhaps then the greatest limitation of budgeting is the difficulty encountered in drawing inferences from the budget of a certain farm and applying them to farms which have resources that differ from the budget model. Of course there would be certain factors on a 100 acre farm that could be applied to say a 300 acre farm; however, there would be certain differences in the resources and organization that would have to be accounted for if the end result is to be reliable. Some of these differences may be the result of differences in soil, weather, topography, livestock and labor resources, and managerial ability. It must be realized, therefore, that a single budget cannot express the costs and returns for all farmers. Too often perhaps a single budget has been used as a model for too wide an area or management level.

Continuing along parallel lines of the above thoughts one will certainly recognize that a degree of risk and uncertainty exist in the budget analysis. The first aspect which makes for this risk and uncertainty is that at the time the budget is prepared the future is unknown. For example weather, insects, disease, changing technology, and prices are difficult to predict. As discussed earlier, use is generally made of historical averages or single-valued expectations conforming to some "normal". Such an analysis evades an important aspect of the problem of decision making. This analysis omits the role of risk and uncertainty in

arriving at optimum solutions. As for decision making, the best decision for some farmers might be the point at which profits are expected to be maximized, whereas for other farmers it may be a position involving less than maximum expected profits especially if such positions involve less uncertainty. Where the enterprises on the farm are such that the risk and uncertainty can be lessened by insuring, the farmer may be willing to accept the more optimum position of expected maximum profits. With insurance the farmer can convert the anticipated probable large losses held with uncertainty to known smaller losses -- the insurance premium. This insurance premium can be handled as a cost; therefore, it can be correctly budgeted.

There are many situations on the farm which offer no opportunity for such convenient insurance arrangements. We do find, however, that the farmer tends to handle such situations very analogous to formal insurance. For example, farmers may invest in addition power and machinery to insure that the job will be done on time and thus prevent loss of crops due to insufficient labor at peak periods. Often farmers handle this element of uncertainty by building flexibility into the design of buildings as a protection against possible shifts in relative profitability of alternative enterprises.

There are of course situations of true uncertainty which present more of a problem in analysis. Objective measures of future prices are perhaps the most outstanding situation of true uncertainty.

It is possible to advise farmers of the merits of alternative decisions by working out budgets for several categories of situations.

These various alternatives can be based on various degrees of risk aversion with one solution based on a very strong risk aversion. In this way the farmer can select the solution applicable to them.¹⁰

¹⁰Ibid., pp. 20-23.

CHAPTER II

SELECTION, RESOURCES, AND DESCRIPTION OF FARMS STUDIED

Here in Chapter II the reasons for selecting the farms studied will be enumerated. Also, in this chapter will be a discussion of the farm resources available on these farms which can be used in planning alternative farming systems through the budget analysis technique.

Selection

The two Unit Test Demonstration farms were selected for a number of reasons. Perhaps most important was that records had been kept for a number of years on both farms. This fact gave greater assurance that the expense and receipt records reflected the actual financial situation more accurately than would have been the case with first year record keepers or with no records available. Secondly, the soil resources found on these two farms covered the majority of soil situations found in East Tennessee. Climatic conditions in the area of the two farms were similar to that found in the eastern part of Tennessee with the exception of the extreme northeastern part of the State.

There was another important factor in selecting these two farms. Here were two dairy farms with owner-operators and considered to be operating more efficiently than most other dairy farms in that part of Tennessee. Farms with relatively high level management were deemed advisable for the study in order to put the alternative budgets to a more severe

test than would have been the case in studying farms with relatively low levels of management. The above statement should not be interpreted to mean that all the resources available on the studied farms were used in the most efficient manner nor that farms operated at lower levels of management should not be studied with the aim in mind of improving the operations so as to increase the earnings of these farmers too.

Both farms had approximately 100 acres of open land. This size was selected since it was deemed that smaller sizes would not lend themselves to as wide variations of cropping systems as would these larger farms. Farms of this size were also more common in the area than were the smaller or larger farms.

A final reason for selecting these two farms was that both were located within the same Grade A milk market, namely, the Chattanooga market area. This fact made it possible to keep milk prices and other costs on a more comparable basis.

Farm Resources and Variables

Land. Land values were kept at the value carried on the records of the farms. The total acres and the acres in open land were both held constant in the study. Land capacity was determined by soil surveys of the various soil types found on the farms. Improvements in the soils were accomplished through the addition of amendments and improved soil conservation practices. All these were budgeted at cost in the various alternative plans.

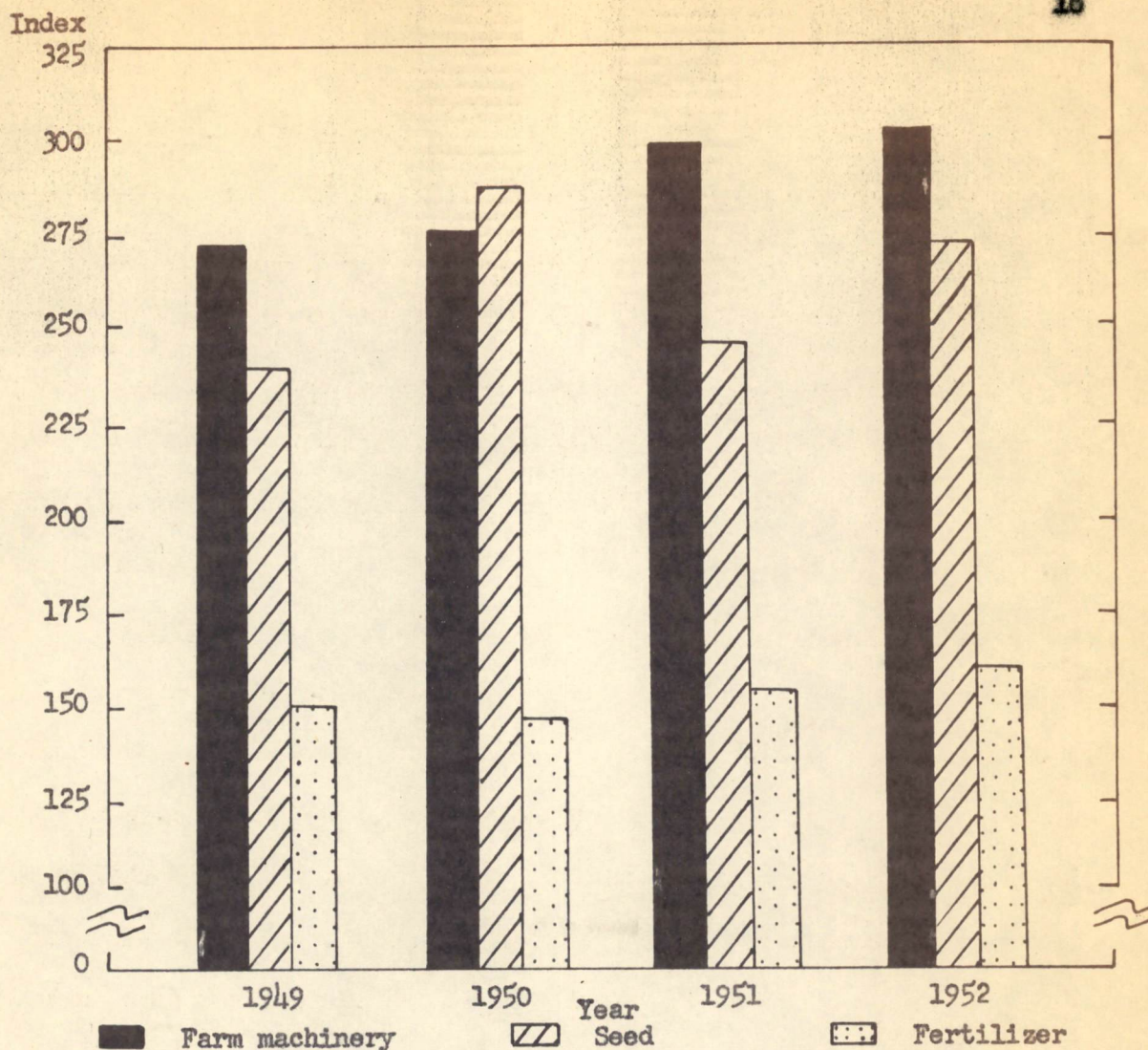
Labor. The labor force on both farms was varied when necessary to increase the net income. All costs of the added labor were computed in the alternative plans. Labor was not added if no increase in net income was possible through additional labor.

Capital. Needed capital for improvements which resulted in increased income was considered available either from saving or farm credit organizations. If capital had been a limiting factor, the aforestated objectives of the study could not have been explored as extensively.

Prices. Prices of both inputs and outputs were based on an average of 1949-1952 prices. It should be pointed out that during these years the fluctuation from the peak period to the lowest period was not extreme (See Figure 1). Even though prices received for farm products have declined and some increases in prices paid have occurred since 1952, most commodities have maintained about the same relationship within commodity groups as during the base period.

Managerial ability. For this study the managerial ability of the farm operator was considered to be adequate to make use of all improved production practices, feeding practices, and marketing facilities in order to maximize profits.

Milk production. In the alternative plans presented for the two farms studied the milk production per cow was adjusted upward to the level of 7,500 pounds annually (Appendix C, Table V). The average production on the two farms at the time of this study was 5,700 pounds annually. This higher production level was justified through the use of improved feeding practices and improved herd management. The milk production figures used in the study were based on recent research conducted



Source: Agricultural Statistics, United States Department of Agriculture.
U. S. Government Printing Office, Washington, D. C., 1954.

Figure 1. Index of prices paid by farmers in the United States for farm machinery, fertilizer, and seed, 1949-1952.

by dairy scientists.¹

Use of enterprises other than those related to milk production.

Other enterprises such as cash grain crops, hogs, and poultry were injected into the alternative plans where the production of dairy products did not make efficient use of all the available resources and where the level of forage and/or grain production limited the number of cows capable of being carried on the farm. No additional labor was hired in order to add enterprises other than dairying. Only surplus labor already on the farm was used for these additional enterprises.

Description of Farms Studied

The two farms studied were located in what is commonly known as the Lower East Tennessee Valley. Information relative to the operator, his family, acreages, soils, present farm layout, and distance from trading center are presented.

Each farm was designated by an alphabetical letter since part of the information presented was taken from the 1954 farm record book of each farm. The information used from these record books was confidential. The farm located in Bradley County was designated as "Farm A" and the one in Marion County as "Farm B". Hereafter each farm will be referred to by letter only.

¹Research data on increased milk production presented by C. R. Hoglund in his paper on Economics in Producing and Feeding Roughage and Grain to Dairy Cows. This paper is referred to more specifically in the latter part of Chapter III.

Farm A

Farm A was located on a macadamized road approximately five miles from Cleveland and 35 miles from Chattanooga, the major trading and marketing center of the area. The owner-operator of Farm A was 45 years of age, married and had no children. He had been on the Unit Test Demonstration Program since 1948.

The farm consisted of 175 acres with 88.6 acres of openland, 78.4 acres in woodland, and 8.0 acres in farmstead, roads, fence rows and wasteland. Figure 2 shows the soil resources and Figure 3 the boundary lines and field layout found on Farm A.²

Farm B

Farm B was located on a similar type road to Farm B. The distance to Jasper, the county seat of Marion County, was about 12 miles and approximately 34 miles from Chattanooga. The operator of Farm B was a man in his early 30's, married, and had a son, five years old. His father also lived on the farm and assisted in the operation of the farm. An Aunt's home was located on the farm; however, she contributed nothing to the farm operation. Farm B was put on the Unit Test Demonstration Program in 1950.

There was a total of 123 acres in the farm. Of the total 107 acres were open land, 11 acres in timber and 5.0 acres in the farmstead, roads, fence rows, and wasteland. The soil resources are presented in Figure 4.³

²For description of soils see Appendix A.

³Also see Appendix A for soil series found on both Farm A and Farm B.

The boundary lines and field layouts are shown in Figure 5.

A careful look at the field layout of both farms in relation to the soil resources revealed that attention had been given to the soil boundaries in laying out the fields. This was evident on the two farms studied because of the advanced planning done by the farmers with the assistance of the supervisors of the Unit Test Demonstration Program.

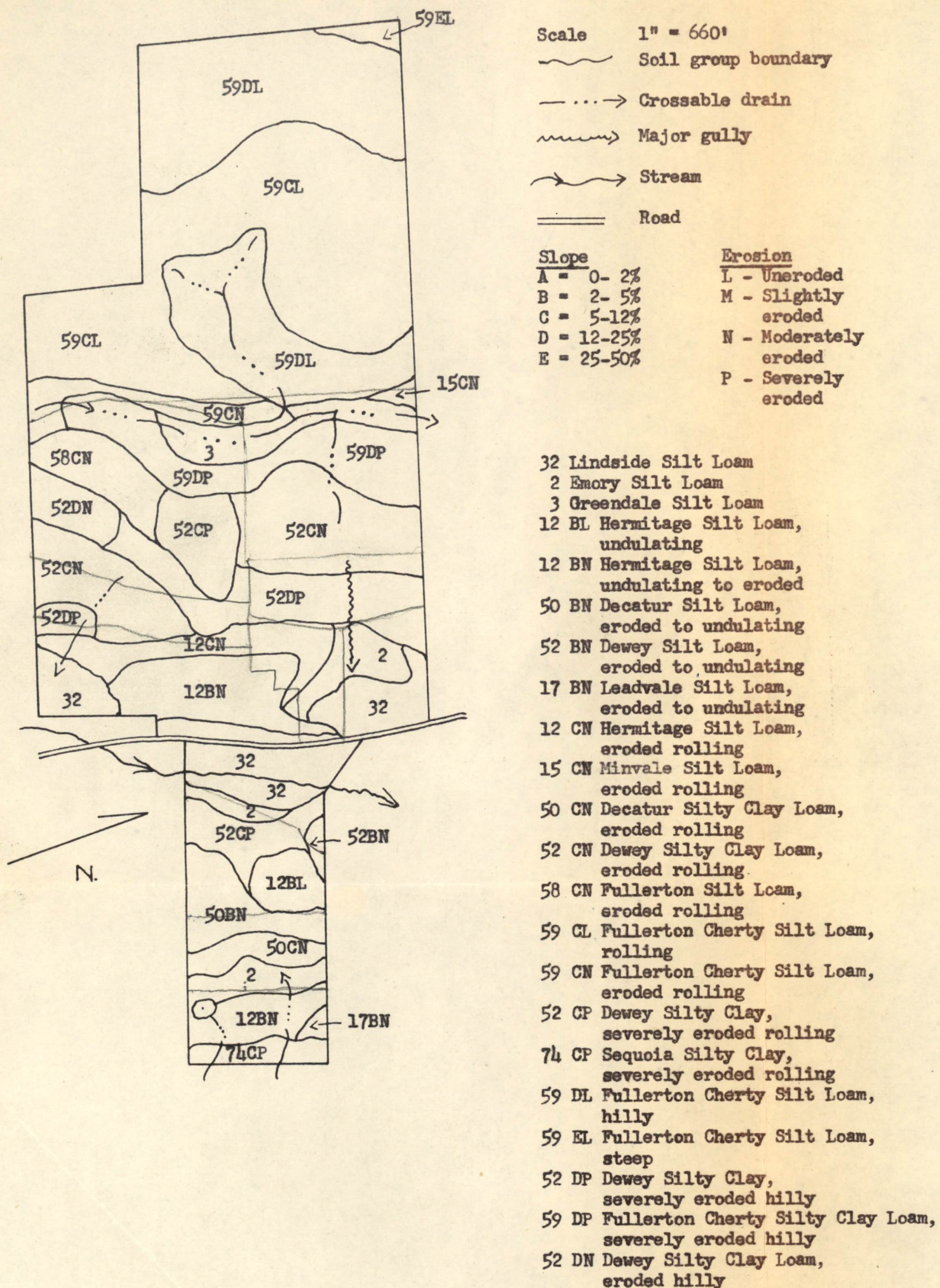


Figure 2. Present soil resources on Dairy Farm A, Bradley County, Tennessee.

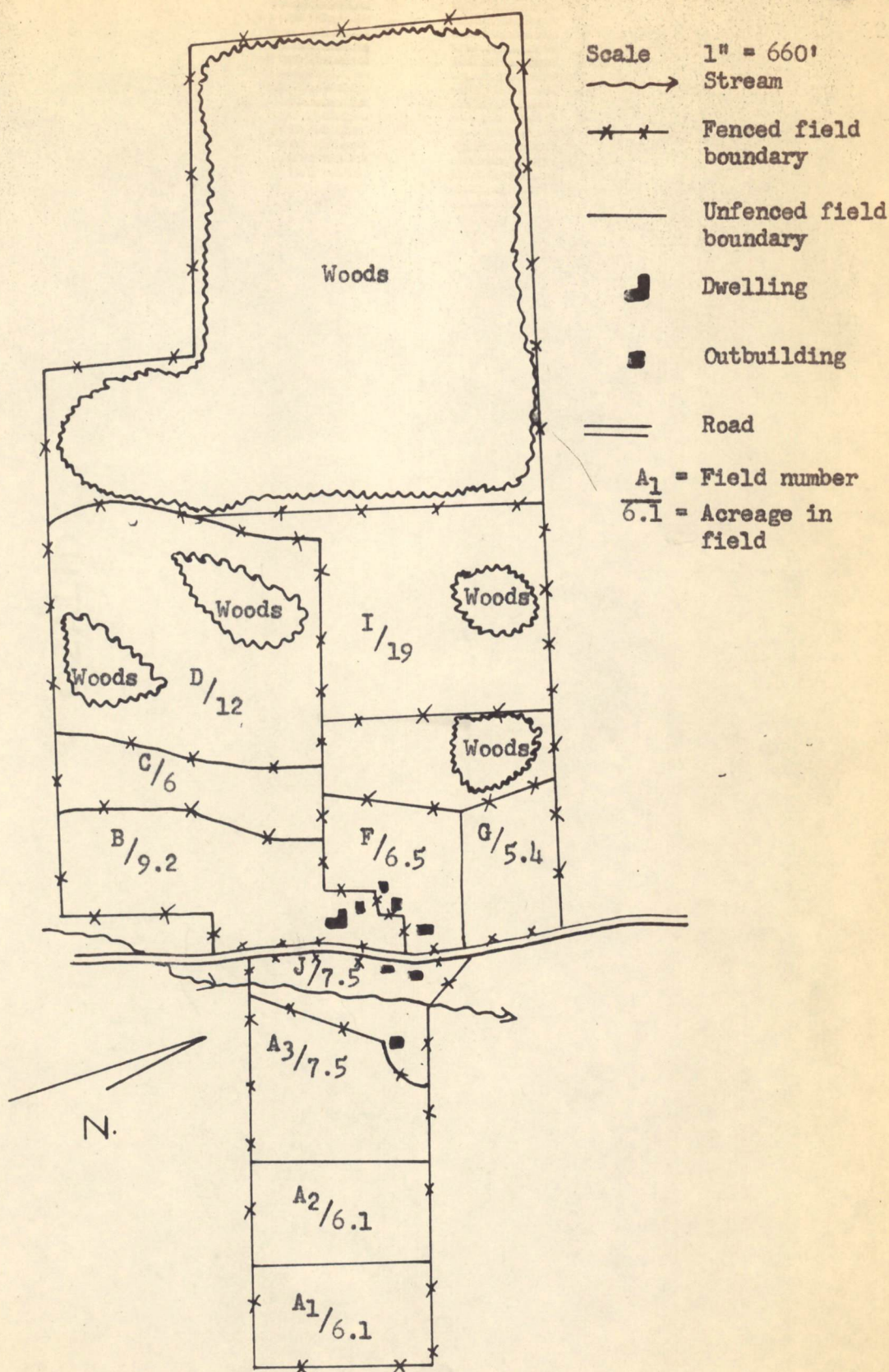


Figure 3. Present field layout on Dairy Farm A, Bradley County, Tennessee.

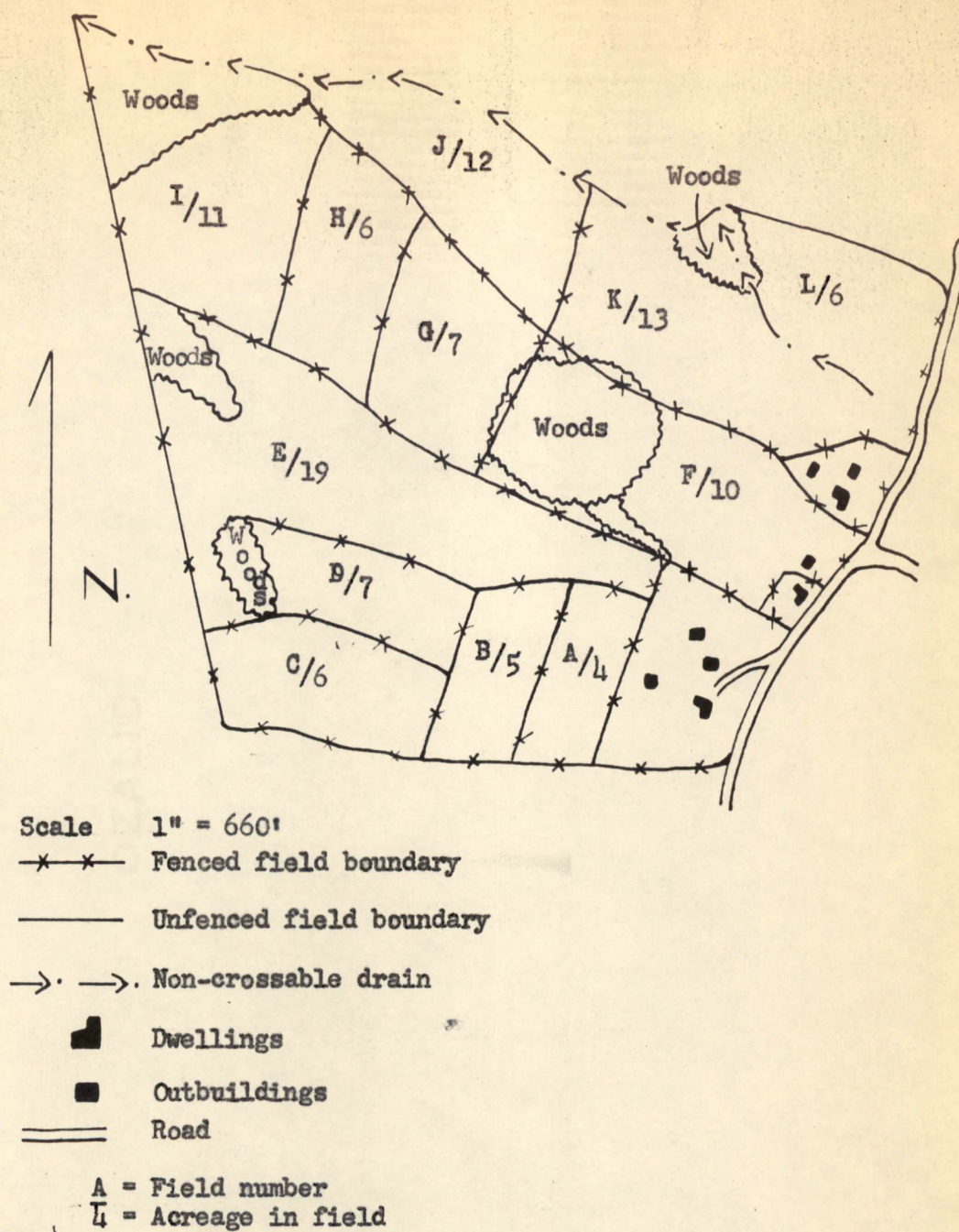


Figure 5. Present field layout of Dairy Farm B, Marion County, Tennessee.

CHAPTER III

BUDGET ANALYSES OF ALTERNATIVE SYSTEMS OF FARMING ON DAIRY FARM A AND DAIRY FARM B, BRADLEY AND MARION COUNTIES, TENNESSEE, RESPECTIVELY

As stated in Chapter II, these two farms were chosen since records were available and since the farm operations had been supervised for the past few years by Test Demonstration Agents.

The rotation of crops on the farms was not deemed necessary since it was assumed that the highest level of management practical would be used and that all crops would be placed on adapted soils. The field layouts found on the two farms followed the major soil separations as closely as practical; therefore, only one field boundary was changed. This change was made on Farm B in fields C and D (Table VIII).

The perennial crops were alfalfa and permanent pasture with an estimated life of 5.0 years and 10 years respectively. In order to maintain an adequate supply of these two crops, the various fields of alfalfa and permanent pasture were seeded in different years. In the year that a given field of alfalfa was to be reseeded, two cuttings were mowed and the seed bed prepared in late summer with the new seeding made in early fall. Weed control was accomplished through frequent cultivations during seed bed preparation. The seeding of permanent pasture was done during the same season of the year as was alfalfa.

Farm A

The present system of farming was that which prevailed on Farm A in 1954 as recorded in the farm record book (Tables II and III). The operator was not using all of his total available resources. Unused resources were evident in the fact that there was no double cropping where possible, and surplus acres of pasture and hay were available for the number of cattle carried.

Although 1.4 man-equivalents of labor were available, less than 1.0 man-equivalent was utilized during 1954 (Table IV).¹ No doubt the operator approached the goal of maximum satisfaction rather than maximum net returns. It was granted that a combination of the two ideals is the more desirable; however, the alternative systems were budget with maximization of net returns the first goal. It has been assumed under the alternative plans that the maximum number of days worked per man-equivalent per month would be 25.

The present cropping system on Farm A consisted of 19.7 acres of alfalfa grown on fields A_1 , A_2 , and A_3 . There were 9.0 acres of corn for grain on Field B with 0.2 acre of field B and 0.2 acre of field J used for a garden. Oats for grain were grown on 9.3 acres on parts of fields F and G. The remainder of fields F and G which totaled 2.6 acres were in oats used for hay. Field H with 3.5 acres was used for lespedeza hay. Fields C, D, and I which totaled 37 acres were in improved pastures of

¹One man-equivalent equal to 300-ten hour days per year. Power used on Farm A was tractor.

orchard grass and ladino clover. In field J there was 7.1 acres of unimproved bluegrass pasture.²

The livestock enterprises found on Farm A are presented in Table III. The buildings found on Farm A at the time of this study consisted of one dwelling, an 11-stanchion barn, two general purpose barns, a tool shed, chicken house, brooder house, and block garage. All buildings were in good repair. There was sufficient farm machinery to carry on the present system of farming.

The fences were not in good repair; therefore, it was estimated that all fences would have to be replaced within five years. The cost of constructing the fences was budgeted at \$1,793. If constructed over a five year period the annual cash outlay for fencing would have been \$359 (Table V). On both Farm A and Farm B, the depreciation on the fences was based on an expected life of 15 years.

Alternative I, 60 Percent Forage

In Alternative I 60 percent of the available cropland was planned for forage crops. The production of less forage and more grain and/or other crops did not seem feasible without abandoning sound soil conservation practices which probably would result in lower long-time crop yields. The alternative cropping practices by fields are shown in Table I and can be related to the soils shown in Figure 2. There were, however, 35 acres double cropped which included a forage crop following a grain crop (Table II).

²For acreage in each field see Table I.

With 60 percent of the open land in forage crops there was a surplus of other crops produced which could not be consumed on the farm. For the total acres of each crop produced see Table II. Under alternative I, 22 cows, 7.0 heifers, 8.0 calves, 2.0 feeder hogs, and 150 hens were capable of being carried (Table III). This was 6.0 cows, 3.0 heifers, and 35 hens more than under the Present System.

Only 18 days of additional labor was needed with the majority needed in May and June for planting and hay harvesting. There was surplus labor in each month except May, June, July, September, and October with an excessive amount available in January, February, and December (Table IV). This available labor during these three months could have been used in cutting pulpwood from the 78.4 acres of woodland. Four man-hours of labor with a bow saw was required to cut one cord of pulpwood. Applying the available labor to this task in January, February, and December would yield 53 cords or added \$742 to the income (Appendix Table I).

The crops grown but not needed for feed on the farm were sold which accounted for the relatively high income of \$1,852 from crops. Under Alternative I the income from sale of livestock decreased by \$231; however, the sale of livestock products increased from \$5,447 to \$9,328 (Table V). Expenses under Alternative I were \$1,286 higher. This was accounted for by the increased row crop acreage. The family farm earnings were increased under Alternative I over the Present System by \$3,689 and the family labor and management earning by \$3,569. The earnings per hour of labor and management were increased over the Present System by 90 cents (Table V).

The cost of establishing Alternative I farming system was \$3,384 (Table VI). This amount was needed for fences, fertilizer spreader, and additional livestock.

Alternative II, 80 Percent Forage

Under Alternative II farming system 80 percent of the cropland was devoted to forage production plus 27.6 acres of forage on double cropped land. The cropping practices by fields under Alternative II are presented in Table I. The shift to 80 percent forage brought about a 6.0 acre decrease in corn for grain and an 8.8 acre decrease in oats for grain from that of 60 percent forage (Table II). The number of dairy cows, heifers, and calves carried on Alternative II increased over the number carried in Alternative I by 4.0, 1.0, and 2.0 respectively. The number of feeder hogs and hens remained the same (Table III).

Labor requirements were reduced per animal unit by the addition of a pit type milking barn. The cost of this barn was \$2,200. If the pit type barn was not added, a full time laborer would have been needed. The annual cost of this additional laborer would have been greater than the barn cost in the long-run. Part time laborers for milking chores are not available in the area. Hired labor was needed only in May, June, and August (Table IV). As in Alternative I there was sufficient labor available to harvest pulpwood from the woodland on the farm. This labor could have harvested 53 cords of pulpwood and added \$743 to the family income during January, February, and December.

The income from crops decreased by \$1,044 from that under Alternative I; however, the livestock income increased \$175 and the livestock products income increased by \$1,482. There was little change in the cash expenses and depreciation. Crop expenses decreased less than \$200 (Table V). Family labor and management earnings were increased by \$4,003 by this Alternative over the Present System and by \$434 over Alternative I, and the earnings per hour of labor and management were increased from 59 cents under the Present System to \$1.69 under Alternative II. This was also 20 cents more than under Alternative I (Table V).

The additional cost of establishing this farming system was \$7,462 (Table V). Needed for establishing Alternative II were fences, pit type milking barn, trench silo, silage wagons, fertilizer spreader and livestock.

Alternative III, 100 Percent Forage

Under Alternative III all the available cropland was seeded to forage crops. Alfalfa, corn silage, and orchard grass-ladino clover pastures were the only crops produced except for 8.8 acres of oats and vetch used as cover and winter pasture after the corn silage was harvested (Table II). The cropping practices by fields are presented in Table I.

With 100 percent of the cropland in forage crops, the number of animal units were increased to their maximum. This farming system made it possible to carry 33 dairy cows, 10 heifers, and 12 calves plus 25 hens for home egg consumption (Table III). The number of hens and feeder hogs were the only livestock enterprises reduced in number under Alternative III.

The labor requirement for Alternative III were lower than for any

of the other systems; however, the total labor needed each month fluctuated less than in the other systems (Table IV). This did not include hiring of the silage cut. The silage acreage was not sufficient to justify the purchase of a field chopper in Alternative III nor in Alternative II. The hiring of the field chopper did not reduce the total hours of labor required for either Alternative II or III.

Cash income under Alternative III was received from livestock and livestock products. The income and expenses were higher under this alternative than under any of the others. The family labor and management earnings were increased by \$2,610 over the Present System; however, they were \$959 less than in Alternative I and \$1,393 less than in Alternative II (Table V). The above difference was true if the operator purchased all his grain concentrates in the form of ready mixed and bagged dairy chow. If, however, the operator had purchased his grains and concentrates separately and had them ground and mixed by a portable custom mill on his farm he could have saved \$365 on purchased feeds (Table VII).

The cash cost of establishing Alternative III was highest of all alternative systems budgeted (Table VI). This was accounted for by additional animal units carried. Additional animal units required more barn space. This additional barn space was provided in the form of a pole type barn costing \$3,100. A pit type milking barn was also added for the same reason given under Alternative II page 30.

TABLE I

CROPPING SYSTEMS BY FIELDS FOR ALTERNATIVE SYSTEMS
OF FARMING ON FARM A, BRADLEY COUNTY, TENNESSEE

Field	Acres	Alternative I 60 Percent Forage	Alternative II 80 Percent Forage	Alternative III 100 Percent Forage
A ₁	6.1	Alfalfa	Alfalfa	Alfalfa
A ₂	6.1	Wheat (grain) Lespedeza (hay)	Wheat Lespedeza (hay)	Alfalfa
A ₃	7.5	Corn (grain) Oats and Vetch (cover and pasture)	Alfalfa	Alfalfa
B	9.2	Oats (grain) Lespedeza (hay)	Corn (grain) Oats and Vetch (cover and pasture)	Corn (silage) Oats and Vetch (cover and pasture)
C	6.0	Garden .4 Acre Orchard Grass and Ladino Clover (pasture)	Garden .4 Acre Orchard Grass and Ladino Clover (pasture)	Garden .4 Acre Orchard Grass and Ladino Clover (pasture)
D	12.0	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)
E		Farmstead		
F	6.5	Alfalfa	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)
G	5.4	Oats (grain) Lespedeza (hay)	Oats (grain) Lespedeza (hay)	Orchard Grass and Ladino Clover (pasture)
H	3.5	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)
I	19.0	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)
J	7.3	Corn (grain) Oats and Vetch (cover and pasture)	Corn (silage) Oats and Vetch (cover and pasture)	Orchard Grass and Ladino Clover (pasture)

TABLE II

PRESENT AND ALTERNATIVE CROPPING SYSTEMS ON
DAIRY FARM A, BRADLEY COUNTY, TENNESSEE

Item	Present System	Alternative I 60 Percent Forage	Alternative II 80 Percent Forage	Alternative III 100 Percent Forage
	Acres	Acres	Acres	Acres
Land and Crops ¹				
Corn (grain)	9.0	14.8	8.8	—
Wheat	—	6.1	6.1	—
Oats (grain)	9.3	14.2	5.4	—
Oats (hay)	2.0	—	—	—
Alfalfa	19.7	12.6	13.6	19.7
Lespedeza (hay)	3.5	(20.2)	(11.5)	—
Corn (silage)	—	—	7.3	8.8
Orchard Grass and Ladino Clover (pasture)	37.0	40.5	47.0	59.7
Oats and Vetch (winter pasture)	—	(14.8)	(16.1)	(8.8)
Oats and Rye Grass (winter pasture)	.6	—	—	—
Bluegrass and Clover (pasture)	7.1	—	—	—
Garden	.4	.4	.4	.4
Total	88.6	88.6	88.6	88.6
Double Cropped	—	(35.0)	(27.6)	(8.8)
Cropland				
Used	88.6	88.6	88.6	88.6
Idle	—	—	—	—
Improved Pastures	37.0*	40.5*	47.0*	52.4*
Unimproved Pastures	7.1*	—	—	—
Woodland	78.4	78.4	78.4	78.4
Farmstead, Roads, Fence Rows and Waste Land	8.0	8.0	8.0	8.0
Total Land	175.0	175.0	175.0	175.0

¹The requirements and production levels of the crops shown can be found in Appendix VI.

* Included under land and crops

TABLE III

PRESENT AND ALTERNATIVE LIVESTOCK SYSTEMS ON
DAIRY FARM A, BRADLEY COUNTY, TENNESSEE

Item	Present System	Alternative I 60 Percent Forage	Alternative II 80 Percent Forage	Alternative III 100 Percent Forage
	Numbers	Numbers	Numbers	Numbers
Livestock				
Dairy Cows	16	22	26	33
Heifers	4	7	8	10
Calves	17 ^a	8	10	12
Feeder Pigs	—	2	2	—
Beef Steer	1	—	—	—
Hens	115	150	150	25
Pullets (raised)	—	200	200	50

^aNumber born but not kept. No record on number kept.

TABLE IV

LABOR SUPPLY AVAILABLE, NEEDED AND HIRED BY MONTHS FOR ALTERNATIVE
SYSTEMS OF FARMING ON DAIRY FARM A, BRADLEY COUNTY, TENNESSEE

Month	Available Under I, II, and III	Alternative I		Alternative II		Alternative III	
		Needed ^a	Hired	Needed ^a	Hired	Needed ^a	Hired
	Days	Days	Days	Days	Days	Days	Days
January	31.0	23.7	—	23.7	—	27.0	—
February	31.0	24.2	—	24.3	—	27.6	—
March	31.0	29.2	—	28.3	—	22.8	—
April	31.0	26.2	—	25.7	—	20.2	—
May	31.0	33.8	2.7	34.1	3.1	30.7	—
June	31.0	43.3	12.3	39.6	8.6	30.4	—
July	31.0	30.9	—	30.9	—	28.2	—
August	31.0	28.8	—	33.3	2.3	32.3	1.2
September	31.0	34.0	3.0	31.2	—	25.6	—
October	31.0	30.7	—	26.3	—	22.1	—
November	31.0	25.2	—	23.5	—	25.8	—
December	31.0	23.7	—	23.8	—	27.1	—
Total	372.0	353.7	18.0	344.7	14.0	319.8	1.2

^aSee Appendix C, Table IV for individual enterprise labor requirements.

TABLE V

FINANCIAL SUMMARY OF PRESENT AND ALTERNATIVE SYSTEMS
OF DAIRY FARMING ON FARM A, BRADLEY COUNTY,
TENNESSEE (1949-1952 AVERAGE PRICE LEVEL^a)

Item	Present System	Alternative I 60 Percent Forage	Alternative II 80 Percent Forage	Alternative III 100 Percent Forage
	Dollars	Dollars	Dollars	Dollars
Cash Income				
Crop	145	1,852	808	—
Livestock	1,012	781	956	1,246
Livestock Products	5,447	9,328	10,810	12,332
Miscellaneous	382	—	—	—
Total	6,986	11,961	12,106	13,578
Value of Products Used in the Home	350	350	350	350
Total Income	7,336	12,311	12,924	13,928
Cash Expenses and Depreciation				
Crops	1,623	2,509	2,371	2,050
Livestock	1,814	1,547	1,549	3,334
Miscellaneous ^b	459	714	693	968
Depreciation	437	849	983	1,317
Total Expenses	4,333	5,619	5,596	7,669
Family Farm Earnings	3,003	6,692	7,328	6,259
Interest on Investment ^c	1,434	1,564	1,756	2,080
Family Labor and Management Earnings	1,569	5,138	5,572	4,179
Hours of Family Labor	2,650	3,455	3,305	3,183
Earnings per Hour of Labor and Management	.59	1.49	1.69	1.31

TABLE V

FINANCIAL SUMMARY OF PRESENT AND ALTERNATIVE SYSTEMS
 OF DAIRY FARMING ON FARM A, BRADLEY COUNTY,
 TENNESSEE (1949-1952 AVERAGE PRICE LEVEL^a)
 (Continued)

Item	Present System	Alternative I 60 Percent Forage	Alternative II 80 Percent Forage	Alternative III 100 Percent Forage
	Dollars	Dollars	Dollars	Dollars
Capital Investment				
Real Estate	18,440	20,233	23,010	26,127
Machinery and Equipment	4,659	4,780	5,348	7,748
Livestock	3,025	4,444	5,228	6,466
Feed and Supplies	2,564	1,814	1,537	1,254
Total	28,688	31,271	35,123	41,595

^aSee Appendix C, Tables I, II, and III.

^bMiscellaneous expenses were computed at 18 percent of the total expenses and depreciation.

^cInterest on investment was computed at 5 percent of the total capital investment.

TABLE VI

CASH COST OF ESTABLISHING ALTERNATIVE FARMING SYSTEMS
ON DAIRY FARM A, BRADLEY COUNTY, TENNESSEE
(1949-1952 AVERAGE PRICE LEVEL)

	Alternative I	Alternative II	Alternative III
	Dollars	Dollars	Dollars
Real Estate			
Buildings	--	2,777	5,894
Fences ^a	1,793	1,793	1,793
Machinery	172	689	3,089
Livestock	1,419	2,203	3,441
Total	3,384	7,462	14,217

^aTotal fence construction spread over a five year period or an annual investment of \$359.

TABLE VII

AMOUNT AND COST OF GRAINS AND CONCENTRATES FOR ALTERNATIVE III
 FARMING SYSTEM ON DAIRY FARM A, BRADLEY COUNTY,
 TENNESSEE (1949-1952 AVERAGE PRICE LEVEL)

	Amount of Feed	Ready Mixed Feeds	Grains Purchased and Custom Mixed
	Pounds	Dollars	Dollars
Dairy Ration 18 percent	61,875	2,660	—
Corn	18,480	—	693
Oats	24,816	—	868
Cottonseed Meal	12,375	—	538
Salt	550	—	12
Crushing and Mixing Cost (including molasses)		—	184
Total		2,660	2,295

Farm B

The Present System of operation on Farm B was that which prevailed during 1954 as recorded in the farm record book. It was indicated from the high number of hours of family labor and the low earnings per hour of labor and management that improvements were badly needed in the farm organization. It was possible that the son's father who is in his mid sixties recorded hours of labor that were not fully productive.

The cropping practices under the Present System showed only 6.5 acres of Alfalfa located in field B and a part of field D. There were 25.5 acres of oats for grain in fields G and K and part of field D. Field H with 6.0 acres was used for a mixed grain crop of oats and barley. Lespedeza for hay was produced on fields H and K for a total of 18 acres. There were 6.0 acres of fescue pasture on field C and 6.0 acres of oats and crimson clover pasture on field L. On field J there was 12 acres of sudan grass pasture. Improved permanent pastures totaled 44 acres and were located on fields A, E, F and I. For field layout on Farm B see Figure 5.

The livestock enterprises found on Farm B are presented in Table X. The buildings found on this farm included the father's dwelling, son's dwelling, and an Aunt's dwelling which was not considered in alternatives budgeted. There were two general purpose barns, one granary, a tool shed, an 11-stanchion milking barn of block construction, and a chicken house. All the buildings were in a reasonably good repair. The son's dwelling was new.

All the productive resources were not fully utilized as was indicated by the small dairy herd compared to the acres of cropland available (Table IX and X). Although all soil resources had not been fully utilized, the field layouts needed little alteration to conform to the major soil separations. The above can be confirmed by comparing soil separations (Figure 4) with field layout (Figure 5). The fences were in a poor state of repair, and it was deemed necessary to rebuild the fences completely within a five year period. This made for an annual capital outlay of \$388 or \$1,939 at the end of the five year period (Table XIII).

Alternative I, 60 Percent Forage

With 60 percent of the cropland in forage crops it was possible to carry 25 cows, 7.0 heifers, and 8.0 calves. There was also sufficient feedstuffs grown under Alternative I to keep 2.0 brood sows and feed out 30 pigs to market weight (Table X). This was an increase over the Present System in dairy cows, brood sows, and pigs by 5.0, 1.0, and 26 respectively. The number of heifers and calves were reduced by 3.0 and 1.0 respectively. An increase in alfalfa acreage, improved pasture acreage, and the addition of corn for grain made possible the additional animal units over that of the Present System. See Table VIII for cropping system by fields under Alternative I.

There were 37.5 days of family labor available each month or 1.5 man-equivalents annually under all three alternatives budgeted.³ June and

³One man-equivalent was equal to 300-ten hour days per year. Power used on Farm B was supplied by tractor.

September were the only months that required hired labor under this alternative. In most months there was some surplus labor (Table XI).

Under Alternative I the cash income from crops increased over that of the Present System by \$2,173. There was also an increase of \$1,408 from livestock and \$3,392 from livestock products. Expenses for Alternative I were less than \$1,000 higher than the Present System (Table XII). The family labor and management earnings were increased by \$5,639 over the Present System, and the earnings per hour of labor and management rose from 15 cents to \$1.70 (Table XII).

Additional capital was needed for fences, a pick-up baler, and livestock. The pick-up baler which cost \$1,860 was justified since there was a combined total of 86 acres over which the baler ran annually.⁴ A total capital outlay of \$4,071 was needed for the establishment of Alternative I (Table XIII).

Alternative II, 80 Percent Forage

Through an increase in forage production, it was possible to add 7.0 cows over the number carried under Alternative I. It was also possible to add 2.0 heifers and 3.0 calves over that of Alternative I (Tables IX and X). For cropping practices by fields see Table VIII.

Under Alternative II the silage was harvested by custom workers. This did not reduce the number of hours of family labor required.

⁴It was noted from, Tennessee Farm and Home Development Handbook, page 72 that approximately 80 acres were needed to fully utilize a pick-up baler.

The cash income from crops in Alternative II was reduced \$1,563 from that in Alternative I and the cash income from livestock was reduced \$930. The income from livestock products increased over that of Alternative I by \$2,322; however, the total cash income was \$171 less than in Alternative I. Total cash expenses and depreciation increase under Alternative II over that of Alternative I by \$154 (Table XII). The family labor and management earnings were lower by \$658 than that of Alternative I; however, they were \$4,981 higher than under the Present System. The earnings per hour of labor and management were \$1.64 or \$1.49 higher than under the Present System of operation but they were 6.0 cents less than in Alternative I (Table XII).

Additional capital was needed for fences, trench silo, pole type barn, pit type milk barn, pick-up baler, livestock, and silage wagons. This called for an outlay of \$11,258 (Table XIII). The trench silo cost \$648; the pole barn, \$2,600; the pit type milk barn, \$2,200; and the pick-up baler, \$1,860.

Alternative III, 100 Percent Forage

When all available cropland was seeded to forage crops, the number of dairy cows carried was increased to 40 as compared to 20 under the Present System, 25 under Alternative I, and 32 under Alternative II. The number of heifers and calves carried also increased over Alternatives I and II. All cropland was devoted either to alfalfa, corn silage, or pasture with oats and crimson clover as a winter cover and winter pasture. For cropping practices by fields see Table VIII.

The family labor and management earnings were increased by \$339 over those in Alternative II; however, they were \$319 lower than under Alternative I (Table XII). If, however, the grains and concentrates fed the milk cows had been purchased separately and custom mixed on the farm, the family labor and management earnings would have exceeded those under Alternative I by \$120 and those under Alternative II by \$778. See Table XIV for amount and cost of feedstuffs under Alternative III.

When ready mixed dairy ration was purchased the earnings per hour of labor and management was \$1.59 or 11 cents less than under Alternative I and 5.0 cents less than under Alternative II. When the grains and concentrates were purchased separately the earnings per hour of labor and management exceeded those in Alternative II by 7.0 cents.

Additional capital in the amount of \$15,521 was needed to establish Alternative III (Table XIII). This amount included such items as fences, trench silo, pole barn, pit type milk barn, pick-up baler, silage wagons, livestock, and pipeline milkers with bulk tank. For equipment cost see Appendix Table III. The trench silo cost \$648; the pole barn, \$3,640; and the pit type milk barn, \$2,200. The pit type milk barn and pipeline milkers with bulk tank were added as labor saving devices.⁵ The capital investment was reduced some over what it might have been through the sale of equipment on hand that was of no value under a system of 100 percent forage.

When all three alternative systems were studied, it was evident that the highest earnings per hour of labor and management were possible under

⁵For discussion on the need of these added facilities see page 30.

Alternative III where the grains and concentrates were purchased separately. The difference was not great and had the owner preferred fewer hours of labor rather than a small additional income he would have operated under Alternative I. Had the operator desired even more freedom and \$658 less earnings, he would have operated under Alternative II where the total days worked were 26.8 less annually than under Alternative I.

Increased Milk Production

In this study the milk production per cow was estimated at 7,500 pounds annually of 4 percent milk. This figure was considerably above the state average; however, this production was deemed essential if the farms budgeted were to be operated efficiently. Seventy-five hundred pounds annually is, however, below the production reached in more recent research conducted by various experiment stations.

In a paper by C. R. Hoglund the milk production response to different levels of feeding indicated that milk production with the feeding of poorer types of roughage and approximately the same amount of grain as used in this study would produce 8,300 pounds of milk annually.¹ With excellent roughage (forage) good cows produced 10,000 pounds on approximately 1,800 pounds of grain (Figure 6).

These facts were presented to show that production much above the State average was not excessive when compared to productions actually obtained.

¹C. R. Hoglund, Economics in Producing and Feeding Roughage and Grain to Dairy Cows, Agricultural Economics No. 620 (Michigan State, June, 1955), p. 14.

TABLE VIII

CROPPING SYSTEMS BY FIELDS FOR ALTERNATIVE SYSTEMS
OF FARMING ON FARM B, MARION COUNTY, TENNESSEE

Field	Acres	Alternative I 60 Percent Forage	Alternative II 80 Percent Forage	Alternative III 100 Percent Forage
A	4	Corn (grain) Oats and Vetch (cover and pasture)	Oats (grain) Lespedeza (hay)	Alfalfa
B	5	Wheat (grain) Lespedeza (hay)	Alfalfa	Alfalfa
C ^a	6	Wheat (grain) Lespedeza (hay)	Orchard Grass and Ladino Clover (pasture)	
D ^a	7	Alfalfa	Alfalfa	Alfalfa
E	19	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)
F	10	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)	Orchard Grass Ladino Clover (pasture)
G	7	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)
H	6	Alfalfa	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)
I	11	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)	Orchard Grass and Ladino Clover (pasture)
J	12	Oats (grain) Lespedeza (hay)	Corn (silage) Oats and Crimson Clover (cover and pasture)	Corn (silage) Oats and Crimson Clover (cover and pasture)
K	13	Oats (grain) Lespedeza (hay)	Oats (grain) Lespedeza (hay)	Orchard Grass and Ladino Clover (pasture)
L	6	Corn (grain) Oats and Vetch (cover and pasture)	Corn (grain) Oats and Vetch (cover and pasture)	Orchard Grass and Ladino Clover (pasture)

^aField C boundary on South side changed in alternative systems so that acreage in field C was made 5 acres and acreage in field D was increased to 8 acres instead of 7 acres. This was the only field boundary changed.

TABLE IX

PRESENT AND ALTERNATIVE CROPPING SYSTEMS ON
DAIRY FARM B, MARION COUNTY, TENNESSEE

Item	Present System	Alternative I 60 Percent Forage	Alternative II 80 Percent Forage	Alternative III 100 Percent Forage
	Acres	Acres	Acres	Acres
Land and Crops				
Corn (grain)	—	10.0	6.0	—
Wheat	—	10.0	—	—
Oats	31.5	25.0	17.0	—
Alfalfa	6.5	14.0	13.0	22.0
Lespedeza (hay)	(19.0)	(35.0)	(17.0)	—
Sudan	12.0	—	—	—
Corn (silage)	—	—	12.0	12.0
Fescue	6.0	—	—	—
Orchard Grass and Ladino Clover (pasture)	44.0	47.0	58.0	72.0
Oats and Crimson Clover (winter pasture)	6.0	—	(12.0)	(12.0)
Oats and Vetch (winter pasture)	—	(10.0)	(6.0)	—
Garden	1.0	1.0	1.0	1.0
Total	107.0	107.0	107.0	107.0
Double Cropped	(19.0)	(45.0)	(35.0)	(12.0)
Cropland				
Used	107.0	107.0	107.0	107.0
Idle	—	—	—	—
Improved Pastures	44.0 ^a	47.0 ^a	58.0 ^a	72.0 ^a
Woodland	11.0	11.0	11.0	11.0
Farmstead, Roads, Fence Rows, and Waste Land	5.0	5.0	5.0	5.0
Total Land	123.0	123.0	123.0	123.0

^aIncluded under land and crops.

TABLE X

PRESENT AND ALTERNATIVE LIVESTOCK SYSTEMS ON
DAIRY FARM B, MARION COUNTY, TENNESSEE

Item	Present System	Alternative I 60 Percent Forage	Alternative II 80 Percent Forage	Alternative III 100 Percent Forage
	Numbers	Numbers	Numbers	Numbers
Livestock				
Dairy Cows	20	25	32	40
Heifers	10	7	9	10
Calves	9	8	11	12
Bulls	1	—	—	—
Mules	2	—	—	—
Brood Sows	1	2	—	—
Pigs	4	30	2	2
Hens	20	25	25	25
Chicks Raised	—	50	50	50

TABLE XI

LABOR SUPPLY AVAILABLE, NEEDED AND HIRED BY MONTHS FOR ALTERNATIVE
SYSTEMS OF FARMING ON DAIRY FARM B, MARION COUNTY, TENNESSEE

Month	Available Under I, II, and III	Alternative I		Alternative II		Alternative III	
		Needed ^a	Hired	Needed ^a	Hired	Needed ^a	Hired
	Days	Days	Days	Days	Days	Days	Days
January	37.5	28.8	—	25.8	—	31.5	—
February	37.5	29.4	—	26.8	—	32.3	—
March	37.5	27.7	—	23.2	—	26.5	—
April	37.5	23.9	—	21.2	—	24.0	—
May	37.5	31.0	—	29.7	—	36.1	—
June	37.5	50.2	12.7	39.2	—	36.1	—
July	37.5	30.0	—	27.7	—	33.2	—
August	37.5	33.5	—	37.4	—	38.5	—
September	37.5	44.0	6.5	34.3	—	30.1	—
October	37.5	33.6	—	27.2	—	25.5	—
November	37.5	29.4	—	25.7	—	30.1	—
December	37.5	28.8	—	26.0	—	31.6	—
Total	450.0	390.3	19.2	344.2	—	375.5	—

^aSee Appendix C, Table IV for individual enterprise labor requirements.

TABLE XII

FINANCIAL SUMMARY OF PRESENT AND ALTERNATIVE SYSTEMS
OF DAIRY FARMING ON FARM B, MARION COUNTY,
TENNESSEE (1949-1952 AVERAGE PRICE LEVEL^a)

Item	Present System	Alternative I 60 Percent Forage	Alternative II 80 Percent Forage	Alternative III 100 Percent Forage
	Dollars	Dollars	Dollars	Dollars
Cash Income				
Crop	—	2,173	610	—
Livestock	544	1,952	1,022	1,279
Livestock Products	5,876	9,268	11,590	14,825
Miscellaneous	120	—	—	714
Total	6,540	13,393	13,222	16,818
Value of Products Used in the Home	700	700	700	700
Total Income	7,240	14,093	13,922	17,518
Cash Expenses and Depreciation				
Crop	1,751	3,029	2,905	2,389
Livestock	1,765	860	906	3,956
Miscellaneous ^b	335	889	912	1,386
Depreciation	977	1,049	1,258	1,355
Total Expenses	4,828	5,827	5,981	9,086
Family Farm Earnings	2,412	8,266	7,941	8,432
Interest on Investment ^c	1,754	1,969	2,302	2,454

TABLE XII

FINANCIAL SUMMARY OF PRESENT AND ALTERNATIVE SYSTEMS
OF DAIRY FARMING ON FARM A, BRADLEY COUNTY,
TENNESSEE (1949-1952 AVERAGE PRICE LEVEL^a)
(Continued)

Item	Present System	Alternative I 60 Percent Forage	Alternative II 80 Percent Forage	Alternative III 100 Percent Forage
	Dollars	Dollars	Dollars	Dollars
Family Labor and Management Earnings	658	6,297	5,639	5,978
Hours of Family Labor	4,500	3,711	3,443	3,755
Earnings per hour of Labor and Management	.15	1.70	1.64	1.59
Capital Investment				
Real Estate	23,763	25,702	31,150	32,190
Machinery and Equipment	4,485	6,345	6,862	7,832
Livestock	4,725	4,997	6,219	7,662
Feed and Supplies	2,110	2,334	1,807	1,394
Total	35,083	39,378	46,038	49,078

^aSee Appendix C, Tables, I, II, and III.

^bMiscellaneous expenses were computed at 18 percent of the total expenses and depreciation.

^cInterest on investment was computed at 5 percent of the total capital investment.

TABLE XIII

CASH COST OF ESTABLISHING ALTERNATIVE FARMING SYSTEMS
ON DAIRY FARM B, MARION COUNTY, TENNESSEE
(1949-1952 AVERAGE PRICE LEVEL)

	Alternative I	Alternative II	Alternative III
	Dollars	Dollars	Dollars
Real Estate			
Buildings	—	5,448	6,488
Fences ^a	1,939	1,939	1,939
Machinery	1,860	2,377	4,157
Livestock	272	1,494	2,937
Total	4,071	11,258	15,521

^aTotal fence construction spread over five year period or an annual investment of \$388.

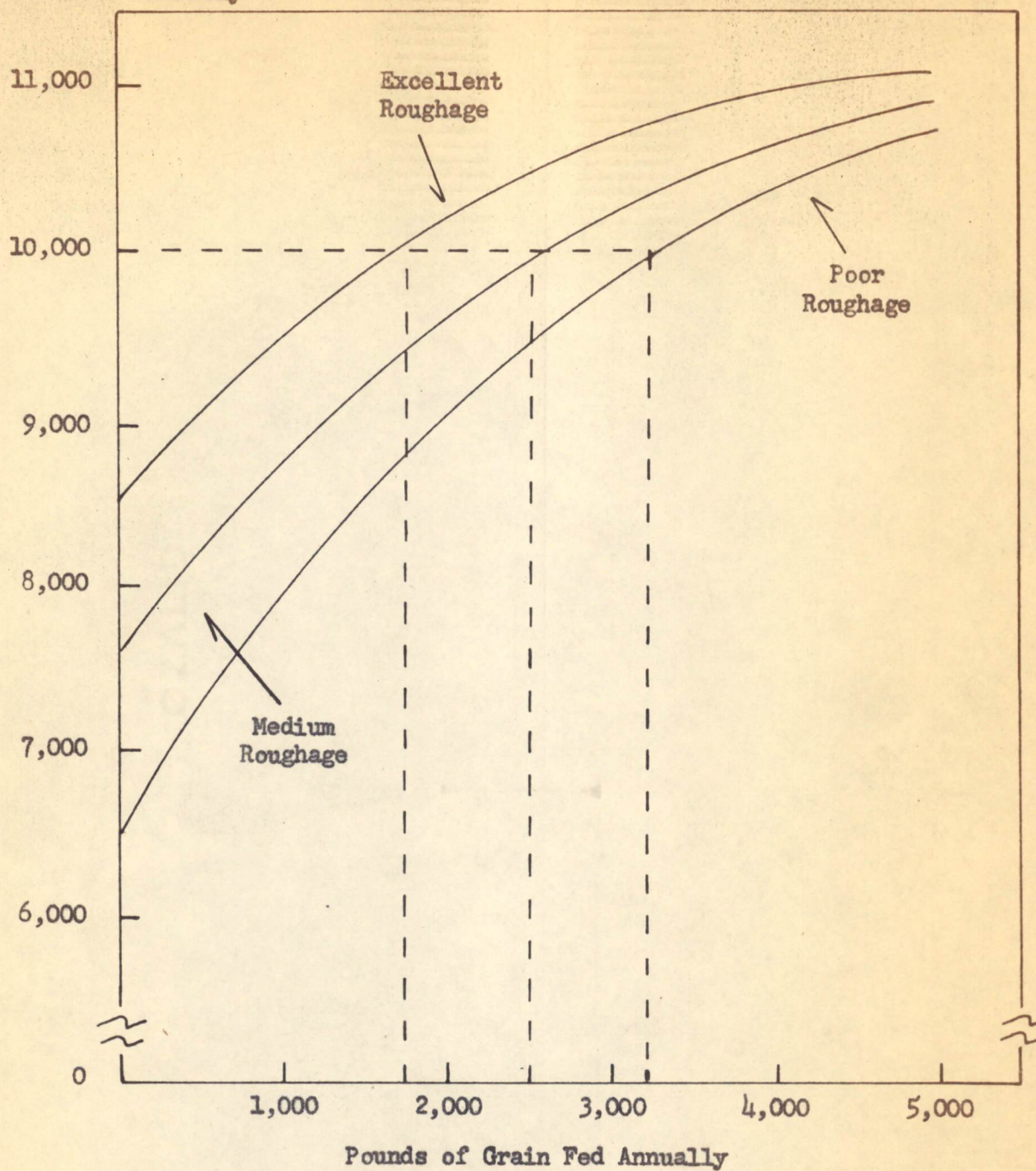
TABLE XIV

AMOUNT AND COST OF GRAINS AND CONCENTRATES FOR ALTERNATIVE III
 FARMING SYSTEM ON DAIRY FARM B, MARION COUNTY,
 TENNESSEE (1949-1952 AVERAGE PRICE LEVEL)

	Amount of Feed	Ready Mixed Feeds	Grain Purchased and Custom Mixed
	Pounds	Dollars	Dollars
Dairy Ration 18 percent	75,000	3,225	--
Corn	22,400	--	840
Oats	30,080	--	1,053
Cottonseed Meal	15,000	--	653
Salt	670	--	14
Crushing and Mixing Cost (including molasses)	--	--	226
Total		3,225	2,786

Pounds 3.5 Milk
Produced Annually

55



Source: Economics in Producing and Feeding Roughage and Grain to Dairy Cows.
C. R. Hoglund. Agricultural Economics No. 620, June 1955, Michigan
State University, p. 15.

Figure 6. Milk production response to different levels of grain feeding when excellent, medium, and poor quality roughage are fed to good cows.

CHAPTER IV

SUMMARY AND CONCLUSION

It was evident from the alternative systems of farming budgeted in this study that the best alternative on Farm A was not necessarily the best on Farm B although the percent of cropland in forage was the same. Even though Farm B was approximately 18 acres larger than Farm A, this was sufficient to carry from 3.0 to 7.0 more milk cows under the alternative systems on Farm B. These extra acres on Farm B also made possible greater acreages of grains which were not needed for feed consumption on the farm thus making for a greater income from the sale of crops under Alternatives I and II. This explains in part the greater earnings for Farm B under Alternative I than under Alternative II; whereas, on Farm A Alternative II provided greater earnings than Alternative I (Table V and XII). The labor requirements for the alternative systems on both farms as found in Tables IV and XI were important in measuring the degree of satisfaction desired.

Alternative I, 60 percent forage, required a greater number of hours of family labor than did all other alternatives on either farm except under Alternative III for Farm B.

On Farm A Alternative II, 80 percent forage, was found to yield higher family labor and management earnings and higher earnings per hour of labor and management than did the Present System, Alternative I, or Alternative III. The relatively high labor requirements coupled with the lower number of animal units carried tended to make Alternative I less

desirable than Alternative II. Although the labor requirements were lowest for Alternative III, the much higher capital requirements made this plan even less desirable.

The capital investment needed to establish the various alternatives on Farm A and Farm B, were given careful consideration. The high additional capital needed on both farms under Alternatives II and III was used mostly for labor saving conveniences such as the pit type milk parlor, the pipeline milker and bulk tank. Had these not been added, the available labor supply would not have been sufficient. The cost of these facilities was less than adding labor over the long run.

As the farms were shifted to more and more forage crops and less grain crops, the capital requirement was the major problem area. With adequate labor and unlimited capital, the study showed that on Farm B Alternative III was the more profitable if grains and concentrates were purchased separately and mixed on the farm. On farms the size of Farm A it was found that Alternative II with 80 percent of the cropland in forage was more profitable than either Alternative I or Alternative III. It was evident that the 18 additional acres on Farm B were significant in the extent to which the farming system could move more and more toward increased forage production.

As shifts were made toward higher acreages of forage crops, it was important that the livestock program be properly adjusted to utilize this forage most efficiently. In a study made by Karl A. Vary it was found that net incomes were increased only on the dairy program as a shift was

made to greater acreages in forage.¹

From the study made of the two Test Demonstration farms it was concluded that dairy farmers should re-evaluate their present farming systems so as to ascertain the profitability of decreasing or increasing their acreages of forage based on their size of farm, labor supply, soil capacities, and available capital.

¹ Karl A. Vary, Economics of Grassland Farming, Special Bulletin 391 (Michigan State College Agricultural Experiment Station, 1954), p. 27

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APPENDIX

APPENDIX A

CHARACTERISTICS OF THE SOIL GROUPS FOUND ON FARMS A AND B,
BRADLEY AND MARION COUNTIES RESPECTIVELY¹

Productivity of the soils found on the two farms studied were based on the capacities of the soil groups as described in soil survey publications. The following Soil Series were found on Farm A and B.

Emory. A colluvial soil derived largely from Decatur and Dewey with brown surface and subsoil. Internal drainage is good.

Lindside. A bottom soil with grayish brown surface soil and mottled subsoil. The internal drainage is moderate.

Greendale. A colluvial soil derived largely from Fullerton and Clarksville. This series has a gray surface soil and yellow subsoil with good to moderate internal drainage.

Staser. A bottom soil with grayish brown surface soil and yellowish brown subsoil. Drainage is good.

Hamblen. Bottom soil with brownish gray surface and mottled subsoil having moderate to slow internal drainage.

Hermitage. Colluvial soil of mature Emory having brown surface and red subsoil. Internal drainage is good.

Decatur. An upland soil which is rolling to level with little chert. The surface soil is brown with dark red subsoil and good internal drainage.

¹Land Use Planning, Subject Matter Mimeo 25 (Department of Agricultural Education, University of Tennessee, Knoxville, Tennessee, 1950).

Etowah. A terrace soil found on low terraces and much like Dewey. Has a grayish brown surface and red subsoil with good internal drainage.

Cumberland. A terrace soil found on high terraces with brown surface and dark red subsoil. The internal drainage is good.

Fullerton. An upland soil with chert and found on ridges. It has a brownish gray surface and yellowish red subsoil with good internal drainage.

Sequatchie. Low terrace soil with grayish brown surface and yellowish brown subsoil. The internal drainage is good.

Sequoia. An upland soil from interbedded limestone and shale generally rolling. It has a surface of brownish gray and subsoil of reddish yellow with good to moderate internal drainage.

Leadvale. A colluvial soil from Upshur Series which is from purple or red shale. Leadvale has brownish gray surface and grayish yellow subsoil with moderate internal drainage.

Whitwell. A low terrace soil with light brown surface and brownish yellow subsoil. Internal drainage is moderate.

Capshaw. A high terrace soil with brownish gray surface and yellow subsoil having moderate internal drainage.

APPENDIX B

DEFINITIONS OF FARM MANAGEMENT AND OTHER TERMS

1. Farm - A unit of land the operation of which is planned and carried out by the owner-operator.
2. Farm Budget - Complete plans for the operation of a farm including the use of the land, the crop to be grown and livestock kept, the estimated production of each, the capital investment, receipts, expenses, and net income from said operation.
3. Value of Products Used in the Home - Estimated value of garden, eggs, milk, and other home grown products consumed by the family.
4. Capital Investment - Includes the estimated value of all real estate properties, machinery, equipment, livestock, and feed and supplies necessary for the operation of the farm.
5. Family Farm Earning - The total farm income less total cash expenses and depreciation.
6. Interest on Investment - 5 percent of total capital investment.
7. Family Labor and Management Earnings - The family farm earnings less the interest charged on investment.
8. Family Labor Used - The total number of hours worked by the operator and members of his family during the year.
9. Forage - As used in the study includes all hays, pastures, and silage.
10. Grains - Include all oats, wheat, and corn produced on the farm or purchased as feedstuffs.
11. Concentrates - Include cottonseed meal, high protein feeds, and all commercial feedstuffs purchased by the operator.

APPENDIX C

STATISTICAL TABLES

APPENDIX TABLE I

ESTIMATED PRICES RECEIVED FOR FARM PRODUCTS
SOLD, TENNESSEE, 1949-1952 AVERAGE PRICE^a

Item	Unit	Price per Unit
		Dollars
Alfalfa hay (baled)	Ton	34.00
Lespedeza hay (baled)	Ton	27.00
Corn	Bu.	1.51
Oats	Bu.	.95
Wheat	Bu.	2.08
Milk Grade A ^b	Cwt.	4.94
Veal Calves	Cwt.	28.30
Heifers (1-2 years)	Head	50.00
Milk Cows	Head	171.00
Hogs	Cwt.	18.75
Chicken (old hens)	Lb.	.22
Eggs	Doz.	.40
Cull Cows	Cwt.	13.00
Pulpwood	Cord	14.00

^aAgricultural Trends in Tennessee, Tennessee Department of Agriculture, Nashville, Tennessee, 1952.

^bMilk Price Data For the Proposed Chattanooga Marketing Area, Prepared by M. Lloyd Downen, Department of Agricultural Economics, University of Tennessee, May 1955. Average for 1950-1952 only.

APPENDIX TABLE II

ESTIMATED PRICES PAID BY FARMERS FOR ITEMS USED
IN PRODUCTION, TENNESSEE, 1949-1952 AVERAGE^a

Item	Unit	Price per Unit
		Dollars
Fertilizer and lime		
Lime ^b	Ton	4.00
6-12-12	Ton	58.95
3-12-12	Ton	47.60
0-0-50	Ton	57.75
0-20-0	Ton	31.80
0-48-0	Ton	63.80
32-0-0	Ton	96.25
3-9-18	Ton	50.65
Borax	Cwt.	4.00
Seed		
Hybrid Corn	Bu.	11.15
Korean Lespedeza	Lb.	.14
Orchard Grass	Lb.	.28
Ladino Clover	Lb.	1.55
Crimson Clover	Lb.	.16
Oats (not certified)	Bu.	1.60
Oats (certified)	Bu.	2.40
Wheat (certified)	Bu.	3.75
Alfalfa	Lb.	.53
Vetch	Lb.	.25
Feed		
Cottonseed Meal	Cwt.	4.35
Dairy Ration 18%	Cwt.	4.30
Calf Starter	Cwt.	6.45
Starter Mash	Cwt.	5.30
Growing Mash	Cwt.	5.05
Laying Mash	Cwt.	4.95
Laver Concentrate 32%	Cwt.	6.10
Corn	Cwt.	3.75
Oats	Cwt.	3.50
Oyster Shells	Cwt.	3.55
Scratch	Cwt.	4.00
40% Hog Chow Concentrate	Cwt.	6.20
Salt	Cwt.	2.10

APPENDIX TABLE II

ESTIMATED PRICES PAID BY FARMERS FOR ITEMS USED
IN PRODUCTION, TENNESSEE, 1949-1952 AVERAGE^a
(CONTINUED)

Item	Unit	Price per Unit
		Dollars
Miscellaneous		
Gasoline	Gal.	.24
Motor Oil	Gal.	1.30
Grease	Lb.	.24
Barbed Wire	80 Rd.	7.50
Post, Wood	Each	.60
Electric Fence		27.25
Breeding Fee	Per Cow	6.00
Wages, No Board No Room	Per Hour	.50

^aAdjusted by Average index of price paid by farmers for equipment used in United States. Agricultural Statistics, United States Department of Agriculture, United States Government Printing Office, 1954.

^bSpread by truck hauler.

APPENDIX TABLE III

ESTIMATED PRICES PAID BY FARMERS FOR FARM
EQUIPMENT, TENNESSEE, 1949-1952 AVERAGE^a

Kind ^b	Value
	Dollars
Fertilizer Spreader	172.00
Silage Wagon (two)	517.00
Baler, with engine	1860.00
Pipeline Milker and Bulk Tank	2400.00

^aAdjusted by Average index of price paid by farmers for equipment in United States. Agricultural Statistics, United States Department of Agriculture, Government Printing Office, 1954.

^bOnly equipment needed in addition to that found on farms listed below.

APPENDIX TABLE IV

ESTIMATED LABOR REQUIREMENTS PER ACRE FOR CROP PRODUCTION
AND PER HEAD FOR LIVESTOCK USING TRACTOR FOR POWER²

Enterprise	Total For Year	J	F	M	A	M	J	J	A	S	O	N	D
Man-hours Per Acre													
Corn													
Hand Picking 2 Row	15.9	—	.2	.2	1.4	2.9	1.7	.4	—	3.1	5.3	.7	—
Plow and Cultivate													
Wheat													
Combine 5 ft. (grain)	8.9	—	—	—	—	—	3.9	.2	—	3.4	1.2	.2	—
(straw)	3.2	—	—	—	—	—	3.0	.2	—	—	—	—	—
Oats													
Combine 5 ft. (grain)	8.1	—	—	.1	—	—	3.2	.4	.3	2.7	1.4	—	—
(straw)	2.7	—	—	—	—	—	2.4	.3	—	—	—	—	—
Alfalfa hay													
4 crops (High mechanization)	13.5	—	—	—	—	4.4	3.5	2.0	1.9	1.7	—	—	—
Establish in Fall	8.2	—	—	—	—	—	.3	2.6	3.5	1.8	—	—	—
Alfalfa Top Dressed in Spring													
1st cutting	4.8	—	—	—	—	5.8	1.4	—	—	.2	.4	—	—
Lespedeza Hay (Establish one crop)													
Machine establish and harvest	5.1	—	.1	.5	.2	—	—	—	2.2	2.1	—	—	—
Establish Permanent Pasture													
(in Fall)	6.2	—	—	—	—	—	.3	1.6	2.6	1.6	.2	.1	—
Maintain Permanent Pasture	1.8	—	.6	—	—	—	.6	.6	—	—	—	—	—

APPENDIX TABLE IV

ESTIMATED LABOR REQUIREMENTS PER ACRE FOR CROP PRODUCTION
AND PER HEAD FOR LIVESTOCK USING TRACTOR FOR POWER^a
(CONTINUED)

Enterprise	Total For Year	Man-hours Per Acre											
		J	F	M	A	M	J	J	A	S	O	N	D
Establish Cover Crops													
Alter corn	1.8	--	--	--	--	--	--	--	--	--	.9	.9	--
Corn Silage													
Harvested with Field													
Chopper	20.1	--	--	.2	1.2	2.8	2.8	.8	9.2	2.6	.4	--	.1
Dairy													
Under 20 cows per herd													
Ten cows or more per													
worker, over 1 single													
milking machine per													
worker (Stanchion													
parlor)	95	9.5	8.6	8.0	7.1	7.1	7.1	7.1	7.1	7.1	7.8	9.0	9.5
Twenty or more cows per													
herd, under 20 cows													
per worker, over 1													
single milking mach-													
ine per worker													
(Stanchion parlor)	95	9.5	8.6	8.0	7.1	7.1	7.1	7.1	7.1	7.1	7.8	9.0	9.5

APPENDIX TABLE IV

ESTIMATED LABOR REQUIREMENTS PER ACRE FOR CROP PRODUCTION
AND PER HEAD FOR LIVESTOCK USING TRACTOR FOR POWER^a
(CONTINUED)

Enterprise	Total For Year	J	F	M	A	M	J	J	A	S	O	N	D	Man-hours Per Acre
Dairy (Con't)														
Twenty or more cows per worker														
Over 1 single milking machine per worker (Stanchion parlor)	80	8.0	7.2	6.6	6.0	6.0	6.0	6.0	6.0	6.0	6.6	7.6	8.0	
Over 1 single milking machine per worker (Pit parlor)	65	6.5	5.8	5.3	4.9	4.9	4.9	4.9	4.9	4.9	5.3	6.2	6.5	
Young Dairy Cattle														
Under 10 animals - 1 person doing chores	30	5.4	5.1	2.7	.6	.6	.6	.6	.6	.9	2.4	5.1	5.4	
10 to 39 animals														
1 person doing chores	13	2.3	2.2	1.1	.3	.3	.3	.3	.3	.4	1.0	2.2	2.3	
Hogs														
2 sows kept (2 litters top hogs)	148	11.7	14.8	11.9	13.3	11.3	11.0	11.2	11.2	14.8	11.8	13.3	11.7	
Feeder Pigs bought														
One lot summer	.6	--	--	--	--	.2	.1	.1	.2	--	--	--	--	

APPENDIX TABLE IV

ESTIMATED LABOR REQUIREMENTS PER ACRE FOR CROP PRODUCTION AND PER HEAD FOR LIVESTOCK USING TRACTOR FOR POWER^a (CONTINUED)

Enterprise	Total For Year	J	F	M	A	M	J	J	A	S	O	N	D
Man-hours Per Acre													
Poultry													
50-150 hens (per 100)	208	17.7	16.0	17.7	17.0	17.7	17.7	17.0	17.7	17.7	17.0	17.7	17.1
Pullets raised (per 100)													
100-300	205	--	--	44.5	37.7	36.5	32.0	35.9	18.4	--	--	--	--

^aLabor Used in Production of Crops in Tennessee, 1955. W. P. Ranney, Farm Economics Circular Nos. 4 and 5, January 1956. The University of Tennessee, Agricultural Experiment Station and Agricultural Extension Service, Knoxville, Tennessee

and
Labor Used in Production of Livestock and Livestock Products in Tennessee, 1955. W. P. Ranney, Farm Economics Circular No. 6, January 1956. The University of Tennessee Agricultural Experiment Station and Agricultural Extension Service, Knoxville, Tennessee.

APPENDIX TABLE V

PRODUCTION RATES AND FEED REQUIREMENTS FOR LIVESTOCK
ALTERNATIVE SYSTEMS OF FARMING, EAST TENNESSEE^a

Production Per Head			Feed Requirements Per Head							
	Product	Amt.	Unit	Corn	Wheat	Oats	Commercial Feed ^b	Hay	Silage	Pasture
				Bu.	Bu.	Bu.	Lbs.	Ton	Ton	Acre
Milk Cow	(a)	75	Cwt.	10	—	23.5	375	1.75 ^c	4	1.5
	(b)	75	Cwt.	—	—	—	1875	1.75	4	1.5
Heifer	—	—	—	—	—	—	—	1.0	—	.75
Calf	—	—	—	4.5	—	10.5	300	.5	—	—
Brood Sow	—	—	—	—	—	—	—	—	—	—
(2 litters)	Pigs	15	Head	30	—	—	175 ^d	—	—	.33
Market Hogs	—	200 ^e	Lb.	12	—	—	60 ^d	—	—	.2
Hens ^f	(a)	21	Doz.	—	—	—	100	—	—	—
	(b)	21	Doz.	.3	.28	—	66	—	—	—
Pullets	—	—	—	—	—	—	—	—	—	—
Raised	—	—	—	—	—	—	25	—	—	—

^aInput-Output Relationships in Milk Production. Elmer, Jensen and others. United States Department of Agriculture Technical Bulletin No. 815, Washington D. C., May 1942. and Tennessee Farm and Home Development Handbook, S. P. 86, Agricultural Extension Service, University of Tennessee, 1955.

^bDairy Cow (a) cottonseed meal, Dairy Cow (b) 18 percent ration. Calf starter feed and milk substitute, Hens (a) Laying mash, Hens (b) Layer 32 percent concentrate; sows and market hogs 40 percent concentrate.

^cWith no silage 3.5 tons.

^eProduction above weight when weaned.

^d40 percent supplement

^fBased on 70 percent production

APPENDIX TABLE VI

REQUIREMENTS AND PRODUCTION LEVELS OF CROPS PROPOSED
FOR ALTERNATIVE FARMING SYSTEMS BUDGETED

Crops	Seeding Rate of Acre	Fertilizer Analysis	Fertilization Rate Per Acre	Yield Per Acre
	Unit	N-P-K	Pounds	Unit
Corn (grain)	1/7 bu.	32-0-0	150	75 bu.
		3-12-12	500	
Corn (silage)	1/4 bu.	32-0-0	150	12 tons
		3-12-12	500	
Wheat	1 1/2 bu.	32-0-0	100	30 bu.
		6-12-12	400	
Oats (certified seed)	2 bu.	32-0-0	100	70 bu.
		6-12-12	400	
Lespedeza (hay)	25 lbs.	Seeded in Small Grain		1.75 tons
Alfalfa: Establish	20 lbs.	Borax	30	
		3-9-18	600	
Alfalfa Maintenance	—	0-20-0	100	3.75 tons
		0-0-50	300	
Oats and Vetch (cover)				
Oats	3 bu.	6-12-12	200	Cover and Pasture
Vetch	5 lbs.			
Oats and Crimson Clover (cover)				
Oats	3 bu.	6-12-12	200	Cover and Pasture
Crimson Clover	8 lbs.			
Pasture: Establish				
Orchard Grass	15 lbs.	6-12-12	600	
Ladino Clover	2 lbs.	0-48-0	100	Grazed at the rate of 1 1/2 acres per animal unit
Pasture: Maintenance	—	0-48-0	150	
		0-0-50	150	