ADJUSTMENT POSSIBILITIES IN ACREAGE EXPANSION, MECHANICAL HARVESTING, AND MECHANICAL HANDLING ON MICHIGAN TREE-FRUIT FARMS

by

DONALD JAY RICKS

AN ABSTRACT

Submitted to the College of Agriculture
Michigan State University of Agriculture and Applied Science
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Department of Agricultural Economics

1960

Approved 

AN ABSTRACT

Fruit production is the dominant enterprise on many western Michigan farms. Commercial fruit farmers in this area commonly operate farms with 20 to 60 acres of tree fruits. Changing economic and technological conditions have caused many of these farm operators to give serious consideration to the possibilities of increasing net income by expanding their fruit acreage. Recently developed techniques of mechanical harvesting with tree-shaking equipment and mechanical handling with fork-lift equipment and bulk boxes may have important implications regarding optimum farm size and amount of specialization.

In this study, an attempt was made to explore the changes in net income which will result from increasing the fruit acreage and adopting mechanical harvesting and handling on medium-sized farms which specialize in the production of tree fruits. In general, the findings suggest that operators of many medium-sized fruit farms can increase net incomes in the long run if moderate acreage increases are made in conjunction with the adoption of mechanical harvesting, mechanical handling, or both. This conclusion follows from comparative budgeting for five selected case farms, four of which have 20 to 60 acres of tree fruits per operator. Several additional farm situations were explored in the analysis of mechanical harvesting and mechanical handling.

The timing of income gains is an important consideration in evaluating the results. New plantings were the means of expanding the fruit acreage on the case farms because there appeared to be no suitable bearing orchards

which could be purchased for expansion purposes. To show the expected changes in net income over time from expanding the tree-fruit acreage in this manner, net incomes were estimated for the four five-year periods between 1960 and 1980. The average annual net incomes during each period were calculated by deducting operating expenses and new capital investments from gross receipts. In an attempt to simplify the comparison of net incomes for the 20-year period, future net incomes were discounted to the year 1960 at a rate of five percent per year.

Investments for mechanical harvesting and handling can be expected to return early benefits if sufficient bearing acreage is operated. Often, however, additional benefits will be realized after the bearing acreage has been expanded.

The analyses indicated that moderate acreage increases (40 to 90 percent) will permit increases in the present value of long-run average net incomes of $500 to $1,000 per year, for the case farms with 20 to 60 acres of fruit per operator. Additional gains of $320 to $2,150 per year were indicated by mechanizing the harvesting and handling operations on the expanded bearing acreages of these farms when the young orchards reach maturity. Thus, although acreage expansion, in itself, will lead to an increase in future net incomes, the adoption of mechanical harvesting and handling will permit larger gains from expanding acreage.

The analysis for the fifth and largest farm showed a decrease in net income from expansion alone. However, if mechanical harvesting and mechanical handling were adopted on an enlarged acreage, net income would increase after the young trees mature.

The general similarity of results from analyses for the five case farms indicates that operators of other medium-sized fruit farms in Michigan can probably expect net income gains from the same kinds of adjustments. Not all of them, however, will have as favorable conditions with regard to managerial capacity and other available resources for expansion as the four case farms with 20 to 60 acres of tree fruit.

ADJUSTMENT POSSIBILITIES IN ACREAGE EXPANSION, MECHANICAL HARVESTING, AND MECHANICAL HANDLING ON MICHIGAN TREE-FRUIT FARMS

by

DONALD JAY RICKS

A THESIS

Submitted to the College of Agriculture
Michigan State University of Agriculture and Applied Science
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Department of Agricultural Economics

1960

ACKNOWLEDGMENTS

A special word of appreciation is extended Dr. R. G. Wheeler, my major professor, for his careful and patient guidance throughout the study and preparation of this thesis. I have gained a great deal of knowledge throughout the study from working with Dr. Wheeler.

I wish to thank Mr. J. H. Levin and Mr. S. L. Hedden, United States Department of Agriculture, Agricultural Research Service, for their cooperation in supplying information to aid in this study. Credit is also due to Mr. A. E. Mitchell and R. P. Larsen, Department of Horticulture, for advice on certain phases of the study.

I also wish to express a special word of thanks to Dr. L. L. Boger for his valuable advice to do graduate work in Agricultural Economics and for the financial assistance which has aided my graduate training.

Gratitude is expressed to all the other faculty members and fellow graduate students in the Department of Agricultural Economics who have made my graduate study here enjoyable.

Credit is extended to Mrs. Sandy Rogers for typing the rough-draft manuscript and to Mrs. Kay Ralston for typing the final copy.

Finally, I wish to express gratitude to my father and my family for the experience in fruit farming which has led me to an interest in this type of study.

TABLE OF CONTENTS

LIST OF TABLES

APPENDIX TABLE Page

CHAPTER I

PROBLEM AND METHODS

Role of Farm Management Decision Making and Future Planning

Operators of fruit farms face special problems in performing their management role. Their management function however, is basically similar to that of other farm managers — each operator must continuously make many decisions regarding the organization and operation of his farm business.

The many decisions are necessary because of the ever-changing situations encountered in our dynamic society. Changes in weather, prices, technology, human institutions, and the interaction of individuals all require constant evaluation and the formation of accompanying decisions relating to business and family operations. It is the dynamic nature of society which creates the need for management. Various farm management workers have noted this need for management. The following quote from Farm Management by Black, Clawson, Sayre and Wilcox illustrates this point:

> The successful farm manager must ..... be constantly on his toes ready for the next move. He is not operating in a static world, but rather in a world of motion. He must keep current of change or the world will go off and leave him. If each growing season were exactly like every other season, if prices always remained the same, and if no other factors changed from year to year, the management problem would largely disappear.[1]

The decisions to be made call for the manager's best judgment in predicting future situations and the implications for the manager and

---

[1] J. D. Black, M. Clawson, C. R. Sayre, and W. W. Wilcox, Farm Management, (New York, MacMillan, 1947), pages 16-17.

his farm business. The future time period involved may be only a few days from the present or it may be 10 to 20 years. Planning for the future, however, is always the essence of decision making.

To make wise decisions regarding the future, the successful farm manager must keep well informed. Information regarding past conditions, present conditions and expected future conditions are all useful in making wise decisions. Information needed by farm managers is classified by G. L. Johnson into the following five major categories: "(1) price structures and changes; (2) production methods and responses (including weather effects); (3) prospective technological developments; (4) the behavior and capacities of people associated with farm businesses; and (5) the economic, political and social situations in which a farm business operates."[2] Accurate information regarding these categories can be used by each farm manager in analyzing his individual situation. The use of this information in a forward looking analytical process will enable the farm manager to make enlightened decisions regarding the future.

Farm management research workers and extension personnel can aid farm managers in making these decisions by providing timely and pertinent information. They can also analyze the best available information in an orderly decision-making framework to provide useful answers to important problems facing farmers. One method of doing this is to determine farm

---

[2]G. L. Johnson and C. B. Haver, Decision-Making Principles in Farm Management, Kentucky Agricultural Experiment Station Bulletin 593, (January 1953), pages 8-9.

management adjustment possibilities which may benefit certain groups of farmers in the future.

Problems Facing Michigan Fruit Farmers

Fruit farm operators, like other farm managers, are faced with rapidly changing economic and technological conditions. The problems are somewhat different, however, from those faced by managers of livestock and general crop operations. The extended production period required for fruit trees to reach full production gives rise to a number of important problems. The extremely perishable nature of fruit and the exceptionally large labor force required at harvest and other peak periods create special problems. The fruit farm operator is faced with many problems involving the use of complex technological operations and inputs. The importance of timeliness of certain operations such as spraying and harvesting also results in a number of problems for the fruit farm manager. In addition, problems arise from the large investments necessary for bearing orchards, land, buildings, and machinery.

Fruit farm operators face a considerable range of adjustment possibilities which may be explored in an attempt to aid farmers in making future decisions. Long-run organizational planning problems such as those concerning optimum size of business, enterprise combinations, and machinery resources offer one important area in which possible adjustments may be analyzed.

Changing economic and technological conditions have caused the operators of many of these farms to give serious consideration to expanding

their present fruit acreage. These farm managers may be aided in making decisions of this nature by answers to such questions as the following:

(1) Under what conditions, if any, regarding farm size, operation, and resources owned, can an increase in tree fruit acreage be expected to result in increased net income?

(2) If the acreage is expanded, and especially if it is expanded by planting young orchards, how much can net income be expected to change during future time periods?

(3) If acreage expansion is undertaken, can additional increases in net income be realized by making adjustments in the relative size of the different crop enterprises?

(4) How much will use of the latest mechanical harvesting methods affect the optimum size?

(5) How much, if any, will the optimum amount of specialization be affected by the adoption of these methods?

An attempt will be made in this study to suggest answers for these important questions facing tree fruit farmers.

Comparative Budgeting for Case Farms as an Analytical Tool

Nonlinear comparative budgeting of case farms is used as an analytical technique for testing alternative adjustment plans which seem to offer promise for improving future farm incomes. Many previous farm management studies have used budgeting as a method of analysis. One of the first studies in which budgeting of case farms was used as a method of analysis was entitled Planning the Farm Business on Three Dairy-Fruit Farms in

Massachusetts.[3] In this study, dairy farm adjustments were the main consideration; however, some accompanying budgeting regarding apple orchards was done.

Since this study was made, many other studies have used budgeting techniques to analyze case-farm situations. Wheeler and Black, for example, used comparative budgeting of case farms as a method of analysis in their planning study of New England dairy farms.[4] Nielson has made a comprehensive study of the uses of budgeting as a tool for analysis and farm planning, especially for use in farm management extension work.[5]

Budgeting of case farms was used by Barraclough and Gould in a forestry planning study entitled Economic Analysis of Farm Forest Operating Units.[6] The extended period of years involved in forest production creates problems which are similar, regarding the time aspect, to those encountered in raising fruit trees. Thus, the methodological approaches used in a forestry planning study of this nature are appropriate for handling the time period problems involved in a farm planning analysis for tree-fruit farms.

---

[3]R. L. Mighell, Planning the Farm Business on Three Dairy-Fruit Farms in Massachusetts, Massachusetts Agricultural Experiment Station Bulletin 275, (1931).

[4]R. G. Wheeler and J. D. Black, Planning for Successful Dairying in New England, (Cambridge, Harvard Press, 1955).

[5]J. M. Nielson, Application of the Budget Method in Farm Planning, (Unpublished Ph.D. Thesis, Harvard University, 1953).

[6]S. L. Barraclough, and E. M. Gould, Economic Analysis of Farm Forest Operating Units, Harvard Forest Bulletin 26, (1955).

Budgeting combines into one method of analysis the use of principles of economic theory and a means for the evaluation of the multiple and constantly changing interrelationships of the many variables found in the real situations facing farm managers. By the use of judgment and the best available information relevant to the analysis, the research worker can take account of all the pertinent variables, including such variables as managerial ability and the operator's tastes and preferences, which are difficult to measure in quantitative terms. Thus, budgeting allows the research worker to use judgment to provide realism throughout the analysis. Although this is a means for bias to enter into the analysis, the skilled use of judgment in an appropriate manner can result in practical answers to real problems facing farm managers. This does not, of course, reduce the need for accurate information to be used in budgeting.

Although comparative budgeting does not necessarily offer a precise means of determining the most profitable farm organization, careful selection of the alternatives used in the budgeting analysis will give useful indications of the direction and magnitude of adjustments which can be made to increase net farm income.

The use of case farms in budgeting provides a realistic setting for the analysis. Use of actual farm situations permits the research worker to consider simultaneously the interactions of all the relevant variables. This approach, referred to as the "operating unit approach" by Wheeler and Black,[7] enables the variables to be evaluated in their operational

---

[7]Wheeler and Black, op. cit.

setting and in their realistic importance to the farm operator. Salter has suggested that the study of a relatively few case farms in their entirety may be more useful in revealing solutions to key problems than the use of larger quantities of data removed from the functional context.[8]

Each individual farm situation is somewhat different from all other farms. Therefore, the resulting solutions from each case-farm analysis will be unique in some respects. However, if the budgeting analysis indicates that a certain type of adjustment will lead to similar results in several different case-farm situations, this adjustment may reasonably be expected to bring about the same kinds of results on a larger population of farms which have similar characteristics of organization and operation. Thus, although the case-farm, operating unit approach is used to insure completeness and realism, it is believed that the results may, also, be useful on a large number of farms of similar size and organization.

Selection of the Case Farms

All of the case farms selected for this analysis involve specialized production of tree fruits. These farms represent situations regarding farm size, crops raised, and future objectives of the operator commonly found in western Michigan.

The selected farm operators were under 55 years of age and were interested in future planning to improve the results of their farm business operations. Two of the case-farm operators did off-farm work as a temporary

---

[8]L. A. Salter, "Cross-sectional and Case-grouping Procedures in Research Analysis," Journal of Farm Economics, (February 1942), pp. 792-805.

means of supplementing the net farm income. However, all of these farmers received all or a major portion of their total family income from the farm business. Each of the case farm operators had participated in earlier research by supplying detailed information regarding prices, markets, practices, and input-output relations.[9] This research provided background information regarding specialized fruit and vegetable farm operations in southwestern Michigan for the years 1956 through 1959.

Additional background information on a limited basis was available from a preliminary survey made in 1956, which attempted to reach an unbiased sample of fruit and vegetable farms of Economic Classes I to IV (as defined in the Census) in four selected townships in Berrien and Van Buren counties. This preliminary survey was used as a basis for selecting the farms studied more intensively in the information-gathering research.

The area in which the case farms operate is somewhat different from other western Michigan fruit producing areas with regard to climatic conditions and available market outlets. Some differences in results can be expected if similar adjustments on tree fruit farms in other areas of western Michigan are to be considered. However, these case farms appear sufficiently similar to many other western Michigan fruit farms to give valid indications of adjustment possibilities. There are approximately 3,600 commercial

---

[9]See R. G. Wheeler and E. F. Lord, "The Southwestern Michigan Fruit and Vegetable Farm Business, 1957, Part I--Farm Costs and Returns," Quarterly Bulletin, Michigan State University Agricultural Experiment Station, (East Lansing, May 1958), Volume 40, No. 4, pp. 838-850; R. G. Wheeler and E. F. Lord, "The Southwestern Michigan Fruit and Vegetable Farm Business, 1957, Part II--Crop Costs and Returns," Quarterly Bulletin,(August 1958) Volume 41, No. 1, pp. 204-218; R. G. Wheeler and D. Ricks, The Southwestern Michigan Fruit and Vegetable Farm Business, 1958, Michigan State University Agricultural Economics Department Mimeo 760, (April 1959).

fruit farms in western Michigan which have more than 10 acres of orchards or vineyards according to data from the 1954 Census of Agriculture.[10] Of these 3,600 farms, 2,200 are located in Berrien and Van Buren counties. The remaining 1,400 farms in western Michigan are probably sufficiently similar in organization to pose management problems similar to those of southwestern Michigan tree-fruit farmers. Thus, the results of this case-farm study may indicate answers for future planning decisions of many tree-fruit farmers in western Michigan

Specific Adjustment Possibilities to be Explored

Preliminary observation of a number of western Michigan tree-fruit farms provided general background data which aided in the determination of specific questions of importance to Michigan fruit farmers. Discussions with university staff members, marketing firm managers, and other individuals concerned with the industry also provided information regarding the present situation and the future for the Michigan tree-fruit industry.

Studies made by other research workers in the area of fruit farm management were also useful in suggesting important questions for study. Studies made by Woodworth and Potter in New Hampshire have shown some of the important considerations for apple orchard management.[11] Recent

---

[10] 1954 Census of Agriculture, Volume 1, Part 6, (United States Department of Commerce, Bureau of the Census, Washington, 1956).

[11] H. C. Woodworth and G. F. Potter, Studies in Economics of Apple Orcharding, New Hampshire Agricultural Experiment Station Bulletin 323, (1940).

studies by Dominick and Stanton at Cornell examine management of apple and cherry operations.[12] In addition, C. G. Garman has published a bulletin entitled How to Make a Fruit Farm Pay.[13] The annual summary and analysis of the fruit farm cooperators in the farm account project of Michigan State University was especially useful in providing data regarding the current situation on western Michigan tree-fruit farms.[14]

The information obtained from the study of southwestern Michigan fruit and vegetable farms indicated that there were many farms with 20 to 60 acres of fruit and vegetables per operator. A number of these farm operators were concerned with expanding their present acreage. Many other fruit farmers in western Michigan fruit producing sections are also concerned with expansion possibilities. Adequate size is needed if the farm operator is to realize the greatest advantage from the large fixed investments in modern machinery and buildings. A large production often aids the farmer in the selection of desirable market outlets for the fruit.

---

[12]B. A. Dominick, Jr., Costs and Returns in Producing Sour Cherries, 1957, (Cornell University, B.A.D. Mimeo 57:139); B. A. Dominick, Jr., Costs and Returns in Producing Sweet Cherries, 1957, (Cornell University, B.A.D. Mimeo 57:137). B. F. Stanton, B. A. Dominick, Jr. and S. C. Fan, Variability in Apple Production Costs and Returns, Agricultural Economics Research Bulletin 17, (Cornell University Agricultural Experiment Station, May 1959).

[13]C. G. Garman, How to Make a Fruit Farm Pay, Cornell University Extension Bulletin 1013, (August 1958).

[14]R. G. Wheeler, Fruit Farming Today, Michigan State University, Agricultural Economics Department Mimeographs 713 (1958) and 749 (1959).

Quantity discounts on purchased inputs are also facilitated by a large size of business. In addition, adequate size is necessary to utilize fully the fixed labor supply available from the operator and his family. An important question, however, is: What is an "adequate" or optimum size or acreage for a given farm operation? It seems evident that questions regarding the expansion of the acreage of fruits per operator constitute an important adjustment area for exploration by budgeting analysis.

Although expansion of fruit acreage seems to offer opportunity for some fruit farmers to improve their net incomes, recent research has shown that farms which had the largest acreages were not necessarily those which ranked the highest in net income per operator. Many of the larger farms produced net incomes which were no larger than the incomes returned on the smaller farms. An indication of this relationship between net income and the acreage per operator is shown in FIGURE 1. This figure shows the financial results achieved by each farm cooperator in the southwestern Michigan fruit and vegetable study during the years 1956 through 1958.[15] Analysis for the fruit cooperators in the farm account project indicates a somewhat similar relationship between acreage and net income.[16] Some of the fruit account cooperators who operate large acreages realize large net incomes. On the other hand, many of the large acreages return net incomes which are smaller than those returned on the smaller farms.

---

[15]For more detailed information see Wheeler and Ricks, op. cit.

[16]Wheeler, op. cit., Fruit Farming Today, 1959 .

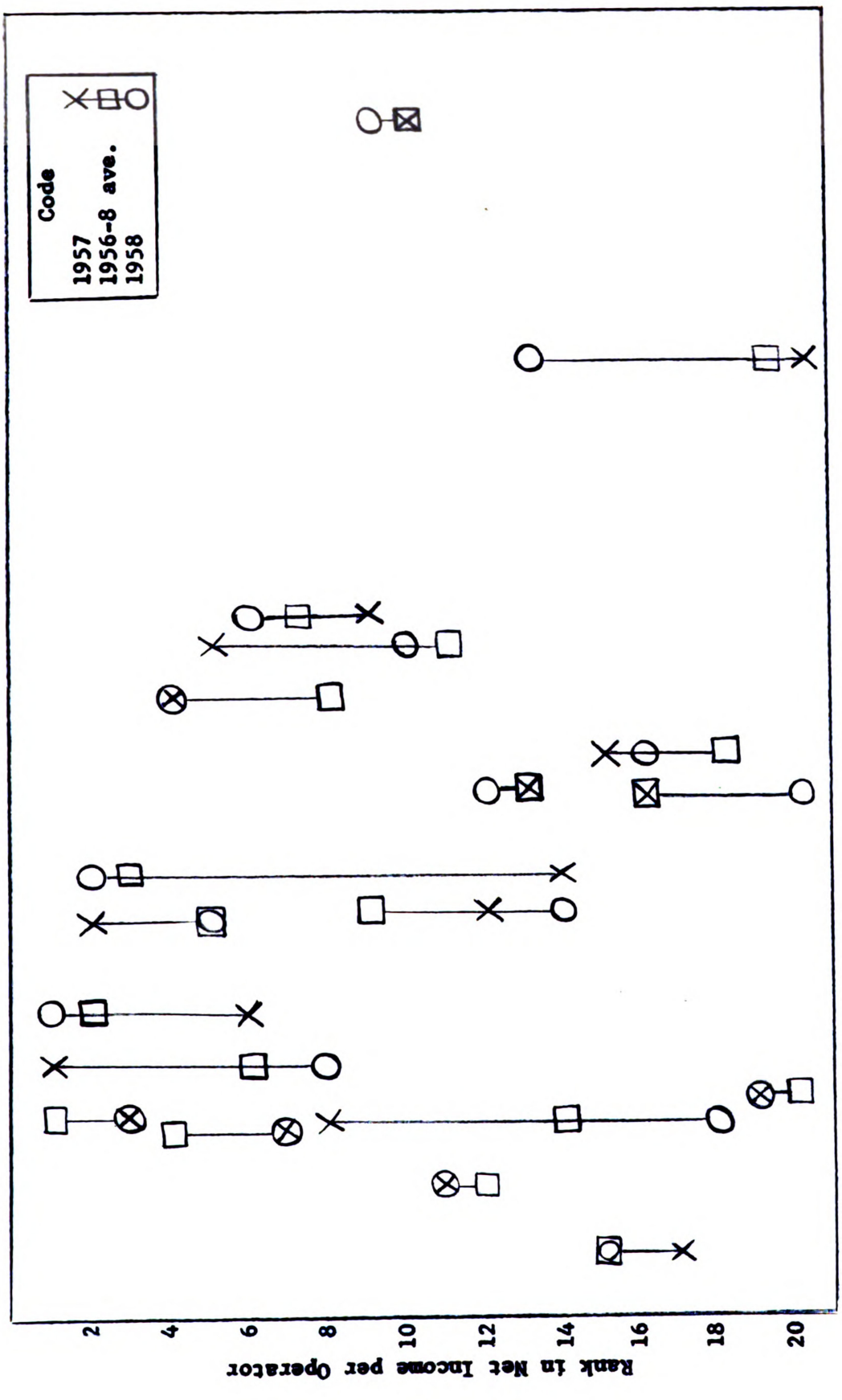

FIGURE 1. Rank in Net Income per Operator as Related to Acres of Fruit and Vegetables

This empirical evidence suggests that, although acreage expansion may be an important adjustment alternative for many fruit farmers, there may be many farm conditions under which an increase in acreage will decrease net profit. The following conditions appeared relevant: (1) present acreage, (2) amount of expansion considered, (3) managerial capacity of the operator, (4) amount of machinery and capital available, and (5) quality of the land and fruit trees. These conditions were considered in the selection and analysis of the case farms and the alternative plans used in budgeting. Thus, an attempt was made to determine the farm conditions under which acreage expansion will increase net income.

On some of the case farms the present organization suggested the possibility of increasing net incomes by adjusting the relative acreages of the crops raised. All of the farms had five or more different crop enterprises. Certain enterprise combinations compete during some periods for supervisory capacity of the operator and the hired labor available. This competition for available labor may be particularly important in operations such as spraying and harvesting operations in which timing is crucial.[17]

Because each additional enterprise increases the amount of knowledge and managerial skill required for effective operation, some farmers may

---

[17]In this respect the enterprise combinations are also related to the total size of the farm business. That is, if there is a minor degree of competition for labor or supervision capacity on a small acreage, the problem may not be serious. However, if operations of two or more major enterprises compete on a large acreage, the problems of providing sufficient labor and supervision may be magnified to the extent that the results obtained per unit of input suffer considerably.

increase their incomes by concentrating on fewer enterprises than they presently operate. The adoption of certain specialized machinery may also affect the advantages of increasing specialization in certain crops.

On the other hand, the effects of weather and price uncertainties may be such that specialization in only one or two crops will reduce net incomes drastically in certain years. Specialization in large acreages of a few crops may also result in large peak labor requirements at certain seasons of the year.

Farmers are slow to make adjustments in tree-fruit enterprise combinations because of the number of years and the large investment required to raise fruit trees to bearing age. An expansion of the present tree-fruit acreage by new plantings, however, offers an excellent opportunity for accompanying adjustments in the relative importance of each crop acreage. Therefore, these possibilities are explored in this analysis in conjunction with the expansion alternatives.

The adoption of mechanical harvesting and mechanical handling methods and their possible effects on the optimum size of farms are also explored. Other research studies have shown that mechanical harvesting and handling of tree fruits can yield savings in labor expenses. Adoption of this labor saving equipment may be an important future adjustment for many fruit farmers because of the large amounts of hired labor presently needed, especially for the harvest operations.

Results of the study of southwestern Michigan fruit and vegetable farms showed that hired labor was the largest single expense item for most farmers. In this study, hired labor accounted for about one third

of all farm operating expenses.[18] Much of the hired labor expense on these and other Michigan fruit farms is for hand labor used in harvest operations.

Under Michigan conditions, harvest labor accounts for the following percentages of the total labor requirements for each tree fruit crop: apples, 45 percent; tart cherries, 79 percent; sweet cherries, 84 percent; peaches, 58 percent; pears, 50 percent; and plums, 50 percent.[19] Much of this harvest labor is provided by seasonal workers.

The large wage expenses, plus problems involved in recruiting, supervising and housing this hired labor force, present one of the major problem areas for fruit farm operators.

A reduction of the seasonal labor force by substitution of labor saving equipment may be a very important future adjustment for many tree-fruit farmers. However, due to technological considerations and to the fixed cost of the equipment, operators with differences in farm size and organization will not benefit equally from the adoption of this equipment.

Therefore, budgeting analysis is used to explore the expected changes in net income if mechanical harvesting and/or handling methods are adopted on case farms of different size and organization. Special attention is given to the possible effects of this equipment upon the optimum size and organization.

---

[18]Wheeler and Lord, op. cit., Part 1, p. 842.

[19]E. E. Gavett, Labor Used for Fruits and Tree Nuts, United States Department of Agriculture, Agricultural Research Service, Statistical Bulletin 323, (Washington, June 1958).

Budgeting the Case Farms

To ascertain the specific means by which the general adjustments could be made on each case farm, several visits to each farm were necessary. Information regarding the quality and quantity of resources available, the goals and preferences of the operator and his family, and general indications of managerial capacity were obtained to supplement the background data already available from the earlier research. Discussions were also carried out with each farm operator regarding possible land purchases, the crops best suited for his farm, and the extent to which use of labor saving equipment might affect his operations. These discussions provided an opportunity for each farm operator to point out specific difficulties and characteristics of the farm which would affect the results of proposed adjustments. These discussions also provided indications of any changes which would need to accompany the proposed adjustments. For example, the operators supplied information regarding machinery needs if the tree fruit acreage were expanded. Also, an indication of the possible effects of the operator's personal characteristics upon the results of proposed adjustments was obtained in this manner. These subjective factors were all considered in budgeting the alternative plans for the future. By considering all of the circumstances and restrictions facing the farm operator, a considerable degree of realism can be achieved in the specific adjustment plans and results.

Based upon the information regarding the individual farm situation with respect to acreage expansion possibilities and restrictions, alternative plans were outlined for this type of adjustment. These plans

included the specific amounts of land, nursery stock, machinery, and buildings needed for the acreage alternatives. The expected changes in labor and other input requirements, as well as in production and general operation of the farm, were also incorporated into each acreage expansion alternative. Budgets of the expected financial results under each alternative plan were made. For comparison, a budget of the financial results expected under the present organization or "benchmark plan" was made. The benchmark plan represents the expected financial results under normal conditions of weather, prices, and operations if no major organizational changes are made by the operator.

In all of the case farm situations the proposed plans for increasing the tree-fruit acreages will involve planting young orchards on purchased or presently owned land. Because of the number of years required for fruit trees to reach full production, there is an extended transitional period involved in an expansion of the fruit acreage by this means. The comparison of the farm operations and financial results during this transition period is important as well as the comparison of the end results. Therefore, plans and comparative budgets of the financial results for each alternative and the benchmark plan were made for each five-year period between 1960 and 1980. By this means, comparisons of the resulting incomes during certain stages of the transition period can be made, as well as after the young trees reach maturity.

Of course, the acreage expansion could be undertaken by the purchase of additional acreage of bearing fruit trees. If this means of expansion were used, the transition period would be much shorter and less important.

However, the purchase of bearing orchards requires a larger initial investment than is required for raising young orchards. Also there are often no bearing orchards for sale in the immediate vicinity of the present farm. Bearing orchards which can be purchased are often on poor orchard sites, or the trees are of poor varieties or near the end of their productive life. The integration of the purchased bearing acreage into the present farm operation also creates problems.

Because of the difficulties involved in finding profitable bearing acreage and integrating them into the present farm business, planting young orchards seems to offer the most promise as a means of increasing the tree-fruit acreage. The use of this means of expansion allows the operator to plan the size of each enterprise, the varieties to be raised, and the markets to be used.

On the five case farms budgeted for this adjustment, only one operator knew of an opportunity to purchase land with bearing fruit acreage suitable for expansion purposes. Thus, plans for the increased acreage adjustment on all the case farms included planting young orchards on owned land or on nearby land to be purchased.

The analysis of possible adjustments in the relative size of the crop enterprises was made in conjunction with the acreage expansion analysis. For certain farms the alternative plans included different proportions of the fruit crops raised on the increased acreages. This was done to determine the effects of adjustments in enterprise combinations upon the profitability of increasing the present acreage.

Data Used in Budgeting

In this study, nonlinear comparative budgeting provides the analytical technique. The indicated results, however, are dependent upon the use of reliable data. In budgeting for future adjustment possibilities, the data must represent, as nearly as possible, conditions which will exist in the future. However, any attempt to predict future prices and other conditions will almost certainly involve errors. Data based upon the best knowledge and judgment available regarding the future are, nevertheless, more useful than historical data only. In this budgeting analysis, therefore, the data regarding future prices and input-output relationships are based upon the best available information and judgment regarding the case farm situations in the future. No absolute certainty can be claimed regarding the exactness of these future predictions.

Historical data do provide a basis for predicting future conditions. Historical data on prices and input-output data from each individual farm were used as a basis for estimating future possiblities on that particular farm. These data were based mainly upon experience of the 1957 and 1958 seasons, although less extensive data regarding conditions in 1956 and 1959 were also available.

It is expected that yields and prices will vary widely from year to year. Therefore, the data used regarding prices and production are "normalized" — that is, the expected annual average during a five-year period is used. The data are not expected to be representative of any one year, but rather to indicate results expected during each five-year period. The five-year periods used were 1960-1964, 1965-1969, 1970-1974, and 1975-1979.

Price Received for Fruit

The average historical price per bushel received for apples on the case farms varied widely from one farm to another depending upon market outlets, quality of fruit, and the bargaining power of the farm operator. These factors were all considered in determining the expected future price for apples on the individual farms. Adjustments from one period to the next were made on the basis of an apple price outlook study made by B. C. French.[20] This comprehensive study of factors affecting the long-run price for apples indicates that the Michigan price can be expected to decline gradually until 1966, and then to increase gradually until 1975. Based on this prediction, an apple price which is 5 percent less than the historical average price was used during the 1960-64 period. A price equal to the historical price was used for the 1965-1969 period, and a 5 percent higher price was used during the 1970-1974 period. The price for the 1970-1974 period was also used for the 1975-1979 period, because insufficient data were available to make a more reliable prediction. Therefore, the budgets for a grower who received an average apple price of $1.00 per bushel during the 1957-1958 period will be based upon an apple price of $.95 per bushel during 1960-1964, $1.00 per bushel during 1965-1969 and $1.05 per bushel from 1970 through 1979.

The price received for tart cherries does not vary widely from one farm to another. Because almost all tart cherries are sold to processors,

---

[20]B. C. French, The Long-Term Price and Production Outlook for Apples in the United States and Michigan, Michigan State Agricultural Experiment Station, Technical Bulletin 255, (April 1956).

the price base is the same for all farmers with only slight variations due to quality differences. The same price was, therefore, used for all the case farms.

Adjustments were made for expected general changes in cherry prices in the future. A cherry tree survey made by the Michigan Cooperative Crop Reporting Service in 1957 indicated large cherry tree plantings in the late 1940's and during the 1950's. Projections of the cherry tree survey data indicate the number of bearing tart cherry trees in Michigan will increase at least until 1965. This increased number of bearing trees will result in a larger average annual production in Michigan during the next ten years. Similar conditions are reported in other tart cherry producing states. Michigan production, however, is very important in determining tart cherry prices, because about 60 percent of the national production comes from the State.

In addition to the increasing supply factor, a study by Cromarty and Shaw has indicated that the total demand for cherries has decreased at an average rate sufficient to account for an annual decrease of .39 cents per pound of unprocessed cherries with a normal supply situation.[21] Both supply and the demand factors, therefore, indicate lower prices for tart cherries during the 1960's.

Promotional programs sponsored by the Michigan Cherry Commission and the National Red Cherry Institute are being used in an effort to increase the demand for tart cherries. These programs, plus the development and

---

[21] W. A. Cromarty and R. A. Shaw, Economic Relationships in Red Cherry Marketing, 1947-1958, Michigan State University, Agricultural Economics Department Mimeograph 763, (June 1959).

promotion of new cherry products, are designed to lessen or reverse the downward trend in the demand for cherries reported by Cromarty and Shaw. It is questionable if these endeavors can meet with sufficient success to offset the expected increases in supply and the existing decreasing demand trend.

The annual average price received by Michigan growers for tart cherries for the period from 1950 to 1959 was $147 per ton according to data from the Michigan Crop Reporting Service.[22] Based upon this average historical price and the expected future changes in supply and demand, tart cherry prices of $120 per ton during the 1960-1964 period and $110 during the periods from 1965 to 1975 were estimated. The lower price was used during the later periods because the decrease in demand and the increase in supply are expected to have a greater effect upon the price during these periods than during the 1960-1964 period.

A similar method of analysis was used in determining expected prices for the other tree fruits. Relatively more reliance was placed upon the historical prices received by the individual farmers, however. This was done because of the lack of complete data regarding future price conditions for these fruits. General indications of future bearing tree numbers in the state, the supply situation in other major producing states, and the demand situation were considered.

---

[22] Michigan Department of Agriculture, Michigan Agricultural Statistics, (July 1959).

Prices Paid for Input Items

In general, expected prices for input items during the periods from 1960 to 1969 were based upon a five percent increase above 1957-1958 average prices. The 1957-1958 prices varied from farm to farm. The five percent increase is based on the past upward trend in prices of farm inputs. Price increases were expected for labor, spray material, gasoline and oil, repairs, farm machinery, taxes, insurance, and utilities. Fertilizer prices were expected to remain near the 1957-1958 level. Nitrogen fertilizer, which is the main fertilizer used in tree fruit production, has shown a decreasing price trend during recent years. The expected prices paid for harvest labor and new machinery received special attention on an individual farm basis.

Input-Output Data

Most of the data used in budgeting were based upon the case-farm operator's past results under normal weather and cultural practices. Some adjustments were made for the increased acreage plans. If adjustments which might affect the input-output relationships were planned in the enterprise combinations, corresponding adjustments in input-output rates were made. The adjustments for size of operation were based upon the general concept that as acres per operator increase, the output per unit of input will tend to decrease.

The physical input-output data for mechanical harvesting and handling methods were obtained from studies on the development and use of these mechanical methods.[23]

---

[23]For a list of these studies see pages 88 and 116 in Chapter III and IV.

The data regarding labor inputs for bearing fruit trees which were obtained in the study of the fruit and vegetable farms were compared to figures obtained by cost studies in Michigan[24] and at Cornell.[25] A management study of the peach enterprise in Canada[26] also provided data concerning this enterprise. Budgeting data regarding farm packing operations were obtained from two recent packing-cost studies made in southwestern Michigan.[27]

Considerable investigation was necessary to ascertain the expected input requirements as well as expected production from the young orchards involved in the expansion adjustments. The use of data from other studies was necessary, because many of the farms studied had no nonbearing orchards for which accurate records could be obtained. General estimates of expenses for the direct inputs involved in raising young fruit trees of different ages were prepared for use in budgeting by consolidation of the available data in other studies and the use of judgment regarding the western Michigan fruit farm situations. These estimates, which are presented in

---

[24]K. T. Wright, and Stanley Johnson, Peach and Cherry Costs in Michigan, Michigan State University Agricultural Experiment Station, Circular Bulletin 201, (1946); and K. T. Wright and Walter Toenjes, Apple and Pear Costs in Michigan, Michigan State University Agricultural Experiment Station, Circular Bulletin 202, (1946).

[25]C. D. Kearl, Cash Crops and Fruits Costs and Returns from Farm Cost Accounts, (1958 and 1959 editions) Cornell University Agricultural Experiment Station, Agricultural Economics Research Bulletins 6 and 31.

[26]J. M. MacCharles, Peach Production Costs, Ontario Department of Agriculture, Toronto, (1958).

[27]J. C. Podany, Costs of Packing Michigan Peaches in 1957, United States Department of Agriculture, Agricultural Marketing Service, Marketing Research Report 290, (December 1958), and D. G. Gillette and B. C. French, "Costs of Packing Apples in Michigan," Quarterly Bulletin, Michigan State University Agricultural Experiment Station, Volume 40, No. 2, November 1957, pp. 286-299.

Appendix TABLES A through F, show expected inputs on farms similar to the case situations. Actual expenses on individual farms, especially in different fruit producing areas, may vary from these estimates by as much as 50 to 100 percent.

Estimates of expected production of fruit trees at various ages were also prepared for use in budgeting the young orchards. These estimates, presented in TABLE G of the Appendix, show expected production for situations similar to those on the case farms. Actual production on individual farms may differ considerably from these estimates.

CHAPTER II

EXPANSION OF ACREAGE

This chapter explores income changes which can be expected with increases in acreage on five case study farms. Possible adjustments in the relative size of the individual fruit enterprises are also considered.

Analysis of Farm A

The Present Situation

Farm A was selected as an example of a farm situation which may provide opportunities to increase income by expanding the tree fruit acreage. A father and son partnership provides two operators for the 56 acres farmed. Thus, there are only 28 acres per operator.

A high degree of managerial capacity is indicated for the small acreage. The machinery inventory and capital available are sufficient for operation of a larger tree-fruit acreage. These conditions suggest opportunities to increase net income by expanding acreage.

Fifty-one acres of tree fruits and 5 acres of asparagus are presently raised. Bearing acreage consists of 26 acres of apples, 17 acres of pears, 4 acres of cherries and 0.5 acre of peaches. There are also 3.5 acres of nonbearing apples.

The combined managerial capacity of the two operators seems sufficient to manage effectively more acreage than the present 56 acres of fruits and asparagus.

The large historical net income per operator from the small acreage and the high standard of performance of all the farm operations indicate a high degree of managerial capacity in relation to the present acreage.

The farm operation is specialized in a relatively few main crops. The results of the present operations indicate the development of a high degree of skill in producing these crops. High yields of very high quality fruit are consistently obtained. Apple yields average 450 to 500 bushels per acre. The apples are large and free from insects and diseases each year. Pear yields have averaged 275 bushels per acre but are expected to increase because most of the trees have not yet reached mature production. Cherry yields have been high on the bearing acreage, but most of the trees have just reached bearing age. The high yields and high quality of the fruit produced indicate that timing of the spray and harvest operations is managed effectively. These performance achievements are probably due, in part, to a high degree of managerial capacity of the operators. However, the high quality resources in orchard site, soil and trees are important as well.

The operators provide all the labor necessary for operations in growing the fruit. In addition, much of the fruit is picked by the operators and their families. The only hired labor is for extra picking labor at harvest time. The largest picking crew used involves about 12 hired hands for picking pears. Thus, little time is required for supervision of hired labor, and the operators have time available to pick as well as to haul the fruit. The operators can provide this large proportion of the labor force partly because no grading or packing is done and partly because a small acreage is farmed per operator. The present situation indicates that the operators can provide the necessary supervision for larger labor crews required on a larger acreage.

In addition to the resources in managerial capacity, labor supply, orchard site and fruit trees, the farm appears to have an abundance of machinery and equipment for the relatively small acreage. The machinery inventory consists of two tractors, an air-blast sprayer, a high-pressure sprayer with a fan attachment, a stake truck, a pickup truck, a mowing machine, an asparagus picker, a brush rake, an orchard trailer, tillage equipment, ladders, and picking equipment for the harvest operation. Because all of the fruit is delivered to a fruit exchange or to processors on an orchard run basis, no grading equipment is needed. The present equipment is sufficient for more than the present acreage.

The situation, then, indicates that a larger acreage of tree fruits can be operated without a large decrease in the effectiveness of the operation.

Selection of the Alternative Plans

The operators of Farm A own 50 acres of land which they do not farm at the present time. They feel, however, that this land is too low to provide adequate air and water drainage for consistently large crops of tree fruits. On the other hand, there are no bearing orchards available for sale in the immediate area. Therefore, any large increase in fruit acreage will involve purchasing suitable land and planting young orchards.

A 40-acre tract of land which is only one-quarter mile from the present farm is available for sale. The operators feel that this land may provide an orchard site equal to that of the present acreage, in terms of expected fruit yields. If this 40-acre tract is purchased and planted

entirely to orchard, the farm will have a total of 91 acres of fruit and 5 acres of asparagus, or 48 acres of fruit and vegetable crops per operator.

This acreage is not large for one operator when the quantity and quality of the other available resources are considered. Operators of Michigan fruit farms commonly operate 40 to 90 acres of tree fruit per operator. A 40-acre increase in acreage should not radically change the basic type of operation. Alternatives I and II, therefore, are plans for buying and planting the 40-acre tract.

Alternative I is based upon planting 20 acres of pears, 10 acres of apples, and 10 acres of tart cherries. Alternative II calls for 20 acres of pears and 20 acres of tart cherries.

The operators feel that additional pears and tart cherries offer more promise for increasing net incomes than any other tree fruit crop. This conclusion is suggested by comparative costs and returns experienced on the main crops. Apples are included in the plan for Alternative I in order to determine the results of a larger acreage with approximately the same percentage enterprise distribution as the present one.

Due to the large capital outlay necessary to purchase and plant 40 acres of young orchards, the plantings will be made in five equal portions during the first five-year period. Thus, the capital and labor requirements for establishing the young orchards will be more uniform throughout the five-year period than if the plantings were all made in one year.

The plan for Alternative III includes increasing the fruit acreage by planting pears on the present asparagus acreage. The asparagus will be sprayed, fertilized, and harvested during the first few years until

the pear trees reach bearing age. This plan is used to determine the results of increasing the acreage of tree fruits without purchasing additional land.

Alternative III increases the acreage of tree fruits but involves no change in total acreage farmed. Thus, this alternative is mainly an adjustment in the combination of enterprises. Both Alternatives I and II represent adjustments in the present acreage proportions of the crop enterprises as well as an increase in acreage.

A summary of the bearing and nonbearing acreage under each alternative during the five-year planning periods is shown in TABLE 1. The somewhat arbitrary classification into bearing and nonbearing acreage is based upon the average age of the different orchards during the five-year period indicated. If expected production is less than 50 percent of full mature production, the orchard is classified as "nonbearing." Although this arbitrary classification is somewhat unrealistic, the table provides an indication of the orchard acreage by age groups during future periods.

The Benchmark Plan reflects the results of continuing the present acreage organization through time. The only acreage changes which occur under this plan are caused by the need to replace certain blocks of trees after the economical part of their productive life has been completed. As these blocks of trees reach an age at which expected fruit production will no longer warrant their care, the trees will be removed and the land replanted with trees of the same species. Therefore, during the periods from 1970 to 1979 the plan calls for the removal and replanting of three acres of pears, one acre of cherries, and 0.5 acre of peaches. This replanting assumption maintains the present acreage of each fruit throughout

TABLE 1. Summary of Bearing and NonBearing Acreage on Farm A Under Four Alternative Plans, 1960-79

Plan & Crop	1960-1964		1965-1969		1970-1974		1975-1979	
	B.	N.B.	B.	N.B.	B.	N.B.	B.	N.B.
	(acres)		(acres)		(acres)		(acres)	
Benchmark								
Apples	26	3.5	29.5	-	29.5	-	29.5	-
Tart cherries	4	-	4	-	4	-	3	1
Pears	17	-	17	-	14	3	14	3
Peaches	0.5	-	0.5	-	0.5	-	-	0.5
Asparagus	5	-	5	-	5	-	5	-
Total	52.5	3.5	56.0	0.0	53.0	3.0	51.5	4.5
Alternative I								
Apples	26	13.5	29.5	10	39.5	-	39.5	-
Tart cherries	4	10	8	6	14	-	13	1
Pears	17	20	17	20	34	3	34	3
Peaches	0.5	-	0.5	-	0.5	-	-	0.5
Asparagus	5	-	5	-	5	-	5	-
Total	52.5	43.5	60.0	36.0	93.0	3.0	91.5	4.5
Alternative II								
Apples	26	3.5	29.5	-	29.5	-	29.5	-
Tart cherries	4	20	12	12	24	-	23	1
Pears	17	20	17	20	34	3	34	3
Peaches	0.5	-	0.5	-	0.5	-	-	0.5
Asparagus	5	-	5	-	5	-	5	-
Total	52.5	43.5	64.0	32.0	93.0	3.0	91.5	4.5
Alternative III								
Apples	26	3.5	29.5	-	29.5	-	29.5	-
Tart cherries	4	-	4	-	4	-	3	1
Pears	17	5	17	5	19	3	19	3
Peaches	0.5	-	0.5	-	0.5	-	-	0.5
Asparagus (interplanted with pears)	(5)[a]	-	(5)	-	-	-	-	-
Total	47.5	8.5	51.0	5.0	53.0	3.0	51.5	4.5

[a]The acreage figures in parenthesis are interplanted acreages which are excluded from the total acreage figure to avoid double counting.

the planning period. This is an attempt to separate the effects of planting young orchards on the larger acreage from changes caused by normal replacement of bearing trees as their economical productive life is completed. In practice, of course, when removal is necessary, the farmer may replant another fruit to aid disease and insect control, or because the economic outlook for another crop seems more promising than for the present fruit. The same fruit was assumed to be replanted, however, to maintain the present acreage and organization for comparison over time.

Certain changes in yield per acre due to aging of the trees were planned for various blocks under the Benchmark Plan as well as for the young orchards under the expansion alternatives.[1] These expected changes in production, along with expected changes in prices during the future periods, are the only major changes from the present farm operation which were included in the Benchmark Plan.

The increased acreage planned under Alternatives I and II will require accompanying changes in other aspects of the farm operation. For each alternative, estimates of the machinery and building needs were made for each five-year period. The additional acreage of cherries planned under Alternatives I and II will require investments in additional housing and picking equipment for the large number of harvest workers needed under both of these alternatives. Investment in a larger air-blast sprayer and a larger tractor will also be needed under Alternatives I and II during the 1970-1974 period.

---

[1]Estimates of relative yields for trees of different ages and estimates of the economical productive life of different fruit trees were made with the advice of Dr. R. P. Larsen of the Horticulture Department at Michigan State University.

The plans for Alternatives I and II include estimates of the labor supply needed and any changes in practices necessary for the larger acreage. The increased acreage will require more labor than the operators and their families can supply. Therefore, hired labor will be needed. Most of this hired labor will be for harvesting fruit and for other hand operations such as hoeing and pruning.

The financial results expected for each plan were determined by estimating production and product prices, as well as the investments, labor, and other variable inputs needed under each plan. A summary of expected financial results for the Benchmark Plan and for each alternative plan are presented in TABLES 2 through 5. The figures in these tables are average annual receipt and expense estimates for each five-year period between 1960 and 1980.

Financial Results During the 1960-1964 Period

Comparison of Receipts - The bulk of the receipts under each plan are from fruit sales. In addition, the asparagus can be expected to produce $1,600 worth of income each year. Rent from the 50 acres of land which is not farmed accounts for an additional income of $230 per year under each plan.

Differences in fruit receipts for the several alternatives within a given period result, in part, from expected differences in production. Expected differences in fruit quality or in the predominance of varieties may also affect the amount of fruit receipts.

During the 1960-1964 period, expected receipts under the Benchmark Plan shown in TABLE 2 include receipts from apple production on 29.5 acres

TABLE 2. Summary of Average Annual Receipts, Expenses and Investments, Farm A, 1960-64

Item	Benchmark	Alt. I	Alt. II	Alt. III
Receipts				
Apples	$13,620	$13,250	$13,250	$13,620
Tart cherries	1,800	1,920	2,040	1,800
Pears	8,730	8,730	8,730	8,730
Peaches	300	300	300	300
Asparagus	1,600	1,600	1,600	1,300
Land rent	230	230	230	230
Total	26,280	26,030	26,150	25,980
Expenses				
Labor - hourly	-	650	720	-
- piecework	2,960	3,010	3,060	2,960
Seed	100	260	260	100
Spray material	2,780	3,060	3,130	2,810
Crate rental	430	430	430	430
Other supplies	100	210	210	130
Fertilizer and lime	950	1,460	1,460	950
Gas and oil	780	890	900	800
Building repairs	120	120	120	120
Machinery repairs	240	310	350	240
Property taxes	240	320	320	240
Insurance	200	200	200	200
Utilities	150	150	150	150
Miscellaneous	140	140	140	140
Replacement of existing equipment and buildings	3,670	3,670	3,670	3,670
Replacement of existing trees	-	-	-	-
Interest on existing debt	-	-	-	-
Interest on new investment	-	620	630	20
Total	12,860	15,500	15,750	12,960
Net Operating Income	13,420	10,530	10,400	13,020
New Investments				
Buildings	-	-	-	-
Machinery and equipment	-	-	-	-
Land	-	2,000	2,000	-
Trees	-	830	940	100
Total	-	2,830	2,940	100
Consumption Income[a]	13,420	7,700	8,460	12,920

[a]"Consumption income" is equivalent to "net cash income" if interest on new investment and replacement charges on existing buildings and equipment are to be incurred as cash outlays within each 5-year period.

of apple trees. A 17-acre block of mature trees is expected to average 475 bushels per acre. These apples are expected to return an average price of $.98 per bushel. Another 9-acre block of younger trees, which will not have reached full production, is expected to produce an average of 450 bushels per acre. This block is predominately Red Delicious and Red Jonathan, varieties which bring a relatively high price. Therefore, a unit price of $1.33 was estimated for the production from this block based upon past prices received by the operator. A 60-bushel yield is expected from a 3.5 acre block of young dwarf apple trees. The trees in this block are all Red Delicious; therefore, a price of $1.50 per bushel is estimated.

The tart cherry receipts are based upon a six-ton production from a mature, one-acre block, and a three-ton yield from 3 acres of young trees. A price of $120 per ton was used for tart cherries. The pear receipts will be from 17 acres of bearing pears, which are expected to produce 300 bushels per acre. A unit price of $1.70 per bushel is estimated. The 0.5 acre of peaches is expected to produce 200 bushels of fruit which will sell for $1.50 per bushel. Asparagus receipts are based upon the average yield and price during 1957-1959.

Receipts during the 1960-1964 period for Alternatives I and II include limited production from the young orchards on the additional acreage. Only the cherry trees can be expected to produce any fruit during this period. Cherry production from this acreage will be very small because of the young age of the trees. Expected apple receipts under these two alternatives will be $370 less than those of the Benchmark Plan. This is because the added labor required to care for the young orchards may reduce

the timeliness of spray applications for the existing apples. Thus, quality of the apples may be reduced. The $370 reduction is based upon a three-cent reduction in price received per bushel of apples because of expected lower quality fruit under the expansion alternatives.

Expected receipts under Alternative III are the same as those for the Benchmark Plan with the exception of asparagus receipts. Asparagus receipts will be reduced somewhat under this plan. The reduced land area available for asparagus after the pears are planted, and conflicting cultural practices for the two interplanted crops will result in less asparagus production. The increased acreage of pears under this plan is not large enough to affect other aspects of the farm operation as may be the case under Alternatives I and II.

Comparison of Expenses - Cash expenses for the expansion alternatives were calculated by adding the estimated expenses for the young orchards to the expenses of the Benchmark Plan. Estimates of approximate labor hours and expenses for fertilizer, spray materials, seed and machinery operation for different fruit trees by age groups are presented in Appendix TABLES A, B and C. These estimates were used with adjustments for the situation of Farm A, to determine the expenses for the larger acreage under Alternatives I, II, and III.

No packages will be purchased on Farm A under any of the alternatives; all of the fruit will be sold on an orchard-run basis through the local fruit exchange or directly to processors. The fruit exchange, however, charges a crate rental of three cents per bushel on all fruit which is

handled through the exchange. This is shown as a separate expense item in TABLE 2.

In addition to cash expense items, a charge for replacement of existing buildings and equipment was made. This figure indicates that an estimated average cash outlay of $3,670 per year will be needed on Farm A to replace existing buildings and equipment as these items wear out.

The charge for replacement of existing trees includes the cost of removing blocks of trees which are beyond an economical productive age, plus cash expenses for nursery stock and replanting the trees.

A five percent interest charge on all new investments is also included in the annual charges. This interest charge represents an actual cash expense if capital must be borrowed. Otherwise, it is a means for recognizing the opportunity cost of the capital investment. The opportunity cost in this case represents a reasonable expected return if the capital were invested outside of the farm business.

Cash expenses plus the charges for replacement and interest account for the "total annual charges," which were deducted from "total annual receipts" to obtain "net annual operating income." If additional investments are required, as under the expansion alternatives, the average annual investment during the five-year period is subtracted from the net annual operating income. The value thus obtained represents the average annual income available from the farm business for consumption or savings by the operators and their families. This income will, hereafter, be referred to as "consumption income." This figure is useful in future planning of various alternative farm plans because it shows the amount of

actual cash available to the operator for nonbusiness uses, i.e., consumption or savings, during each period. This consumption income for Farm A is a return for the joint efforts of the two operators.

During the 1960-1964 period, cash expenses necessary under the expansion alternatives are much more than those of the Benchmark Plan because of the additional acreage of young trees. Under Alternative I, an estimated $650 expense for hourly hired labor will be needed during this period. This estimate is calculated as follows: The sum of the estimates of labor hours for each operation shown in Appendix TABLES A, B, and C indicate a total annual labor requirement of 950 hours for the planting and care of the additional acreage of young trees under Alternative I. Considering the seasonal distribution of the labor needed on the additional acreage, the operators can probably provide 300 hours of the 950. Thus, labor must be hired for 650 hours. At an estimated wage rate of $1.00 per hour, the hourly labor expense will be $650 per year, as shown in TABLE 2. Most of this will be for planting trees, hoeing and other hand labor.

More hourly labor is required under Alternative II than under Alternative I. This is because of the extra hand labor required to plant and hoe the 108 cherry trees per acre under Alternative II compared to the 54 apple trees per acre planned under Alternative I. Spray material expense will also be more under Alternative II than under Alternative I. This is because the cherry trees will be more nearly mature than the apples and will require a full spray schedule while the nonbearing apple trees are small and need only a portion of the complete spray schedule for bearing apples. Although there are more cherry trees to fertilize under Alternative II, cherries are more vigorous growing trees and require less

fertilizer per tree. Consequently, fertilizer expense will be the same for both Alternatives I and II. The expenses for seed, fertilizer, and spray material for the young trees are based upon the estimates presented in Appendix TABLES A, B and C. Sample spray schedules were worked out to check the estimated spray material expenses for the young trees.

Expense for "other supplies" includes mouse bait and guards to protect the trees from mouse damage.

Comparison of Investments and Net Incomes - The additional cash expenses under Alternatives I and II, plus the interest charges on new investments, coupled with the reduced receipts, result in net operating incomes for the expansion alternatives which are about $3,000 less than the net operating income from the Benchmark Plan. Investments in land and young trees under Alternatives I and II during the 1960-1964 period will reduce the consumption income of these alternatives still further. The 40 acres of land can be purchased for $10,000. This amounts to an average annual investment during the five-year period of $2,000 per year under both alternatives. Purchase of the nursery stock planned under Alternative I will require a total investment of $4,150 or an annual average investment of $830 during the period. Nursery stock for Alternative II will require an average annual investment of $940. After these investments are deducted from the net operating incomes, expected consumption incomes for Alternatives I and II are $7,700 and $8,460, respectively. These incomes can be compared to the $13,420 consumption income expected under the Benchmark Plan for this period.

Thus, the analysis shows that during the first five-year period (1960-1964) consumption incomes expected under Alternatives I and II will be considerably less than that of the Benchmark Plan.

If these incomes are considered below a minimum requirement for the operators' family living expenses, the operators may borrow funds during this period and delay a portion of the repayments until later periods. One way this may be done is by purchasing the additional land on a long-term mortgage. Other types of long-term loans may also allow the operators to borrow funds during this early period and make at least a portion of the repayments during later periods in which the young trees will be in production.

Under Alternative III, the expenses incurred by planting the young pears will be small during the 1960-1964 period. The operators will be able to supply the extra labor to care for the young trees. Other expense items account for a total increase in annual charges of $100 more than under the Benchmark Plan. This increase in expenses, plus a $300 reduction in asparagus receipts, and a $100 investment in young pear trees, results in a consumption income of $500 less than that of the Benchmark Plan.

The Alternative Plans for the 1965-1969 Period

The Benchmark Plan - During the period from 1965 to 1969, some of the existing trees in the 17-acre block of apples will be removed. On the other hand, the dwarf trees and the trees in the younger block of apples will increase in size. Therefore, expected total apple production is reduced

slightly from that of the previous period. The expected upward trend in apple prices results in greater receipts for apples (TABLE 3) in this period than during the 1960-1964 period. The three acres of young cherry trees will be mature in this period with an accompanying increase in production. Therefore, cherry receipts will also increase even though cherry prices are expected to decrease. Production and receipts of pears and peaches will also be greater during this period than during the 1960-1964 period.

Because of increased production, expenses for hired picking labor will be larger than those during the 1960-1964 period. Spray material expense will be somewhat less because there will be fewer apple trees to spray. The increased size of the remaining trees will compensate, to some extent, for the fewer number of trees.

Net operating income for the Benchmark Plan during this period is expected to increase over that of the Benchmark Plan during the 1960-1964 period. This results mainly from expected increases in production and higher apple prices during the 1965-1969 period.

Alternative I - During the period between 1965 and 1969, the young apple and pear trees will begin to bear some fruit. Although little production can be expected from these trees, the cherry trees can be expected to produce an average of two tons per acre during this period. Production of 50 bushels of apples and 35 bushels of pears per acre can be expected. Apple and pear receipts will be somewhat larger than those of the Benchmark Plan during this period, and cherry receipts will be $1,800 larger than those of the Benchmark Plan.

TABLE 3. Summary of Average Annual Receipts, Expenses and Investments, Farm A, 1965-1969

Item	Benchmark	Alt. I	Alt. II	Alt. III
Receipts				
Apples	$14,090	$14,470	$13,730	$14,090
Tart cherries	2,200	4,070	6,270	2,200
Pears	9,270	10,430	10,430	10,150
Peaches	380	380	380	380
Asparagus	1,600	1,600	1,600	800
Land rent	230	230	230	230
Total	27,770	31,180	32,640	27,850
Expenses				
Labor - hourly	-	950	960	-
- piecework	3,220	4,840	5,690	3,320
Seed	100	230	240	110
Spray material	2,740	3,300	3,320	2,800
Crate rental	380	400	390	380
Other supplies	100	220	220	110
Fertilizer and lime	950	1,450	1,460	720
Gas and oil	680	910	940	860
Building repairs	120	140	180	120
Machinery repairs	240	320	320	240
Property taxes	240	320	320	240
Insurance	200	210	220	200
Utilities	150	160	160	150
Miscellaneous	140	140	140	140
Replacement of existing equipment and buildings	3,670	3,670	3,670	3,670
Replacement of existing trees	-	-	-	-
Interest on existing debt	-	-	-	-
Interest on new investment	-	820	910	20
Total	12,930	18,080	19,140	12,920
Net Operating Income	14,840	13,100	13,500	14,930
New Investments				
Buildings	-	400	600	-
Machinery and equipment	-	50	100	-
Land	-	-	-	-
Trees	-	-	-	-
Total	-	450	700	-
Consumption Income	14,840	12,350	12,800	14,930

Expenses for labor, spray materials, and machinery operation will all be greater during this period than the expenses of the previous period due to increased size of the trees. Also, all 40 acres will require care during the entire 1965-1969 period, whereas due to the staggered planting plan only a portion of the acreage was farmed throughout the 1960-1964 period.

The increased amounts of labor required to spray and prune the larger trees, as well as for hoeing and cultivating the increased acreage, will increase labor expense under Alternative I during this period. Piecework labor expense will also increase.

Although there will be more fertilizer needed for the trees during this period than during 1960-1964, there will be no need for fertilizer for soil building crops as in the previous period. Therefore, fertilizer expense remains about equal to that of the previous period. The five percent interest charge is based on the investments in land and trees made during the 1960-1964 period plus the investments during the 1965-1969 period.

Although the receipts during the 1965-1969 period under Alternative I are greater than those of the Benchmark Plan the expected cash expenses and interest charges are also much larger. Thus, the net operating income under Alternative I will be less than that of the Benchmark Plan. The difference is not as great as the difference between the incomes of these two plans during the 1960-1964 period, however.

During this period the large numbers of cherry pickers necessary under Alternative I will require more investments in housing and ladders

than will be required under the Benchmark Plan. A $2,000 investment in new housing for harvest workers and a $250 investment in additional ladders is planned.

The deduction of these investments from the net operating income results in a consumption income of $12,350 under Alternative I. This income is about $2,500 less than the consumption income of the Benchmark Plan during this period.

Alternative II - The situation for Alternative II is essentially the same as that for Alternative I except that more cherries will be produced under Alternative II.

The resulting net operating income expected under Alternative II will be greater than that of Alternative I; mainly because the additional 10 acres of cherries under Alternative II come into production sooner than the apples planned on the same 10 acres under Alternative I.

Larger investments in picker housing and ladders will be needed for Alternative II than for Alternative I. Investments of $3,000 for housing and $500 for ladders are planned for Alternative I during this period. Thus, the consumption income expected under Alternative II will be $12,800, which is more than that of Alternative I but about $2,000 less than that of the Benchmark Plan.

Alternative III - During the 1965-1969 period, the young pear trees under Alternative III will start to produce. The asparagus will be picked only the first three years of the period. Thus, asparagus receipts will be less than during the previous period. The pear trees will require more

expenses for spray material and picking labor than the asparagus on this 5 acres under the Benchmark Plan. Less fertilizer is used for the pears than for the asparagus, however. Both total receipts and total expenses are nearly the same under Alternative III as under the Benchmark Plan. The resulting net operating income, which is equal to the consumption income for Alternative III, is $100 larger than that of the Benchmark Plan during this period.

The Alternative Plans Between 1970 and 1974

The young plantings will approach mature bearing age during this period. Thus production from the increased acreage under Alternatives I and II will result in much larger fruit receipts under these alternatives than under the Benchmark Plan (TABLE 4). Expected yields and production from the young orchards will increase from those of the previous period, while production under the Benchmark Plan will decline somewhat from that of the 1965-1969 period. The oldest original pear block must be removed during this period. Part of the apple trees from the old orchards will be removed due to old age and crowding. Thus, production from the original orchards will be reduced.

During this period the new cherry plantings on the added acreage are expected to reach full production of 5 tons per acre. Apples are expected to yield 275 bushels per acre and pears 210 bushels per acre. Growing and harvesting expenses, of course, will increase from those of the previous period. However, the net incomes from Alternatives I and II are expected to be considerably larger than the income from the Benchmark

TABLE 4. Summary of Average Annual Receipts, Expenses and Investments, Farm A, 1970-74

Item	Benchmark	Alt. I	Alt. II	Alt. III
Receipts				
Apples	$13,190	$17,270	$12,850	$13,190
Tart cherries	1,980	7,480	12,980	1,980
Pears	8,330	15,510	15,510	10,720
Peaches	330	330	330	330
Asparagus	1,600	1,600	1,600	-
Land rent	230	230	230	230
Total	25,660	42,420	43,500	26,600
Expenses				
Labor - hourly	-	910	1,160	-
- piecework	2,600	7,370	8,900	2,880
Seed	100	160	190	100
Spray material	2,740	3,730	3,520	2,850
Crate rental	340	350	290	350
Other supplies	100	220	220	110
Fertilizer and lime	950	1,430	1,490	710
Gas and oil	690	1,090	1,090	710
Building repairs	120	120	120	120
Machinery repairs	240	330	330	240
Property taxes	240	320	320	240
Insurance	200	200	200	200
Utilities	150	200	220	150
Miscellaneous	140	140	140	140
Replacement of existing equipment and buildings	3,670	3,670	3,670	3,670
Replacement of existing trees	40	40	40	40
Interest on existing debt	-	-	-	-
Interest on new investment	-	920	1,210	20
Total	12,320	21,200	23,110	12,500
Net Operating Income	13,340	21,220	20,390	14,100
New Investments				
Buildings	-	100	800	-
Machinery and equipment	-	370	380	-
Land	-	-	-	-
Trees	-	-	-	-
Total	-	470	1,180	-
Consumption Income	13,340	20,750	19,210	14,100

Plan. These incomes are shown in TABLE 4. Alternative III also shows a small expected increase in net income over that of the Benchmark Plan.

Under Alternatives I and II, investments will be needed in housing for cherry harvest workers in addition to the investments made during the 1965-1969 period. An additional $500 will be needed under Alternative I and $4,000 under Alternative II. In addition to these investments, a larger air-blast sprayer will require an investment of $600 more than the existing one. A larger tractor will require $1,200 more investment than the value of the present tractor. Also, $250 worth of the ladders purchased during the 1965-1969 period under Alternative I will need to be replaced. Under Alternative II, $500 will be needed to replace ladders during this five-year period.

Even with these investments, the income available to the operators for consumption and savings will be considerably greater under Alternatives I and II than under the Benchmark Plan. Consumption income under Alternative I will be greater than under Alternative II because of the larger acreage of apples.

The Alternative Plans During the 1975-1979 Period

The expected financial results from the various alternatives during 1975-1979 are summarized in TABLE 5. During this period, the young apples and pears under the expansion alternatives will reach mature bearing age. Therefore, these alternatives are expected to return larger consumption incomes than those expected during the 1970-1974 period. At the same time, expected income from the Benchmark Plan will decrease somewhat.

TABLE 5. Summary of Average Annual Receipts, Expenses and Investments, Farm A, 1975-79

Item	Benchmark	Alt. I	Alt. II	Alt. III
Receipts				
Apples	$12,360	$19,180	$12,000	$12,360
Tart cherries	1,650	7,150	12,650	1,650
Pears	8,650	20,300	20,300	11,310
Peaches	40	40	40	40
Asparagus	1,600	1,600	1,600	-
Land rent	230	230	230	230
Total	24,530	48,500	46,820	25,590
Expenses				
Labor - hourly	-	1,230	1,430	-
- piecework	2,380	8,390	9,270	2,730
Seed	100	160	190	100
Spray material	2,740	3,970	3,700	2,880
Crate rental	350	560	420	360
Other supplies	100	220	220	110
Fertilizer and lime	950	1,540	1,610	720
Gas and oil	690	1,270	1,270	710
Building repairs	120	120	120	120
Machinery repairs	240	370	370	240
Property taxes	240	320	320	240
Insurance	200	200	200	200
Utilities	150	190	190	190
Miscellaneous	140	140	140	140
Replacement of existing equipment and buildings	3,670	3,670	3,670	3,670
Replacement of existing trees	40	40	40	40
Interest on existing debt	-	-	-	-
Interest on new investment	-	920	1,210	20
Total	12,110	23,110	24,370	12,470
Net Operating Income	12,420	25,190	22,450	13,120
New Investments				
Buildings	-	-	-	-
Machinery and equipment	-	50	100	-
Land	-	-	-	-
Trees	-	-	-	-
Total	-	50	100	-
Consumption Income	12,420	25,140	22,350	13,120

Thus, the difference between the consumption incomes from the expansion alternatives and that of the Benchmark Plan will be greater during this period than at any other time during the 20-year planning period.

The consumption income from Alternative III is, also, somewhat greater than that of the Benchmark Plan, although it is not as large as the incomes for Alternatives I and II.

Comparison of the Expected Incomes Over Time

A summary of the annual consumption incomes expected under the various plans on Farm A during each five-year period is shown in TABLE 6. This table shows that expected income will remain about the same from period to period under the Benchmark Plan. The expansion alternatives involve a sacrifice in consumption income during the earlier years to obtain a greater income in the later years. Under Alternatives I and II, consumption incomes during the first five-year period will be substantially smaller than the income expected under the Benchmark Plan. This results from the investments for land and trees under the expansion alternatives and the additional expenses for the nonbearing acreage. Consumption incomes for Alternatives I and II increase from period to period, reaching the highest point during the last five-year period. The income for Alternative III increases slightly from period to period throughout the 20 years, and averages slightly higher than that of the Benchmark Plan. Thus, each of the four alternative plans results in a different expected income stream for the 20-year planning period from 1960 to 1980.

The value of the trees, buildings, and land remaining in 1980 are also different for each plan. These values must be considered in comparing

TABLE 6. Summary of Future Income Streams For Various Plans, Farm A

Item	Benchmark	Alt. I	Alt. II	Alt. III
Consumption Incomes by Period				
1960-64	$ 13,420	$ 7,700	$ 8,460	$ 12,920
1965-69	14,840	12,350	12,800	14,930
1970-74	13,340	20,750	19,210	14,100
1975-79	12,420	25,140	22,350	13,120
Ending Value of Farm	40,420	64,020	64,120	41,820
Total of Incomes and Ending Value	310,520	393,720	378,220	317,170
Discounted Totals				
at 5 percent rate	184,590	206,423	201,390	186,730
at 8 percent rate	142,090	147,260	145,190	142,920

the income streams of the various alternative plans. The remaining value of these assets in 1980 for each plan is shown in TABLE 6. The ending value of the assets under Alternatives I and II includes the value of the additional 40 acres of land and fruit trees, plus the remaining value of housing built for harvest labor. The ending value for Alternative III includes five additional acres of pears. These values reflect the comparative physical resources of land, buildings, and fruit trees remaining in 1980, rather than estimated absolute market prices of these assets at that time. Calculation of the value of fruit trees is based upon the remaining productive life of the trees in 1980 and upon estimates of the cost to raise the orchard. The value of bearing apple and pear orchards, which have a relatively long productive life, will be higher than the value of cherry and peach orchards of the same age, which will have fewer remaining productive years. Value of the added buildings is based on the new investment minus depreciation.

The sum of the expected consumption incomes in each of the 20 years plus the ending value of the farm may be used for a simplified comparison of the different income streams. This sum for each alternative is shown in TABLE 6. Alternative I can be expected to produce $83,000 more total income during the 20-year period than the Benchmark Plan. Under Alternative II, the expected total income will be $68,000 more than the Benchmark Plan. Under Alternative III, the total income will be only $7,000 more than the Benchmark Plan income for the whole planning period.

This comparison of the total future incomes assumes the operators have an equal time preference with respect to the distribution of income

during the 20-year period. However, incomes in the near future would ordinarily be expected to have a greater value to the operators than equal incomes in the more distant future. Therefore, a discounting procedure was used to compare the value in 1960 of the expected incomes and ending values of each plan. Each of the expected future values was discounted at rates of 5 and 8 percent per year for the period intervening between 1960 and the time at which the income would be realized.

The end of the median year in each five-year period was taken as the average numbers of years intervening between 1960 and the period in question because most of the income from fruit farming is received near the end of the year.

The total discounted values of the consumption incomes and ending value of the farm assets for each plan are shown in TABLE 6.

These discounted values show that the present value of the income stream expected under Alternative I will be about $22,000 more than that of the Benchmark Plan, if a 5 percent discount rate is used. Alternative II incomes have a present value of about $15,000 more than those of the Benchmark Plan.

When an 8 percent discount rate is used, the value of the expected income from Alternative I is only $5,000 greater than that expected from the Benchmark Plan. Thus, the use of the higher discount rate, which accounts to some extent for the added risk and uncertainty of incomes in future periods, reduces the apparent advantages of the expansion alternatives. Nevertheless, incomes from the expansion alternatives remain greater than those of the present organization.

The results of the analysis indicate that more tree-fruit acreage on Farm A will increase incomes over time, even after discounting future gains substantially. Alternatives I and II will yield fairly similar income streams, but total incomes from either plan will be greater than under the Benchmark Plan. These income comparisons will be evaluated differently according to individual attitudes about the risks and uncertainties under the several plans.

Analysis of Farm B

The Present Situation

Farm B is a 40-acre farm which is specializing in tree-fruit production. There are 38 acres of bearing and nonbearing fruit (TABLE 7). The operator does off-farm carpentry work during the winter months. This off-farm work provides an income of approximately $3,000 per year in addition to the consumption income which the farm business returns. The operator hires one full-time man.

Most of the apples and peaches are graded and packed in bushel baskets for sale on the Benton Harbor Produce Market. The labor required for the packing operation and the fact that the operator does off-farm work contribute to the need for a hired man. The operator feels that the present hired man has exceptional capabilities for performing the farm operations with a minimum of supervision.

The farm has sufficient machinery and equipment for present activities. Major machinery items include a two-ton stake truck, a pick-up truck, a two-plow tractor, a small air-blast sprayer, an orchard trailer, a power pruner, a brush cutter, a fruit grader, and tillage equipment.

TABLE 7. Summary of Bearing and Nonbearing Acreage on Farm B Under Three Alternative Plans, 1960-79

Plan & Crop	1960-1964		1965-1969		1970-1974		1975-1979	
	B.	N.B.	B.	N.B.	B.	N.B.	B.	N.B.
	(acres)		(acres)		(acres)		(acres)	
Benchmark								
Apples	15	4	19	-	19	-	19	-
Tart cherries	9	-	6	3	9	-	7	2
Pears	-	-	-	-	-	-	-	-
Peaches	7	-	7	-	7	-	4	3
Peaches (interplanted with apples)	(4)	-	(4)	-	-	-	-	-
Plums	-	-	-	-	-	-	-	-
Grapes	3	-	3	-	3	-	3	-
Total	34.0	4.0	35.0	3.0	38.0	0.0	33.0	5.0
Alternative I								
Apples	18	4	22	-	19	3	22	-
Tart cherries	12	-	9	3	9	3	10	2
Pears	-	12	-	12	12	-	12	-
Peaches	7	-	7	-	7	-	4	3
Peaches (interplanted with apples)	(4)	-	(4)	-	-	-	-	-
Plums	3	10	8	5	13	-	10	3
Grapes	3	-	3	-	3	-	3	-
Total	43.0	26.0	49.0	20.0	63.0	6.0	61.0	8.0
Alternative II								
Apples	18	15	22	11	30	3	30	3
Tart cherries	12	-	9	3	9	3	10	2
Pears	-	-	-	-	-	-	-	-
Peaches	7	11	18	-	18	-	18	-
Peaches (interplanted with apples)	(4)	-	(4)	-	-	-	-	-
Plums	3	-	3	-	3	-	-	3
Grapes	3	-	3	-	3	-	3	-
Total	43.0	26.0	55.0	14.0	63.0	6.0	61.0	8.0

Moderate yields of high quality fruit are obtained. An average apple yield of 350 bushels can be expected from the bearing acreage. Mature peaches are expected to yield 230 bushels of packed fruit. The tart cherries will produce three tons per acre under normal weather conditions. As most of the fruit is sold on a graded and packed basis, a high unit price is received. However, more labor and package expenses are involved in this type of marketing program than would be required if unpacked, orchard-run fruit were sold.

Alternatives for Expansion

The farm under its present organization and operation, can be expected to return a moderate net income for the operator and his family. However, the operator feels that more net income can be realized if the acreage is expanded. A 31-acre tract of land which is located one-quarter mile from the present farm can be purchased for $8,500. The entire 31 acres are well suited for tree fruit. There are 9 acres of existing mature fruit on this land. The operator believes little additional machinery investment will be necessary to operate this 31-acre tract in addition to the present acreage. Somewhat more hired labor will be required.

The operator feels that the hired man can supervise the extra hired labor as well as perform other farm operations on the increased acreage. Thus, even though an expansion of acreage will require more labor, the operator will plan to continue the off-farm work. Past results on the present relatively small acreage indicate that an additional 30 acres of tree fruits can be grown with little decrease in the effectiveness of the operation.

As shown in TABLE 7, 38 acres of fruit will be maintained under the Benchmark Plan. On the land to be purchased under Alternatives I and II, there are three acres of apples, three acres of tart cherries, and three acres of plums. On the remaining 22 acres of this new tract, 12 acres of pears and 10 acres of plums will be planted under Alternative I. Eleven acres of apples and 11 acres of peaches will be planted under Alternative II. Under both of the alternatives, 69 acres of bearing and nonbearing fruit will be maintained throughout the 20-year planning period.

Comparison of the Alternative Plans

Summaries of the expected receipts, expenses and planned investments for the alternatives on Farm B for each five-year period are shown in TABLES 8 through 11. The expected annual net operating income and consumption income during each period are also shown.

The 1960-1964 Period - During the five-year period from 1960 to 1964, the larger acreage of young trees planned under Alternatives I and II will require more expenses than will be required under the Benchmark Plan (TABLE 8). However, increased receipts from the established fruit on the new acreage (and from the young peaches planted under Alternative II) will be sufficient to return a higher net operating income than that of the Benchmark Plan during this period. On the other hand, required investments under the expansion alternatives will reduce the consumption income from these alternatives to less than the income under the Benchmark Plan. The larger acreage planned under Alternatives I and II will require investment in another tractor and a new disc. This machinery will require a capital outlay of $3,100 during the five-year period, or an average outlay of $620

TABLE 8. Summary of Average Annual Receipts, Expenses and Investments, Farm B, 1960-64

Item	Benchmark	Alt. I	Alt. II
Receipts			
Apples	$10,770	$12,810	$12,810
Tart cherries	3,020	4,100	4,100
Pears	-	-	-
Peaches	4,310	4,310	4,670
Plums	-	1,920	1,920
Grapes	1,080	1,080	1,080
Total	19,180	24,220	24,580
Expenses			
Labor - hourly	2,000	3,040	2,800
- piecework	2,240	2,990	2,990
Seed	70	140	140
Spray material	2,600	3,280	3,290
Packages	3,100	3,680	3,750
Other supplies	50	100	100
Fertilizer and lime	600	1,080	1,070
Gas and oil	1,020	1,280	1,280
Building repairs	150	180	180
Machinery repairs	510	660	660
Property taxes	160	240	240
Insurance	220	230	230
Utilities	200	220	220
Miscellaneous	280	330	330
Replacement of existing equipment and buildings	1,580	1,580	1,580
Replacement of existing trees	-	-	-
Interest on existing debt	950	950	950
Interest on new investment	-	650	640
Total	15,730	20,630	20,450
Net Operating Income	3,450	3,590	4,130
New Investments			
Buildings	-	-	-
Machinery and equipment	-	620	620
Land	-	1,620	1,620
Trees	-	450	300
Total	-	2,690	2,540
Consumption Income	3,450	900	1,590

per year. An additional investment of $8,500 in land will be made under these two plans. Cash outlay for young trees will amount to an average of $450 annually under Alternative I and $300 per year under Alternative II during the 1960-1964 period.

Owing to these investment requirements, the expected consumption income from the farm business will average only $900 under Alternative I and $1,590 under Alternative II during this period. The $3,000 income from off-farm work will provide supplementary funds for family living during this period. Even the combined income from farm and nonfarm sources may not provide sufficient funds for family living needs under these alternatives. Therefore the operator may need to borrow for the investments under Alternatives I and II. A long-term mortgage on the purchased land may be a practical method of borrowing a portion of the needed capital.

The 1965-1969 Period - During this period, the expansion alternatives will require an investment in a larger air-blast sprayer. This new sprayer will cost $1,700 more than the value of the present sprayer, or an average annual capital outlay of $340 in the period (TABLE 9).

Because of this investment and owing to the nonbearing stage of many of the trees, consumption income under Alternative I will be about equal to that of the Benchmark Plan during this period. The consumption income under Alternative II, however, will be greater than that of the Benchmark Plan.

The Periods Between 1970 and 1979 - Fruit receipts from the large acreage of mature bearing trees under Alternative I and II will be much greater than the expenses and investments (TABLES 10 and 11). Thus, the

TABLE 9. Summary of Average Annual Receipts, Expenses and Investments, Farm B, 1965-69

Item	Benchmark	Alt. I	Alt. II
Receipts			
Apples	$13,090	$15,030	$15,860
Tart cherries	2,080	2,970	2,970
Pears	-	780	-
Peaches	5,380	3,840	7,960
Plums	-	3,840	1,920
Grapes	1,080	1,080	1,080
Total	21,630	27,540	29,790
Expenses			
Labor - hourly	2,240	3,180	3,250
- piecework	2,240	3,210	3,730
Seed	50	140	140
Spray material	2,710	3,390	3,550
Packages	3,680	4,580	5,280
Other supplies	50	100	100
Fertilizer and lime	600	1,150	1,150
Gas and oil	1,040	1,320	1,320
Building repairs	150	150	150
Machinery repairs	510	680	680
Property taxes	160	240	240
Insurance	220	240	240
Utilities	200	230	240
Miscellaneous	300	350	360
Replacement of existing equipment and buildings	1,580	1,580	1,580
Replacement of existing trees	60	60	60
Interest on existing debt	950	950	950
Interest on new investment	-	780	760
Total	16,740	22,330	23,780
Net Operating Income	4,890	5,210	6,010
New Investments			
Buildings	-	-	-
Machinery and equipment	-	340	340
Land	-	-	-
Trees	-	-	-
Total	-	340	340
Consumption Income	4,890	4,870	5,870

TABLE 10. Summary of Average Annual Receipts, Expenses and Investments, Farm B, 1970-74

Item	Benchmark	Alt. I	Alt. II
Receipts			
Apples	$14,900	$14,900	$20,070
Tart cherries	2,510	2,610	2,610
Pears	-	4,500	-
Peaches	4,420	4,250	10,150
Plums	-	6,930	1,620
Grapes	1,080	1,080	1,080
Total	22,910	34,270	35,530
Expenses			
Labor - hourly	2,340	3,350	4,030
- piecework	2,460	3,800	3,810
Seed	40	80	80
Spray material	2,750	3,470	3,820
Packages	3,720	5,330	6,190
Other supplies	50	100	100
Fertilizer and lime	600	1,010	1,150
Gas and oil	1,050	1,340	1,340
Building repairs	150	150	150
Machinery repairs	510	680	680
Property taxes	160	240	240
Insurance	220	240	240
Utilities	200	230	230
Miscellaneous	320	340	410
Replacement of existing equipment and buildings	1,580	1,580	1,580
Replacement of existing trees	-	-	-
Interest on existing debt	950	950	950
Interest on new investment	-	950	930
Total	17,100	23,840	25,930
Net Operating Income	5,810	10,430	9,600
New Investments			
Buildings	-	-	-
Machinery and equipment	-	700	700
Land	-	-	-
Trees	-	100	100
Total	-	800	800
Consumption Income	5,810	9,630	8,800

TABLE 11. Summary of Average Annual Receipts, Expenses and Investments, Farm B, 1975-79

Item	Benchmark	Alt. I	Alt. II
Receipts			
Apples	$14,900	$15,600	$24,210
Tart cherries	2,290	2,930	2,930
Pears	-	6,900	-
Peaches	2,600	2,250	8,470
Plums	-	6,400	-
Grapes	800	800	800
Total	20,590	34,880	36,410
Expenses			
Labor - hourly	1,950	3,330	3,950
- piecework	2,270	3,800	4,000
Seed	40	80	80
Spray material	2,780	3,530	4,220
Packages	4,050	6,280	7,120
Other supplies	50	100	100
Fertilizer and lime	600	1,080	1,250
Gas and oil	1,040	1,350	1,350
Building repairs	150	150	150
Machinery repairs	510	680	680
Property taxes	160	240	240
Insurance	220	240	240
Utilities	200	240	250
Miscellaneous	320	350	460
Replacement of existing equipment and buildings	1,580	1,580	1,580
Replacement of existing trees	90	90	90
Interest on existing debt	950	950	950
Interest on new investment	-	960	940
Total	16,960	25,030	27,650
Net Operating Income	3,630	9,850	8,760
New Investments			
Buildings	-	-	-
Machinery and equipment	-	-	-
Land	-	-	-
Trees	-	60	60
Total	-	60	60
Consumption Income	3,630	9,790	8,700

increase in acreage planned for Farm B under Alternatives I and II will result in much larger incomes during the second decade of the planning period than under the Benchmark organization.

Comparison of the Expected Incomes Over Time - The resulting income streams of the Benchmark Plan and the expansion alternatives for Farm B follow much the same pattern as the respective income streams for Farm A. The sum of expected future incomes (including ending values) is $53,000 greater under Alternative I, and $58,000 greater under Alternative II than under the Benchmark Plan (TABLE 12). The discounted values of future incomes from Alternatives I and II are about $20,000 greater than that for the Benchmark Plan, assuming a five percent discount rate.

Part of this difference in incomes results from differences in the value of the farm at the end of the 20-year period. Many fruit trees remaining in 1980 under the Benchmark Plan will be nearing the end of their productive life. By comparison, the value of the farm under the expansion alternatives will include an additional 31 acres of fruit trees which at this time will be in the early stages of maturity. Therefore, the value of the farm resources in 1980 will be greater for Alternatives I and II than for the Benchmark Plan.

Although Alternative I is expected to return more total future income than Alternative II, the discounted value of future incomes of Alternative II is greater than that of Alternative I. This relationship exists because the peaches planned under Alternative II will come into production earlier than the plums and pears planned under Alternative I. Therefore, more consumption income can be expected under Alternative II during the

TABLE 12. Summary of Future Income Streams For Various Plans, Farm B

Item	Benchmark	Alt. I	Alt. II
Consumption Incomes by Period			
1960-64	$ 3,450	$ 900	$ 1,590
1965-69	4,890	4,870	5,870
1970-74	5,810	9,630	8,800
1975-79	3,630	9,790	8,700
Ending Value of Farm	20,370	40,090	38,170
Total of Incomes and Ending Value	109,270	166,040	162,970
Discounted Totals			
at 5 percent rate	62,070	81,350	82,520
at 8 percent rate	46,490	55,280	57,420

early periods when the discounting procedure places a relatively high value on income.

Comparison of discounted totals under the expansion alternatives to that of the Benchmark Plan indicates that the operator will benefit by the expansion adjustment in the long run. Alternatives I and II can be expected to yield rather similar results.

Analysis of Farm C

The Present Situation

Farm C is a 60-acre fruit farm with 36.5 acres of bearing and nonbearing tree fruit. There are 8.5 acres of idle land which are suitable for tree fruits. Approximately 11 acres of other idle land are suited for Christmas trees or forest production. The remaining four acres include waste land, buildings, and roads.

Many of the existing fruit trees are nonbearing or have just reached bearing age. Because the trees are young and the acreage is relatively small, total farm production has been low and farm consumption income has been insufficient for family living requirements. Consequently, the owner-operator works at a full-time factory job in a neighboring city. This job provides sufficient income for normal family living expenses. Therefore, the net operating income from the farm is available for investment or additional consumption.

The operator would like to discontinue the off-farm job and devote his full time to the farm business. Expanding the tree-fruit acreage provides one possible method of increasing farm income to permit this.

An expansion of this nature may be undertaken by one of the following means:

(1) planting suitable owned land

(2) planting fruit trees on additional purchased land

(3) purchasing land with established fruit trees

(4) any combination of the first three possibilities.

The operator must meet annual payments for a rather large debt upon the existing farm. The existence of this debt, coupled with the limited amount of earnings and capital available for investment, will make it difficult for the operator to obtain sufficient capital to purchase additional land.

If the operator purchases an additional acreage of open land and plants young orchards, he will need to continue the off-farm job until the young trees reach bearing age. If he continues off-farm work, however, he will encounter difficulty in managing more acreage than is presently owned.

Comparison of the Alternatives

As shown in TABLE 13, 36.5 acres of tree fruit will be maintained under the Benchmark Plan. This plan includes replanting tart cherries on a three-acre block presently in old peaches. The operator has already incorporated this change into his present plans for the future.

Alternative I is used to determine results of planting the presently owned land which is suitable for fruit. This plan involves planting three acres of tart cherries, three acres of interplanted apples and

TABLE 13. Summary of Bearing and Nonbearing Acreage on Farm C Under Two Alternative Plans, 1960-79

Plan & Crop	1960-1964		1965-1969		1970-1974		1975-1979	
	B.	N.B.	B.	N.B.	B.	N.B.	B.	N.B.
	(acres)		(acres)		(acres)		(acres)	
Benchmark								
Apples	9	-	9	-	9	-	9	-
Tart cherries	7	-	7	3	6	4	10	-
Sweet cherries	-	4	4	-	4	-	4	-
Pears	-	1.5	1.5	-	1.5	-	1.5	-
Peaches	15	-	12	-	10	2	7	5
Christmas trees	-	-	-	-	-	-	-	-
Total	31.0	5.5	33.5	3.0	30.5	6.0	31.5	5.0
Alternative I								
Apples	9	3	9	3	12	-	12	-
Tart cherries	7	3	10	3	9	4	13	-
Sweet cherries	-	4	4	-	4	-	4	-
Pears	-	4	1.5	2.5	4	-	4	-
Peaches	15	-	12	-	10	2	7	5
Peaches (interplanted with apples)	-	(3)	(3)	-	(3)	-	-	-
Christmas trees	6	5	11	-	5	6	11	-
Total	37.0	19.0	47.5	8.5	44.0	12.0	51.0	5.0

peaches, and 2.5 acres of pears. Also the 11 acres suitable for Christmas trees will be used for raising 6 acres of Scotch Pine and 5 acres of White Spruce under Alternative I. (The Christmas tree acreage is classified as "bearing" or "nonbearing" in TABLE 13 according to the five-year period in which cuttings will be made.) Thus, under Alternative I the farm plan will include 47 acres of tree fruits and 11 acres of Christmas trees.

Almost all of the labor for the additional acreage will be hired, because the present operation requires most of the operator's time which is available for farm work. The operator will have enough time, however, to supervise the operation and make managerial decisions for the additional acreage.

In addition to greater expense for hired labor and other cash expense items under Alternative I, investments in machinery and nursery stock will be required for the larger acreage. A new disc will call for a $500 investment during the 1960-1964 period (TABLE 14). Cash outlay for young fruit and Christmas trees on the additional 19.5 acres under Alternative I will also require an average annual investment of $260 during this period.

During the 1965-1969 period, an air-blast sprayer will be purchased. This sprayer will be needed under the Benchmark Plan as well as under Alternative I because of the need to spray larger trees when the present trees mature. Under Alternative I, however, the operator will need a somewhat larger sprayer than under the Benchmark Plan. The bearing cherry acreage under Alternative I will require an investment of $1,000 in housing for harvest laborers during the 1965-1969 period.

TABLE 14. Summary of Average Annual Receipts, Expenses and Investments, Farm C, 1960-69

Item	1960-1964		1965-1969	
	Benchmark	Alt. I	Benchmark	Alt. I
Receipts				
Apples	$ 3,230	$ 3,230	$ 3,400	$ 3,740
Tart cherries	2,480	2,480	2,580	3,340
Sweet cherries	450	450	1,520	1,520
Pears	270	270	630	1,140
Peaches	3,600	3,700	2,460	2,900
Christmas trees	-	180	-	1,440
Total	10,030	10,310	10,570	14,080
Expenses				
Labor - hourly	620	1,070	840	1,580
- piecework	1,990	2,000	2,760	3,190
Seed	100	130	100	130
Spray material	1,510	1,680	1,570	1,840
Crate rental	200	200	170	200
Other supplies	-	-	-	-
Fertilizer and lime	490	640	510	670
Gas and oil	220	360	230	370
Building repairs	80	80	80	90
Machinery repairs	450	490	520	530
Property taxes	300	300	300	300
Insurance	80	100	80	110
Utilities	70	80	70	100
Miscellaneous	-	-	-	-
Replacement of existing equipment and buildings	890	890	890	890
Replacement of existing trees	-	-	330	330
Interest on existing debt	500	500	500	500
Interest on new investment	-	90	30	130
Total	7,420	8,610	8,990	10,860
Net Operating Income	2,610	1,700	1,610	3,220
New Investments				
Buildings	-	-	-	200
Machinery and equipment	-	100	700	800
Land	-	-	-	-
Trees	-	260	-	-
Total	-	360	700	1,000
Consumption Income	2,610	1,340	890	2,220

Additional housing for cherry harvesting laborers will also be required under both plans during the 1975-1979 period. Under Alternative I somewhat more investment will be required than under the Benchmark Plan (TABLE 15). Also, the sprayer will be replaced under both plans during this period.

Production and sale of Christmas trees during the last 15 years of the analysis will account for a portion of the expected receipts under Alternative I. The planting, pruning, spraying, and other operations for Christmas tree production also, will require greater expenses under this alternative than under the Benchmark Plan.[2] Nevertheless, a portion of the increased consumption income under Alternative I will result from the Christmas tree enterprise.

Comparison of Financial Results Over Time

Although the Benchmark Plan is expected to return a greater consumption income than Alternative I during the 1960-1965 period, consumption income expected from Alternative I will be greater than for the Benchmark Plan during each of the later periods (TABLE 16). The ending value of the farm real estate under Alternative I will also be somewhat larger than the ending value under the Benchmark Plan. The difference is not great, however, because total land area under each plan will be the same. In addition, the fruit acreage under Alternative I will be only 8.5 acres

---

[2]The data regarding Christmas tree planting and production practices, expenses, yields, prices, and time of harvest were largely obtained from L. M. James, Production and Marketing of Plantation Grown Christmas Trees in Michigan, Michigan Agricultural Experiment Station, Special Bulletin 423, 1959.

TABLE 15. Summary of Average Annual Receipts, Expenses and Investments, Farm C, 1970-79

Item	1970-1974		1975-1979	
	Benchmark	Alt. I	Benchmark	Alt. I
Receipts				
Apples	$ 3,370	$ 4,560	$ 3,180	$ 4,370
Tart cherries	2,420	3,910	3,980	5,460
Sweet cherries	2,150	2,150	2,150	2,150
Pears	690	1,610	690	1,830
Peaches	3,380	4,360	2,210	2,210
Christmas trees	-	550	-	960
Total	12,010	17,140	12,210	16,980
Expenses				
Labor - hourly	1,060	2,060	1,020	1,650
- piecework	3,090	4,160	3,650	4,700
Seed	100	120	100	120
Spray material	1,600	2,010	1,690	1,950
Crate rental	180	240	150	200
Other supplies	-	-	-	-
Fertilizer and lime	510	730	550	680
Gas and oil	230	350	230	350
Building repairs	80	100	100	140
Machinery repairs	450	510	450	520
Property taxes	300	300	300	300
Insurance	80	170	80	150
Utilities	70	120	70	130
Miscellaneous	-	-	-	-
Replacement of existing equipment and buildings	890	890	890	890
Replacement of existing trees	190	190	430	430
Interest on existing debt	500	500	500	500
Interest on new investment	30	130	80	190
Total	9,360	12,580	10,290	12,920
Net Operating Income	2,650	4,560	1,920	4,060
New Investments				
Buildings	-	-	300	500
Machinery and equipment	-	100	700	800
Land	-	-	-	-
Trees	-	30	-	-
Total	-	130	1,000	1,300
Consumption Income	2,650	4,460	920	2,760

TABLE 16. Summary of Future Income Streams For Various Plans, Farm C

Item	Benchmark	Alt. I
Consumption Incomes by Period		
1960-64	$ 2,610	$ 1,340
1965-69	890	2,220
1970-74	2,650	4,460
1975-79	920	2,760
Ending Value of Farm	20,210	22,420
Total of Incomes and Ending Value	55,560	76,320
Discounted Totals		
at 5 percent rate	30,850	39,310
at 8 percent rate	26,520	31,420

greater than the acreage under the Benchmark Plan, and the Christmas tree acreage under Alternative I will have been harvested and will need to be replanted at this time. The consumption income and ending value under Alternative I will result in a total expected future income which is about $20,800 more than the future income under the Benchmark Plan. The discounted incomes will also be larger under Alternative I than under the Benchmark Plan. These comparisons indicate the increasing fruit acreage is expected to be more advantageous for the operator of Farm C than the present organization. The analysis shows, however, that continuation of off-farm employment will be necessary under both plans.

Analysis of Farm D

The operator of Farm D presently owns 53 acres of land on which there are 38 acres of fruit trees and three acres of asparagus. There are 7 acres in woods, and the remaining four acres include roads and the farmstead.

The farm operator believes that expansion of the fruit acreage will increase farm income available for family consumption. Operation of the present farm business indicates a high degree of management capacity and skill in raising fruit crops. High yields of very high quality fruit are obtained. The present machinery is sufficient to farm a larger acreage without major additional investments in equipment. The operator has no present debt. The present farm organization produces sufficient net income to provide moderate amounts of investment capital. Thus, capital is not a severe limitation upon farm business alternatives.

An adjacent 22 acre tract of land can be purchased for $5,500. This tract has 20 acres of open land suitable for fruit and two acres of woods. The land is similar in site and quality to that of the present acreage. Therefore, yields from this additional acreage are expected to be comparable to yields from the present acreage. Woodland on the present farm offers another opportunity to increase the acreage available for tree fruits. Clearing this woodland will provide 7 acres of land comparable in quality to the present orchard land.

Alternatives I and II are used to explore the results if the adjacent 22 acres are purchased. Under these alternatives, young orchards will be planted on the 20 acres of open land. Under Alternative III, the present fruit acreage will be increased by 29 acres. This area includes the 20 acres of open land on the purchased tract plus the 7 acres of woodland on the present farm and two acres of woodland on the purchased land.

Existing fruit acreage consists of 28.5 acres of peaches, 7 acres of apples, one acre each of plums and pears, and 0.8 acre of tart cherries. In addition, three acres of asparagus are raised (TABLE 17.) The present specialization in a large peach enterprise, with a limited acreage of apples and only token amounts of pears, plums, and cherries, requires much hired labor during certain peak periods, such as during peach thinning time. On the other hand, during periods when there are no operations involving the peach enterprise, relatively little labor is required.

More uniform labor needs throughout the year would result from decreasing the relative importance of the peach enterprise and increasing the importance of one or more of the other fruit enterprises. The operator

TABLE 17. Summary of Bearing and Nonbearing Acreage on Farm D Under Four Alternative Plans, 1960-79

Plan & Crop	1960-1964		1965-1969		1970-1974		1975-1979	
	B.	N.B.	B.	N.B.	B.	N.B.	B.	N.B.
	(acres)		(acres)		(acres)		(acres)	
Benchmark								
Apples	7	-	5	2	5	2	7	-
Tart cherries	0.8	-	0.8	-	0.8	-	0.8	-
Pears	1	-	1	-	1	-	1	-
Peaches	25.5	3	10.5	18	28.5	-	28.5	-
Plums	1	-	1	-	1	-	1	-
Asparagus	3	-	3	-	3	-	3	-
Total	38.3	3.0	21.3	20.0	39.3	2.0	41.3	0.0
Alternative I								
Apples	7	-	5	-	5	-	5	-
Tart cherries	0.8	10	8.8	8	16.8	-	16.8	-
Pears	1	13	1	13	14	-	14	-
Peaches	25.5	3	10.5	9	19.5	-	19.5	-
Plums	1	-	1	5	6	-	6	-
Asparagus (interplanted with pears)	(3)	-	(3)	-	-	-	-	-
Total	35.3	26.0	26.3	35.0	61.3	0.0	61.3	0.0
Alternative II								
Apples	7	-	5	2	5	2	7	-
Tart cherries	0.8	16	13.8	3	16.8	-	16.8	-
Pears	1	4	1	4	5	-	5	-
Peaches	25.5	3	10.5	18	28.5	-	28.5	-
Plums	1	-	1	-	1	-	1	-
Asparagus	3	-	3	-	3	-	3	-
Total	38.3	23.0	34.3	27.0	59.3	2.0	61.3	0.0
Alternative III								
Apples	7	-	5	2	5	2	7	-
Tart cherries	0.8	10	8.8	8	16.8	-	16.8	-
Pears	1	17	1	17	18	-	18	-
Peaches	25.5	3	10.5	9	19.5	-	19.5	-
Plums	1	5	6	3	9	-	9	-
Asparagus (interplanted with pears)	(3)	-	(3)	-	-	-	-	-
Total	35.3	35.0	31.3	39.0	68.3	2.0	70.3	0.0

would then need less hired labor for a given volume of business. The present peach acreage includes 21 acres of old peach trees which are near the end of their economically productive life and which will need to be removed within a few years.

Therefore, a reduction of peach acreage, in combination with an increase in acreage of other fruits, is planned under Alternative I and III (TABLE 17). Under Alternative II the acreage of tart cherries and pears will be increased, while the acreage of all other enterprises will remain the same as under the Benchmark Plan. The financial results under these alternatives are shown in TABLES 18 through 21 and summarized in TABLE 22.

Consumption incomes under the expansion alternatives will be less than the expected consumption income under the Benchmark Plan during the 1960-1965 period. On the other hand, during each of the later five-year periods the expansion alternatives are expected to provide larger consumption incomes than the Benchmark Plan. In addition, the ending values of the farm real estate, as shown in TABLE 22, will be greater under the expansion alternatives than under the Benchmark Plan. Thus the total income from these alternatives during the 20-year planning period will be much larger than that of the Benchmark Plan. Discounted values of future expected incomes under the different plans also show higher incomes for the expansion alternatives. Alternative III appears to be the most favorable size and enterprise combination. Comparison of the total and discounted incomes from Alternatives I and II, both of which involve the same acreage, indicates that there may be little advantage in adjusting the present crop acreages as planned under Alternative I.

TABLE 18. Summary of Average Annual Receipts, Expenses and Investments, Farm D, 1960-64

Item	Benchmark	Alt. I	Alt. II	Alt. III
Receipts				
Apples	$ 2,800	$ 2,800	$ 2,800	$ 2,800
Tart cherries	580	710	800	710
Pears	410	410	410	410
Peaches	8,770	8,770	8,770	8,770
Plums	650	650	650	850
Asparagus	540	460	540	460
Total	13,750	13,800	13,970	14,000
Expenses				
Labor - hourly	720	1,190	1,170	1,300
- piecework	2,290	2,340	2,460	2,370
Seed	90	160	160	170
Spray material	950	1,260	1,240	1,260
Crate rental	300	300	300	300
Other supplies	100	160	160	160
Fertilizer and lime	460	580	580	600
Gas and oil	720	920	920	970
Building repairs	170	170	170	170
Machinery repairs	530	590	590	630
Property taxes	140	200	200	210
Insurance	110	110	110	110
Utilities	160	170	170	170
Miscellaneous	80	90	90	90
Replacement of existing equipment and buildings	1,410	1,410	1,410	1,410
Replacement of existing trees	60	70	60	70
Interest on existing debt	-	-	-	-
Interest on new investment	-	310	300	450
Total	7,810	10,050	10,090	10,440
Net Operating Income	5,940	3,750	3,880	3,560
New Investments				
Buildings	-	-	-	-
Machinery and equipment	-	80	80	80
Land	-	1,100	1,100	1,400
Trees	-	480	420	620
Total	-	1,660	1,600	2,820
Consumption Income	5,940	2,090	2,280	740

TABLE 19. Summary of Average Annual Receipts, Expenses and Investments, Farm D, 1965-69

Item	Benchmark	Alt. I	Alt. II	Alt. III
Receipts				
Apples	$ 2,200	$ 2,200	$ 2,200	$ 2,200
Tart cherries	530	4,270	5,980	4,270
Pears	480	2,040	1,110	3,170
Peaches	5,880	4,960	5,880	4,960
Plums	680	890	680	2,320
Asparagus	540	180	540	180
Total	9,310	15,020	16,390	17,100
Expenses				
Labor - hourly	570	710	880	930
- piecework	1,750	3,340	4,290	2,790
Seed	110	150	150	170
Spray material	650	1,130	1,210	1,250
Crate rental	200	230	220	270
Other supplies	90	140	140	140
Fertilizer and lime	280	400	400	420
Gas and oil	680	900	930	970
Building repairs	170	170	170	170
Machinery repairs	510	610	610	630
Property taxes	140	200	200	210
Insurance	110	110	110	110
Utilities	150	180	190	190
Miscellaneous	80	90	90	90
Replacement of existing equipment and buildings	1,410	1,410	1,410	1,410
Replacement of existing trees	380	380	380	380
Interest on existing debt	-	-	-	-
Interest on new investment	-	350	340	490
Total	7,280	10,500	11,720	10,620
Net Operating Income	2,030	4,520	4,670	6,480
New Investments				
Buildings	-	-	-	-
Machinery and equipment	-	-	-	-
Land	-	-	-	-
Trees	-	-	-	-
Total	-	-	-	-
Consumption Income	2,030	4,520	4,670	6,480

TABLE 20. Summary of Average Annual Receipts, Expenses and Investments, Farm D, 1970-74

Item	Benchmark	Alt. I	Alt. II	Alt. III
Receipts				
Apples	$ 2,510	$ 2,190	$ 2,510	$ 2,190
Tart cherries	440	7,260	9,240	7,260
Pears	480	5,430	2,010	6,960
Peaches	12,270	7,760	11,970	7,760
Plums	680	3,070	680	5,120
Asparagus	540	-	540	-
Total	16,920	25,710	26,950	29,290
Expenses				
Labor - hourly	510	1,140	1,310	1,590
- piecework	2,530	6,430	6,640	7,100
Seed	90	150	150	170
Spray material	740	1,270	1,390	1,470
Crate rental	330	360	360	420
Other supplies	110	120	120	120
Fertiliser and lime	360	510	510	610
Gas and oil	700	920	920	990
Building repairs	170	200	200	200
Machinery repairs	520	650	650	690
Property taxes	140	200	200	210
Insurance	110	140	140	140
Utilities	160	190	190	200
Miscellaneous	80	90	90	90
Replacement of existing equipment and buildings	1,410	1,410	1,410	1,410
Replacement of existing trees	-	-	-	-
Interest on existing debt	-	-	-	-
Interest on new investment	-	640	630	780
Total	7,960	14,390	14,890	16,160
Net Operating Income	8,960	11,320	12,060	13,130
New Investments				
Buildings	-	800	800	800
Machinery and equipment	-	370	370	370
Land	-	-	-	-
Trees	-	-	-	-
Total	-	1,170	1,170	1,170
Consumption Income	8,960	10,150	10,890	11,960

TABLE 21. Summary of Average Annual Receipts, Expenses and Investments, Farm D, 1975-79

Item	Benchmark	Alt. I	Alt. II	Alt. III
Receipts				
Apples	$ 2,870	$ 2,010	$ 2,870	$ 2,010
Tart cherries	360	9,160	9,160	9,160
Pears	480	6,670	2,380	8,570
Peaches	12,880	7,470	12,480	7,470
Plums	680	3,740	680	5,790
Asparagus	540	-	540	-
Total	17,810	29,050	28,110	33,000
Expenses				
Labor - hourly	640	1,630	2,610	2,230
- piecework	2,710	7,240	6,670	7,950
Seed	90	150	150	170
Spray material	950	1,570	1,600	1,770
Crate rental	340	390	370	450
Other supplies	120	140	140	140
Fertilizer and lime	460	710	710	820
Gas and oil	720	950	950	1,030
Building repairs	170	260	260	260
Machinery repairs	540	670	670	710
Property taxes	140	200	200	210
Insurance	110	150	150	150
Utilities	160	210	210	220
Miscellaneous	80	100	100	100
Replacement of existing equipment and buildings	1,410	1,410	1,410	1,410
Replacement of existing trees	-	-	-	-
Interest on existing debt	-	-	-	-
Interest on new investment	-	690	680	830
Total	8,640	16,430	16,840	18,410
Net Operating Income	9,170	12,620	11,270	14,590
New Investments				
Buildings	-	200	200	200
Machinery and equipment	-	-	-	-
Land	-	-	-	-
Trees	-	-	-	-
Total	-	200	200	200
Consumption Income	9,170	12,420	11,070	14,390

TABLE 22. Summary of Future Income Streams For Various Plans, Farm D

Item	Benchmark	Alt. I	Alt. II	Alt. III
Consumption Incomes by Period				
1960-64	$ 5,940	$ 2,090	$ 2,280	$ 740
1965-69	2,030	4,520	4,670	6,480
1970-74	8,960	10,150	10,890	11,960
1975-79	9,170	12,420	11,070	14,390
Ending Value of Farm	83,340	89,600	89,250	103,930
Total of Incomes and Ending Value	213,840	235,500	233,800	271,780
Discounted Totals				
at 5 percent rate	73,460	75,710	76,820	84,810
at 8 percent rate	61,560	61,560	61,930	68,160

Analysis of Farm E

Farm E is somewhat larger than the other case farms. The farm includes 107 acres of land on which there are 97 acres of tree fruits and five acres of asparagus (TABLE 23).

Much of the apple crop and all of the peaches and plums are graded and packed in bushel baskets for sale on the Benton Harbor Market. The large acreage of tree fruit and the accompanying packing operations require large amounts of hired labor. In addition to seasonal harvest labor, the operator hires one full-time man during the growing season. The operator and a high-school age son, who is paid an hourly wage, complete the labor force.

Although cherry yields are relatively high (four tons per acre), the yields of apples, peaches, and plums are relatively low. Prices received for these fruits are also relatively low when the expenses for packages and for grading and packaging are considered.

Although machinery is adequate for a larger fruit acreage, present results indicate a relatively low degree of managerial capacity for this size and type of farm operation. Difficulties are encountered in timeliness of operations, handling of harvest labor crews, and other aspects of the farm business. A larger acreage may only accentuate these problems.

Nevertheless, a budgeting analysis was used to estimate changes in consumption income if the fruit acreage of Farm E is increased. Alternative I assumes that a nearby 40 acres will be purchased. Thirty acres of the land are suited for tree fruit, and will be planted to 15 acres of tart cherries and 15 acres of peaches.

TABLE 23. Summary of Bearing and Nonbearing Acreage on Farm E Under Two Alternative Plans, 1960-79

Plan & Crop	1960-1964		1965-1969		1970-1974		1975-1979	
	B.	N.B.	B.	N.B.	B.	N.B.	B.	N.B.
	(acres)		(acres)		(acres)		(acres)	
Benchmark								
Apples	44	-	44	-	44	-	35	9
Tart cherries	25	-	25	-	12	13	19	6
Peaches	13	-	13	-	-	13	13	-
Plums	15	-	15	-	15	-	8	7
Plums (interplanted with apples)	(3)	-	-	-	-	-	-	-
Asparagus	5	-	5	-	5	-	5	-
Total	102.0	0.0	102.0	0.0	76.0	26.0	80.0	22.0
Alternative I								
Apples	44	-	44	-	44	-	35	9
Tart cherries	25	15	31	9	27	13	34	6
Peaches	13	15	25	3	15	13	28	-
Plums	15	-	15	-	15	-	8	7
Plums (interplanted with apples)	(3)	-	-	-	-	-	-	-
Asparagus	5	-	5	-	5	-	5	-
Total	102.0	30.0	120.0	12.0	106.0	26.0	110.0	22.0

Owing to increased hired labor expense, other cash expenses, and to necessary investments under Alternative I, a negative operating income and consumption income are indicated during the 1960-1964 period. During the periods from 1965-1975, the expected consumption income for Alternative I will also be less than the income for the Benchmark Plan (TABLES 24 and 25). This is partly because of the labor expense for operating the large acreage. Other very important factors are expected low yields and relatively low quality fruit. These expectations are based upon the historical results of the present operation.

Although the consumption income expected under Alternative I is less than that of the Benchmark Plan during the periods from 1960-1974, the income under Alternative I will be greater than that of the Benchmark Plan during the 1975-1979 period (TABLE 26). The ending value of the farm real estate is also higher under Alternative I. Nevertheless, the total expected income from the Benchmark Plan during the 20-year planning period is $15,000 more than that expected from Alternative I. The total discounted value of the future incomes (including ending farm value) is also less for Alternative I than for the Benchmark Plan. This comparison, plus the fact that consumption incomes during the first 15 years of the analysis are considerably below a minimal requirement, indicates that expansion of tree-fruit acreage will not be profitable on Farm E.

General Results from Expansion

The analyses for four of the five case farms indicate opportunities for increasing future consumption incomes by moderate expansions in tree fruit acreage. However, much of the increases in net income will not begin to accrue until 10 to 15 years after planting the additional acreage.

TABLE 24. Summary of Average Annual Receipts, Expenses and Investments, Farm E, 1960-69

Item	1960-64		1965-69	
	Benchmark	Alt. I	Benchmark	Alt. I
Receipts				
Apples	$17,000	$16,500	$17,800	$17,300
Tart cherries	11,280	11,570	9,570	12,210
Peaches	3,720	4,130	3,150	6,170
Plums	3,910	3,910	4,060	3,890
Asparagus	600	600	600	600
Total	36,510	36,710	35,180	40,170
Expenses				
Labor - hourly	3,300	5,110	3,260	4,420
- piecework	7,510	7,610	7,730	9,160
Seed	310	440	310	400
Spray material	3,450	4,180	3,820	4,820
Packages	4,520	4,610	4,380	5,050
Other supplies	-	100	-	60
Fertilizer and lime	2,280	2,640	2,380	2,800
Gas and oil	2,320	2,470	2,320	2,560
Building repairs	110	110	110	140
Machinery repairs	2,010	2,130	2,010	2,230
Property taxes	350	530	350	530
Insurance	370	370	370	380
Utilities	80	100	80	120
Miscellaneous	290	310	290	340
Replacement of existing equipment and buildings	4,390	4,390	4,390	4,390
Replacement of existing trees	-	-	-	-
Interest on existing debt	1,200	1,200	1,200	1,200
Interest on new investment	-	550	-	620
Total	32,490	36,850	33,000	39,220
Net Operating Income	4,020	-140	2,180	950
New Investments				
Buildings	-	-	-	200
Machinery and equipment	-	-	-	100
Land	-	1,600	-	-
Trees	-	590	-	-
Total	-	2,190	-	300
Consumption Income	3,740	-2,330	2,180	650

TABLE 25. Summary of Average Annual Receipts, Expenses and Investments, Farm E, 1970-79

Item	1970-74		1975-79	
	Benchmark	Alt. I	Benchmark	Alt. I
Receipts				
Apples	$17,890	$17,410	$17,180	$16,740
Tart cherries	5,730	12,330	6,820	13,420
Peaches	440	5,120	2,870	7,550
Plums	3,120	2,950	1,990	1,990
Asparagus	600	600	480	480
Total	27,780	38,410	29,340	40,180
Expenses				
Labor - hourly	2,330	4,280	2,290	4,450
- piecework	5,050	8,360	5,710	9,020
Seed	310	400	310	400
Spray material	3,230	5,520	3,750	5,040
Packages	3,590	4,620	3,250	4,280
Other supplies	-	40	-	40
Fertilizer and lime	1,890	2,400	1,830	2,360
Gas and oil	1,880	2,180	1,840	2,140
Building repairs	110	140	110	170
Machinery repairs	1,600	1.870	1,500	1,780
Property taxes	350	530	350	530
Insurance	370	380	370	390
Utilities	80	130	80	130
Miscellaneous	290	360	290	360
Replacement of existing equipment and buildings	3,990	4,390	3,990	4,390
Replacement of existing trees	610	610	450	450
Interest on existing debt	1,200	1,200	1,200	1,200
Interest on new investment	-	620	-	640
Total	26,880	38,030	27,320	37,770
Net Operating Income	900	380	2,020	2,410
New Investments				
Buildings	-	-	-	200
Machinery and equipment	-	-	-	-
Land	-	-	-	-
Trees	-	-	-	-
Total	-	-	-	200
Consumption Income	900	380	2,020	2,210

TABLE 26. Summary of Future Income Streams For Various Plans, Farm E

Item	Benchmark	Alt. I
Consumption Incomes by Period		
1960-64	$ 3,740	$ -2,320
1965-69	2,180	650
1970-74	900	380
1975-79	2,020	2,210
Ending Value of Farm	52,030	62,150
Total of Incomes and Ending Value	81,270	66,750
Discounted Totals		
at 5 percent rate	34,620	18,820
at 8 percent rate	24,200	9,340

The resulting future incomes from planting additional acreages exhibit the same general pattern on all five case farms. Expected consumption incomes from the larger acreages are smaller during the first several years than incomes from the present acreage. On the other hand, incomes in the later years, as well as the ending value of farm assets after 20 years, will be larger from the increased acreages than than returns from the present farm size. Net results on four of the five farms indicate an increase in long-run returns even if future incomes are discounted at rates of 5 to 8 percent. Although the results indicate the expansion adjustment on these farms will be profitable in itself, this adjustment may be considerably more important if it is accompanied by the adoption of mechanical harvesting and mechanical handling technologies. The effects on net income of interrelationships between various farm sizes and the adoption of these technologies are explored in the following two chapters.

CHAPTER III

Adopting Mechanical Harvesting

Large amounts of harvest labor are a major input on tree-fruit farms. Hired labor costs on Michigan fruit farms have been increasing in recent years and are expected to continue to increase in the future. Fruit farmers often have difficulty in obtaining sufficient seasonal harvest labor. Substitution of machinery for hand labor will result in large savings in hired labor expenses for many fruit growers.

Recent experiments indicate the technical feasibility of harvesting certain Michigan fruits by mechanical methods.[1] The experiments indicate that new mechanical harvesting methods are especially well suited for harvesting tart cherries. However, plums and sweet cherries can also be harvested mechanically if they are to be sold for canning. Owing to the technical difficulties encountered in harvesting easily bruised fruits, satisfactory mechanical harvesting methods for apples, pears, and peaches have not been developed to date.

Tart cherries are an important crop on many Michigan tree-fruit farms. In 1958 there were 41,700 acres of tart cherry trees in Michigan, compared to 66,800 acres of apples, 20,700 acres of peaches, 9,000 acres of pears, 5,600 acres of sweet cherries, and 3,100 acres of plums.[2]

---

[1]H. P. Gaston, J. H. Levin, and S. L. Hedden, "Mechanical Harvesting of Michigan Grown Fruits," Eighty-eighth Annual Report of the Michigan State Horticultural Society, (December 1958); H. P. Gaston, J. H. Levin, and S. L. Hedden, "Experiments in Harvesting Cherries Mechanically," Quarterly Bulletin, Michigan State University Agricultural Experiment Station, Volume 41, No. 4, pp. 805-811, May 1959; J. H. Levin, H. P. Gaston, S. L. Hedden, and R. T. Whittenberger,"Mechanizing the Harvest of Red Tart Cherries," Quarterly Bulletin, Michigan State University Agricultural Experiment Station, Volume 42, No. 4, May 1960.

[2]Michigan Department of Agriculture, Michigan Agricultural Statistics, (July 1959).

Among 95 southwestern Michigan fruit and vegetable farms surveyed in 1956, 81 were growing tart cherries.[3] Thirty-one of 46 fruit farm cooperators in the Michigan State University farm account project during 1958 grew tart cherries.[4] These samples, although not completely representative of all Michigan fruit farms, indicate the number of growers who may be concerned about adjustments involving the tart cherry enterprise.

Although experimental results suggest that many tart cherry growers can profit by adoption of mechanical harvesting, the size of the farm, amount of specialization, and other farm characteristics will influence the gain which can be realized.

This chapter will examine the profitability of adopting mechanical harvesting methods under various farm situations.

Relevant factors include:

(1) Acreage of tart cherries on the farm.

(2) Yield per acre or per tree.

(3) Equipment costs for mechanical harvesting. (Within this category are expenses for original investment, repairs, interest, and insurance. The life of the equipment, as determined by deterioration and obsolescence, is also important in determining equipment costs.)

(4) Equipment costs for ladders, picking pails, and straps used for hand harvesting.

---

[3]From unpublished data in files of Michigan State University Agricultural Economics Department.

[4]R. G. Wheeler, op. cit., Fruit Farming Today, (1959).

(5) Hired labor expenses for both mechanical and hand harvesting methods. (These expenses include the amount paid for social security taxes and employer's liability insurance.)

(6) Housing expenses for harvest workers.

(7) Relative quality of fruit from the two methods.

(8) Relative yield from the two methods.

(9) Amount of supervision necessary.

(10) Damage to the trees.

(11) Amount of pruning needed.

(12) Supplementarity between fruit enterprises for the use of mechanical equipment.

(13) Risks involved in both methods.

(14) Personal preferences of the operator.

The Case-Farm Analysis

Budgeting of five case farms was used to determine the combined effect of each of the above factors upon the profitability of adopting mechanical harvesting methods under different farm situations. These case farms represent different situations regarding acreage and yield of tart cherries, as well as acreage of sweet cherries or plums.

On each case farm, financial results were estimated for the use of mechanical harvesting and hand harvesting methods. This was done by evaluating the pertinent factors of the particular farm situation as they affect net income. A summary of the financial results on the five case farms is presented in TABLES 27 and 28. For each farm, Plan I shows the expected results if hand harvest methods are continued. Plan II

TABLE 27. Comparative Financial Summary for Alternative Harvesting Plans, Farms A, B and C.

Item	Farm A		Farm B		Farm C		
	Plan I	Plan II	Plan I	Plan II	Plan I	Plan II	Plan III
Receipts							
Tart cherries	$4,070	$3,850	$3,020	$2,970	$5,460	$5,180	$5,180
Sweet cherries	--	--	--	--	2,150	2,150	1,720
Plums	--	--	--	--	--	--	--
Other receipts	27,290	27,290	14,890	14,890	9,460	9,460	9,460
Total	31,360	31,140	17,910	17,860	17,070	16,790	16,360
Expenses							
Labor - hourly	950	2,000	2,000	2,620	1,650	2,730	2,980
- piecework	4,870	2,760	2,280	1,110	4,700	2,180	1,180
Gas and oil	1,090	1,120	1,020	1,040	490	520	530
Building repairs	140	120	150	150	190	140	140
Machinery repairs	320	420	510	620	520	620	640
Insurance	240	260	240	260	190	210	210
Utilities	160	140	200	180	130	110	110
Interest on new investment	50	100	--	100	100	100	100
Replace mach.	50	740	--	740	40	740	740
Replace build.	50	--	--	--	120	--	--
All other charges	10,350	10,350	6,290	6,290	4,440	4,440	4,440
Total	18,270	18,020	12,690	13,070	12,570	11,790	11,070
Net income	13,090	13,120	5,220	4,790	4,500	5,000	5,290
Additional income from mechanical harvesting		30		-430		500	790

TABLE 28. Comparative Financial Summary for Alternative Harvesting Plans, Farms D and F

Item	Farm D			Farm F	
	Plan I	Plan II	Plan III	Plan I	Plan II
Receipts					
Tart cherries	$7,260	$6,800	$6,800	$6,600	$6,290
Sweet cherries	--	--	--	--	--
Plums	3,070	3,070	2,910	--	--
Other receipts	15,380	15,380	15,380	42,050	42,050
Total	25,710	25,250	25,090	48,650	48,340
Expenses					
Labor - hourly	1,140	2,240	2,640	5,860	7,530
- piecework	6,430	1,920	2,390	9,500	6,730
Gas and oil	920	950	970	1,680	1,720
Building repairs	200	120	120	420	420
Machinery repairs	650	790	840	1,150	1,300
Insurance	140	160	160	850	870
Utilities	190	170	170	740	710
Interest on new investment	190	100	100	--	100
Replace mach.	50	740	740	--	740
Replace build.	200	--	--	--	--
All other charges	4,110	4,110	4,110	23,330	23,330
Total	14,220	11,310	11,190	43,530	43,460
Net income	11,490	13,940	13,900	5,120	4,880
Additional income from mechanical harvesting		2,450	2,410		-240

shows the expected results if mechanical harvesting is used for tart cherries. Plan III for Farms C and D shows the expected results if sweet cherries or plums are harvested mechanically in addition to the tart cherries.

Adoption of mechanical harvesting does not involve an extended transitional period. Therefore, the figures in TABLES 27 and 28 represent expected results soon after the mechanical harvesting equipment is purchased. The figures are based on average conditions regarding weather and prices. The replacement charges reflect straight-line depreciation of the capital outlay over the estimated life of the machinery or buildings.

Basic Data for Budgeting

The 1959 season was the first season during which a few growers used the mechanical harvesting equipment on a commercial scale. The experience of these growers provides a limited commercial test for the new technology. The indicated results, as reported by Levin, Gasten, Hedden, and Whittenberger[5] are used for budgeting in this analysis.

The original investment for each farm includes $2,700 for a hydraulically operated shaker-boom attachment for a farm tractor and $600 for catching equipment. All of the case farms have two or more farm tractors, one of which can be used for mounting the shaker-boom.

The annual replacement charge for equipment on each case farm is based upon an estimated life of five years for the shaker and three years for the catching equipment. Owing to the recent development of this

---

[5]Levin, et. al, op. cit., "Mechanizing the Harvest of Red Tart Cherries."

equipment and to expected improvements in the design during the next few years, obsolescence is a key factor in determining the estimated life. Present indications of the need for improvements in the catching-frame design suggest this equipment may become obsolete sooner than the shaker.

The investment figures and the estimated life of the equipment result in an annual fixed cost for machinery replacement of $740 per year. A five percent interest charge on the average investment results in an additional annual charge of $100. To this is added a one percent charge for insurance and miscellaneous costs, which equals $20. Thus, a total annual fixed cost of $860 is calculated for the mechanical harvesting equipment.

Labor expenses for mechanical harvesting operations include wages for a seven-man crew at $1.25 per hour for each man. (Deductions are made on certain farms, to allow for the existing labor supply.)

Experimental results indicate that yield and quality of fruit harvested mechanically may be equal to that of hand picked fruit. If the equipment is not properly adjusted, however, or if conditions are less than ideal, both yield and quality of the fruit may be less for mechanical harvesting than for hand harvesting. Therefore, a three percent reduction in yield and a two percent reduction in price because of lower quality cherries are estimated in the budgeting analysis to allow for possible technical difficulties in the mechanical operation.

A factor which may affect long-run yields is possible damage to the tree by use of the shaker. Although little is known about the effects on yield from mechanical harvesting damage to the trees, observed damage does not appear to be serious. Therefore, in this analysis no attempt

is made to place an economic value on this factor. It may, however, in the future prove to be a major technical difficulty.

Experimental results have indicated that 8 to 15 tart cherry trees per hour can be harvested with present mechanical harvesting methods. A rate of 12 trees per hour may be considered standard for usual conditions. Young dense trees, uneven ground, high vegetative cover, or closely spaced trees will tend to reduce the number of trees harvested per hour.

The experimental results indicate that approximately the same rate of harvest can be maintained with large yields per tree as with lower yields. Pruning the trees to facilitate mechanical harvesting may increase the rate of harvest. However, little information is available regarding the amount of pruning necessary and the effect of pruning on the harvest rate. It seems probable that the pruning operation directed toward mechanical harvesting will involve a different type of pruning rather than larger amounts of labor.

Experiments in harvesting sweet cherries mechanically indicate that these methods may be technically feasible, particularly for ripe cherries sold for canning. Present methods, however, are not as satisfactory for harvesting sweet cherries as for harvesting tart cherries. Mechanical harvesting of ripe sweet cherries can be expected to reduce yield 10 percent from that obtained by hand methods and reduce fruit price 10 percent because of lower quality. Experiments with mechanical harvesting of unripe sweet cherries sold for maraschinos indicate even greater reductions in yield and fruit quality. Further research can be expected to improve this harvesting performance. However, the present performance, which can be expected to result in approximately a 20-percent reduction in sweet cherry receipts, is the basis for the budgeting analysis.

Analysis of Farm A

Farm A has a 14-acre tart cherry enterprise. Six-year old trees are planted on 10 of these acres. There are a total of 1,400 trees to be harvested. The operator normally obtains very high yields on the bearing acreage. Therefore, although the trees are relatively young, a three-ton yield is expected on the entire acreage. A total annual crop of 42 tons is expected.

Because there are two operators on Farm A, it is assumed that one will be free from other farm duties to supervise the mechanical harvesting operation and fulfill the duties of one member of the seven-man harvest crew. The other operator will haul the fruit. Therefore, expense for a six-man hired crew is assumed for budgeting.

The young, dense trees on much of the cherry acreage of Farm A are expected to result in a mechanical harvesting rate of 10 trees per hour. Thus a total of 140 hours will be required to harvest the 1,400 trees mechanically, at a hired labor expense of $1,050. On the other hand, harvesting the cherries by hand will require $2,110 for piecework labor, figured at $52 per ton for 40 tons.[6] (The remaining two tons will be picked by the operators' families.) Expenses of $30 for social security taxes and liability insurance are also included in the $2,110 labor expense for hand harvesting under Plan I.

Present housing facilities on Farm A are inadequate for the number of workers needed to harvest 40 tons of cherries by hand. Therefore,

---

[6]The $52 per ton is based upon the operators' recent piecework wage rates.

continuation of hand harvest methods will require an investment of $1,000 in living quarters for harvest workers. An annual replacement charge of $50 plus $20 for repairs, is estimated for these additional buildings. Five percent interest on the investment accounts for another $50 charge under Plan I. No new housing investment is needed under Plan II, because existing housing facilities are sufficient for the limited number of workers needed for mechanical harvesting.

Ladders and picking equipment will be needed for the hand method. A certain number of ladders will be needed for the other fruit enterprises on Farm A even if mechanical harvesting is used for tart cherries. Harvesting the tart cherries by hand, however, will require more ladders than harvesting the other fruit crops. Therefore, $50 is charged for replacement of ladders used only in the tart cherry harvest.

In addition to the fixed cost of mechanical harvesting equipment of $860 per year, machinery repairs and gasoline expenses are estimated at $100 and $30 respectively for mechanical harvesting on Farm A.

There are no sweet cherries or plums to be harvested mechanically on Farm A. Savings in labor and housing expenses from mechanical harvesting on this farm are just large enough to cover the costs of the machinery and the reduced receipts. Thus, as shown in TABLE 27, a net gain of only $30 can be expected if mechanical harvesting is adopted on this farm.

Analysis of Farm B

The operator of Farm B is concerned with the relative merits of harvesting 9 acres of tart cherries by hand or with mechanical equipment.

[redacted]

Labor savings of $300 for apple handling can be expected on the basis of a 30-hour saving per 1,000 bushels of apples. Handling the plums sold for processing in bulk boxes will lead to another $40 savings in expenses for handling labor. Savings of $20 for handling peaches can be expected by handling crates on pallets with the fork-lift equipment. The use of a fork-lift for handling cherries can be expected to lead to savings of 0.8 hours per ton, based on experimental results obtained by Levin and Gaston.[9] Thus, savings of $60 can be expected for the 80 tons of cherries on Farm E. The use of bulk boxes can be expected to save expenses for picking labor of $110 for apples and $20 for plums based upon savings of $.20 per 18 bushels. Total labor savings from mechanical harvesting will be $550.

Because most of the fruit is packed on the farm as it is picked, only 1,000 field crates will be needed for harvesting apples, peaches and plums. If an average life of five years is estimated for these field

addition, 500 field crates will be needed to harvest the peaches, which cannot be handled in bulk boxes. Thus, a $45 expense for field crate replacement will be needed even if bulk boxes are used for apples and plums. Container replacement charges will, therefore, be the same for both methods of fruit handling.

Apple receipts are expected to increase by $100 on Farm E because of reduced bruising if bulk-box handling is used.

TABLE 32 indicates that the savings in labor expenses plus increased apple receipts will be $330 more than equipment costs for mechanical handling. In addition to this gain, mechanical handling methods will probably enable the operator to speed up the harvest operation. Thus, the yield of harvested fruit may be increased because of a more timely harvest. The quality of the harvested fruit may also be improved by harvesting when the fruit is at the best stage of ripeness.

Analysis of Farm F

An average annual production of 13,000 bushels of apples, 5,000 bushels of peaches, and 80 tons of cherries is expected on Farm F.

Savings in labor are expected to reduce handling expenses by $390 for apples, $70 for peaches, and $60 for cherries.

Additional labor savings of $140 for apple picking can also be expected, and apple receipts will be increased by $130 if bulk-box handling is used.

The operator of Farm F owns 1,000 field crates, which are used for both peaches and apples. Average annual replacement expenses for these crates will be $90. In addition, the operator rents 12,000 crates at $.05

each in which to store the apple crop. Thus, a total container expense of $690 is required when field crates are used.

If bulk boxes are used to harvest and store the apples, a rental of $.04 per bushel for 12,000 bushels will be paid — a total of $480. In addition to the bulk boxes, the 1,000 field crates which are owned will be needed to harvest the peach crop. The expense of $90 for replacement of field crates will, therefore, be needed for both handling methods. Pallets will also be needed to handle the peaches in field crates with the fork-lift. Therefore, 40 pallets at $3.00 apiece will be purchased if the mechanical handling method is used. Thus, the total container costs for both handling methods will be about the same on Farm F.

The savings in labor expenses, plus the increased apple receipts, will result in an increase in net income of $650 if a fork-lift and bulk boxes are used on this farm. The savings from the use of bulk boxes would be considerably larger if it were necessary to purchase instead of renting containers for the 12,000 bushel of apples. Nevertheless, the adoption of the mechanical handling methods for the size and production on Farm F appears to be a profitable adjustment.

Analysis of Farm A

Farm A has an expected production of 14,000 bushels of apples, 12,000 bushels of pears, and 65 tons on cherries. Savings in handling labor of $380 for apples, $330 for pears and $60 for cherries are expected if mechanical handling is used. These savings are based upon a hired wage rate of $1.10 per hour on this farm.

All of the containers used on Farm A, are rented from a fruit exchange, except containers for 7,000 bushels of pears which are provided

by the processor buyer. Container expenses are based upon rental rates of $.01 per bushel for bulk boxes and $.03 per bushel for field crates. Savings in container expenses of $280 for apples and $100 for pears are expected from mechanical handling.

Total savings in labor and container expenses of $1,430 are expected. Apple receipts will be increased by $140. Additional costs of $260 for equipment will be involved with mechanical handling. The resulting $1,310 increase in net farm income indicates a distinct advantage in using the fork-lift equipment and bulk boxes on this farm.

Analysis of Farm B

Farm B is expected to produce an annual average of 5,000 bushels of apples, 1,600 bushels of peaches, and 25 tons of cherries. Savings in expenses for handling labor are based upon a wage rate of $1.10 per hour. Labor savings of $140 for apple handling, $60 for apple picking, $30 for peach handling, and $20 for cherry handling are expected.

The existing 1,000 field crates are sufficient for harvesting the apples and peaches. A $90 annual replacement expense for these field crates will be necessary if only field crates are used. If bulk boxes are used for apples, replacement expense of $45 will be required for these boxes. However, 500 field crates will still be needed for the peaches. These crates will require $45 for replacement expenses. Thus, container expenses will be the same for the two methods of handling.

The operator grades and packs much of the fruit on the farm. A bulk-box dumper will be needed to continue to grade apples.

Thus, on this farm equipment expenses for mechanical handling will be $320 (TABLE 32). Savings in hired labor expenses will be $250, while

apple receipts will be increased by $50 with the use of mechanical handling. Adoption of mechanical handling methods will result in a decrease in net income of $20. For this farm size and organization, the present method of handling field crates by hand appears to be the most advantageous handling method.

Analysis of Farm J

Farm J produces 3,200 bushels of peaches and 12 tons of cherries. These crops can be handled on pallets with a fork-lift. No bulk boxes can be used with these crops. Labor savings of $40 for peaches and $10 for cherries could be expected.

The annual charges for the fork-lift would be more than the savings in labor and net income would be decreased by $140 if this equipment were purchased. This farm situation with a relatively small production of peaches and cherries does not warrant the purchase of a fork-lift.

Analysis of Farm K

Farm K is used to explore the advantages of mechanical handling equipment on a large fruit farm which produces all five of the major tree fruits grown in Michigan. The financial results of handling the production of 36,000 bushels of apples, 160 tons of cherries, 5,000 bushels of pears, 1,200 bushels of plums, and 3,500 bushels of peaches mechanically are shown in TABLE 32. This farm is equipped with a refrigerated storage. Consequently, much of the apple crop is stored on the farm. The large fruit production and the farm storage operation necessitates an investment in an industrial fork-lift truck as well as a fork-lift attachment for one of the farm tractors. A bulk-box dumper is also needed to facilitate grading the apples which are handled in bulk boxes.

The lift truck will require an investment of approximately $3,000. If a 10-year life is estimated, an annual replacement charge of $300 will result. A five percent interest charge on the average investment will be equal to $80 annually. Expenses for repairs, fuel and oil, and insurance for the lift truck are estimated at $100 per year. Thus a total annual cost of $480 is estimated for the lift truck. In addition, annual equipment costs include $80 for the box dumper, and $190 for the tractor fork-lift attachment. Gasoline expenses for operating the tractor are estimated at $120 per year. Total costs for mechanical handling equipment are $870 per year.

Savings of 40 hours per 1,000 bushel of apples are estimated for this farm because of the use of the lift truck in the storing and grading operations in addition to the tractor fork-lift in orchard handling. Thus labor savings of 1,440 hours for apple handling are estimated. This is equivalent to savings in labor expenses of $1,650, at a wage rate of $1.15 per hour. Likewise, savings in handling labor expenses of $170 for pears, $30 for plums, $70 for peaches, and $150 for cherries can be realized by using mechanical handling equipment.

A total savings of $460 can be made by using bulk boxes in picking apples, pears, and plums. Also, apple receipts can be expected to increase by $360 owing to higher quality apples afforded by bulk-box handling.

All the fruit crops except apples are sold to processing companies, which provide containers and will provide bulk boxes and pallets if desired. Therefore, comparison of container expenses on Farm K involves containers only for apples. Crates or bulk boxes with a capacity for

30,000 bushel of apples are needed on the farm. Bulk boxes with a 30,000 bushel capacity will require an average annual replacement expense of $1,320. The same capacity of field crates requires an annual replacement expense of $2,250. Thus savings of $930 in container expenses can be realized by the use of bulk boxes.

Even though machinery expenses for mechanical handling will be greater on this large farm than on the smaller farms discussed previously, savings in container costs and hired labor expenses lead to a larger gain from mechanical handling on this farm than on the smaller farms. Net income can be expected to increase by $3,050 if the mechanical handling is used on this farm (TABLE 32). Thus, this farm situation appears particularly well suited for adoption of these handling methods.

Conclusions of Mechanical Handling Analysis

The preceding analysis of seven different case farms shows that mechanical handling of fruit with fork-lift equipment, with or without bulk boxes, may increase net farm income on a number of Michigan tree-fruit farms.

The analysis indicates, however, that small farmers with limited production cannot realize sufficient savings in hired labor expenses and container costs to offset expenses of owning and operating the necessary equipment. To realize a gain from mechanical handling, a farmer must have a moderate size of business, as measured by the bushels or tons of fruit produced. The production of apples or pears is especially important because bulk boxes can be used for these fruits with accompanying savings in handling expenses, picking expenses, and container costs as

well as increased apple receipts owing to less bruising. The analysis indicates that farms with production of 10,000 bushels or more of apples and pears can benefit from these handling methods. Although operators of smaller farms may also realize a gain by adopting mechanical handling methods, the main benefits will accrue to farmers with large production. Because of the large production needed, many small and medium sized farms can realize benefits from mechanical handling by expanding the fruit acreage and adopting these handling methods.

The market outlet is also an important consideration. If the fruit is marketed through a fruit exchange or other wholesale buyer who receives orchard-run fruit, no box dumper is needed. Also the savings in container costs afforded by bulk boxes will be more important for farmers who, because of the type of market used, must purchase large quantities of returnable containers.

CHAPTER V

SUMMARY AND CONCLUSIONS

The problem of this study, as outlined in Chapter I, concerns the inter-related possibilities for the future of expanding acreage and adopting mechanical harvesting and mechanical handling on medium-sized fruit farms. The analyses in Chapters II, III, and IV have indicated gains from the adjustments of acreage expansion, mechanical harvesting with tree shaking equipment, and mechanical handling with fork-lift equipment and bulk boxes, considered separately. What are the implications for combining these adjustments (a) for the case farms and (b) for other fruit farms?

In general, the findings indicate that operators of many medium-sized fruit farms can increase net incomes in the long run if moderate acreage increases are made in conjunction with the adoption of either or both mechanical harvesting and mechanical handling. This conclusion follows from comparative budgeting for the five selected case farms, four of which have 20 to 60 acres of tree fruits per operator. The timing of income gains, however, is an important consideration in evaluating the results.

Planting young orchards was selected as a means of expanding the fruit acreage on the case farms because there appeared to be no suitable bearing orchards which could be purchased for expansion purposes. For growers who use this method of acreage expansion, the time period involved in raising fruit trees to maturity results in a delay in the major net

income gains until 10 to 15 years have elapsed. Therefore, in this analysis, net incomes were explored for the 20-year period between 1960 and 1980. In an attempt to make a simplified comparison of net incomes over time, future incomes from the various acreages were discounted to the year 1960 at a rate of five percent per year.

Possible gains in net income from mechanical harvesting and mechanical handling can be realized soon after adoption of these new techniques. Additional gains from use of these techniques on a larger acreage will be delayed several years if acreage is to be expanded by planting young orchards. Thus, for the case farms, the benefits of mechanical harvesting and mechanical handling on the larger acreages will be realized only after the young trees reach maturity. If there were opportunities for expanding acreage by purchasing additional bearing orchards for these farms, larger gains from mechanization could be realized sooner.

Combined Opportunities on the Case Study Farms

On Farm A, an increase in the tree-fruit acreage of about 70 percent will account for an increase in average discounted future incomes of $1,000 per year over the 20-year period. One expansion plan for this farm included an increase from the present four acres of tart cherries by planting an additional 10 acres. Analysis of mechanical harvesting for tart cherries indicated an increase in net income of $800 per year from this larger acreage after the trees reach maturity. By comparison, purchase of the necessary equipment for mechanical harvesting of the present acreage would result in a reduction in net income.

Adoption of mechanical handling equipment on the present acreage will result in an increase in average annual net income of $700, while using this equipment on the larger fruit acreage will result in an increase in net income of about $1,300 per year after mature production is obtained. Thus, the adoption of these new technologies on the larger acreage will result in an annual net income of $1,400 more than the net income if the new technologies are adopted on the present acreage. This illustrates the inter-relationships between increasing acreage and adopting the new labor-saving technologies. The combination of these adjustments will result in considerable more gain than any one adjustment alone.

The analysis of increasing the fruit acreage by 90 percent on Farm B indicated an increase of $1,000 in the present value of average annual incomes during the 20-year planning period. The expansion plans included no tart cherries; therefore, no gains from mechanical harvesting could be expected from the larger acreage. Mechanical handling of fruit on the larger acreage will result in a gain of $320 per year after the trees reach maturity, while mechanical handling on the present acreage will result in a decrease in net income. The expansion of acreage on Farm B allows a greater gain from mechanical handling, although the gain is not as great as that expected from mechanization of the harvest operations on Farm A.

Expanding the acreage on Farm C by 40 percent will result in an increase in average net incomes of about $500 per year, when future incomes are discounted at five percent per year. Adopting mechanical harvesting and mechanical handling on the larger acreage when mature production is

obtained will result in additional increases in net income of $700 and $340 respectively. On the present acreage, net income would show no gain with adoption of these technologies.

A 70 percent increase in acreage on Farm D will result in an average increase in net income of $550 per year. Mechanical harvesting on this larger acreage when the trees are mature will permit an additional increase in annual net income of $2,020. Use of mechanical handling will account for another $130 increase. A total increase in net income of $2,150 can thereby be realized on the larger acreage with use of mechanical harvesting and mechanical handling for the larger production. Adoption of mechanical handling on the present acreage will result in an increase in net income of $60, while mechanical harvesting will decrease the net income. Thus, the advantages of using the mechanical methods on a larger acreage are clearly indicated by the analysis for this case farm.

Farm D like Farm A would have about 14 acres of tart cherries after the planned expansion. The analysis of mechanical harvesting with standard performance rates and various yield levels shows that with 14 acres of tart cherries, yields of 6 tons per acre will permit a gain of $2,290 from mechanical harvesting. On the same acreage with yields of only two tons per acre, a decrease in net income of $330 is expected if mechanical harvesting is used. Thus, although the expansion of acreage will increase the possible benefits from mechanical harvesting, high yields must also be obtained on the larger acreage.

On Farm E, a larger unit with less favorable conditions for expansion than the other farms, increasing the fruit acreage would result in an

$800 decrease in annual discounted net income. However, if the increase in acreage is accompanied by adoption of mechanical harvesting and mechanical handling, an increase in net income of $600 per year can be expected after the trees reach bearing age. This illustrates the importance of the new mechanical equipment for the situation of Farm E.

On each of the case farms, a gain in net income will be realized if an expansion of the fruit acreage is combined with the adoption of either or both mechanical harvesting and mechanical handling. An expansion of fruit acreage of 40 to 90 percent resulted in an expected increase in net income in itself on the four farms with 20 to 60 acres of fruit. However, the adoption of mechanical harvesting and handling techniques on the larger acreages after the trees reach maturity will add another $300 to $1,700 per year to the present value of future net incomes for these farms.

Although an acreage expansion on the fifth farm would result in a decrease in net income, the adoption of mechanical harvesting and mechanical handling on the larger acreage will permit an increase in net income.

Implications for Fruit Farms in General

The analyses of the case study farms suggest income-increasing possibilities for many other medium-sized fruit farms through expansion of acreage and adoption of mechanical equipment for harvesting and handling operations.

The general analysis of mechanical harvesting indicates that at least 10 to 14 acres of tart cherries are needed to increase net incomes if

average yields of four tons per acre are obtained. (Considerably larger acreages are necessary if average yields are less than four tons per acre.)

The 1956 southwestern Michigan fruit and vegetable survey indicated that a large number of fruit farmers will be concerned with mechanical harvesting and other adjustments for the tart cherry enterprise. Ninety-three percent of the commercial fruit farms with gross incomes of $10,000 or more in this survey had some tart cherries. Only about a third of these farms had more than 10 acres of cherries--the others had from 1 to 10 acres.[1] Therefore, many of these fruit farmers will need to expand their tart cherry acreage in order to realize the benefits from mechanical harvesting which can generally be obtained on farms with 10 acres or more of tart cherries. Harvesting sweet cherries or plums mechanically in addition to the tart cherries offer additional possibilities for increasing net incomes in the future.

The analysis also indicated that farms which produced 10,000 bushels of apples and/or pears, in addition to other fruits, can increase net incomes by using mechanical handling methods. Some medium-sized farms with 20 to 60 acres of fruit trees per operator may have sufficient production to realize a gain from mechanical handling. However, the possibilities of increasing net incomes with this technology are much greater on larger farms.

---

[1]From unpublished data in the files of the Department of Agricultural Economics, Michigan State University.

Operators of farms which are smaller than these indicated sizes will, in general, face considerable difficulty in benefiting from mechanical harvesting or mechanical handling. To obtain the benefits of these new technologies, operators of many medium-sized fruit farms will need to consider expanding their tree-fruit acreages. Tree-fruit acreage can be expanded by planting young trees (as in the case-farm analyses) or by purchasing additional bearing orchards. Purchasing suitable bearing orchards as opportunities arise will enable many fruit farm operators to expand acreage and obtain the benefits of mechanical harvesting and mechanical handling on larger acreages. Although this method of expansion may entail a larger initial investment than planting young orchards, the benefits from the larger acreage will begin to accrue soon after expansion.

The use of mechanical harvesting equipment, which is particularly well suited for tart cherries, may tend to increase the specialization in that crop on some fruit farms. However, the present mechanical methods are technically feasible for harvesting plums and sweet cherries as well. Further improvements will probably enable these fruits to be harvested economically with mechanical equipment in the future, although the present technology offers limited possibilities. Therefore, the supplementarity among these enterprises for the use of mechanical harvesting equipment will encourage diversification to some extent. This supplementarity will somewhat balance the particular advantages for specialization in tart cherries.

Handling fruit mechanically with fork-lift equipment and bulk boxes is particularly well suited for apples, although pears, plums, and

clingstone peaches can also be handled with this equipment. In addition the fork-lift equipment can be used with pallets to handle cherries and freestone peaches. Therefore, although mechanical handling may tend to encourage specialization in apple production to a degree, the supplementarity with the other fruit enterprises for the equipment will also tend to encourage diversified production of several fruit crops. The particular advantages of mechanical harvesting for tart cherries and mechanical handling for apples are further balanced, to some extent, by the fact that adoption of both of these technologies will provide advantages for the production of all of the major tree fruits grown in Michigan. Thus, although the use of these technologies provides an added incentive for increasing total fruit acreage, the prospect of increased specialization in fewer tree-fruit crops is less apparent.

The results from analyses of a limited number of case farms have certain limitations regarding general applicability to a large population of farms. No two farms are exactly alike. Each individual farm operates under somewhat different conditions including differences in size, kinds of crops, amounts of other resources (including management capacity), available market outlets, and climatic conditions of the area. Because of the unique situation of each farm, the results of the case-farm analyses cannot be expected to apply directly on other farms. However, because the results of all five case-farm analyses indicate similar patterns of income changes from similar adjustments, it seems reasonable to expect the same general pattern of results on many other medium-sized fruit farms in western Michigan.

Data from the 1954 Census of Agriculture indicate that there are about 1,700 commercial fruit farms in western Michigan with 20 to 60 acres of tree fruits. Of these 1,700 farms in western Michigan, approximately 1,100 are in Berrien, Van Buren and Allegan counties. Because the case farms are located in these counties, the results of this study will be especially relevant for farms in this area. The results are probably also applicable in some degree to medium-sized farms in other Michigan fruit producing areas.

Farms with effective management and with high quality resources in land and orchard site will, of course, have greater possibilities for increasing income by expansion than farms with more limited resources. Four of the five case farms which were used to explore the acreage expansion probably represent rather favorable conditions for expanding the tree-fruit acreage. All four of these farms have 20 to 60 acres of fruit crops per operator, with indications of effective management by the operator as well as relatively high quality resources in land and orchard site. The fifth farm, which includes 100 acres of fruit trees, represents a somewhat less favorable situation for expansion, in that management and orchard resources appear to be less adequate than on the four smaller farms.

The benefits of mechanical harvesting and mechanical handling can probably be obtained on many farms with various qualities of management and orchard resources. Relatively high yields and large production, however, are needed to increase incomes with these technologies. Mechanical handling methods will be particularly important for the farms with large production of apples and pears, although farms which produce large quantities of other tree fruits may also benefit from this technology. In general,

increasing acreage in connection with adopting the recently developed techniques for mechanical harvesting and mechanical handling will probably be important future adjustments for managers of many medium-sized tree-fruit farms in Michigan.

APPENDIX

APPENDIX TABLE A

Estimated Annual Inputs Per Acre for Young Apple Orchards

Inputs	Year before planting	Year of planting	Age 1 to 5	Age 6 to 10	Age 11 to 15	Age 15 & older
	Hr.	Hr.	Hr.	Hr.	Hr.	Hr.
Labor						
Land clearance (removal of brush, stones, etc.)	6	-	-	-	-	-
Plowing and fitting land	6	-	-	-	-	-
Planting trees	-	10	1	-	-	-
Placing tree guards	-	2	-	-	-	-
Fertilizing and seeding	2	2	2	2	1	1
Hand hoeing	-	10	8	4	-	-
Cultivating or mowing	-	4	4	4	3	2
Spraying	-	6	10	13	15	16
Pruning	-	2	4	8	12	22
Management and miscellaneous	-	2	2	4	6	6
Total hours	14	38	31	35	38	47
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Materials Expenses						
Nursery stock (54 trees per acre)	-	51	3	-	-	-
Fertilizer for cover crop	18	9	9	4	3	3
" for trees	-	-	5	10	12	17
Lime	9	-	-	-	-	-
Cover crop seed	6	3	3	3	-	-
Spray material	-	10	15	30	50	60
Mouse bait	-	3	3	3	-	-
Tree guards	-	6	-	-	-	-
Machine Operating Expenses	15	10	8	10	15	17

APPENDIX TABLE B

Estimated Annual Inputs Per Acre for Young Pear Orchards

Inputs	Year before planting	Year of planting	Age 1 to 5	Age 6 to 10	Age 11 to 15	Age 15 & older
	Hr.	Hr.	Hr.	Hr.	Hr.	Hr.
Labor						
Land clearance (removal of brush, stones, etc.)	6	-	-	-	-	-
Plowing and fitting land	6	-	-	-	-	-
Planting trees	-	18	3	-	-	-
Placing tree guards	-	3	-	-	-	-
Fertilizing and seeding	2	2	2	2	1	1
Hand hoeing	-	16	16	3	-	-
Cultivating or mowing	-	4	4	4	3	2
Spraying	-	4	7	7	9	9
Pruning	-	2	3	6	12	18
Management and miscellaneous	-	2	2	4	6	6
Total hours	14	52	37	26	31	36
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Materials Expenses						
Nursery stock (108 trees per acre)	103	-	-	-	-	-
Fertilizer for cover crop	18	7	7	3	3	3
" for trees	-	-	4	9	11	14
Lime	9	-	-	-	-	-
Cover crop seed	6	3	3	3	-	-
Spray material	-	10	12	16	26	38
Mouse bait	-	3	3	3	-	-
Tree guards	-	12	-	-	-	-
Machine Operating Expenses	15	16	9	9	11	12

APPENDIX TABLE C

Estimated Annual Inputs Per Acre for Young Tart Cherry Orchards

Inputs	Year before planting	Year of planting	Age 1 to 5	Age 6 to 10	Age 11 to 15	Age 15 & older
	Hr.	Hr.	Hr.	Hr.	Hr.	Hr.
Labor						
Land clearance (removal of brush, stones, etc.)	6	-	-	-	-	-
Plowing and fitting land	6	-	-	-	-	-
Planting trees	-	20	2	-	-	-
Thinning	-	-	-	-	-	-
Fertilizing and seeding	2	2	2	2	2	2
Hand hoeing	-	20	14	2	-	-
Cultivating or mowing	-	4	4	4	4	4
Spraying	-	6	8	10	11	11
Pruning	-	3	7	9	10	10
Management and miscellaneous	-	3	2	2	3	3
Total hours	14	58	39	29	30	30
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Materials Expenses						
Nursery stock (108 trees per acre)	-	108	5	-	-	-
Fertilizer for cover crop	18	9	9	9	9	9
" for trees	-	-	4	8	13	17
Lime	5	-	-	-	-	-
Cover crop seed	6	3	3	3	3	3
Spray material	-	8	15	20	22	23
Mouse bait	-	3	3	-	-	-
Tree guards	-	12	-	-	-	-
Machine Operating Expenses	15	16	9	10	12	12

APPENDIX TABLE D

Estimated Annual Inputs Per Acre for Young Sweet Cherry Orchards

Inputs	Year before planting	Year of planting	Age 1 to 5	Age 6 to 10	Age 11 to 15	Age 15 & older
	Hr.	Hr.	Hr.	Hr.	Hr.	Hr.
Labor						
Land clearance (removal of brush, stones, etc.)	6	-	-	-	-	-
Plowing and fitting land	6	-	-	-	-	-
Planting trees	-	17	2	-	-	-
Fertilizing and seeding	2	2	2	2	2	2
Hand hoeing	-	17	15	3	-	-
Cultivating or mowing	-	4	4	4	4	4
Spraying	-	6	8	10	12	13
Pruning	-	3	6	9	10	10
Management and miscellaneous	-	3	2	2	3	3
Total hours	14	52	39	30	31	32
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Materials Expenses						
Nursery stock (90 trees per acre)	-	94	-	-	-	-
Fertilizer for cover crop	18	9	9	9	9	9
" for trees	-	-	4	8	14	17
Lime	9	-	-	-	-	-
Cover crop seed	6	3	3	3	3	3
Spray material	-	8	13	25	30	31
Mouse bait	-	3	3	-	-	-
Tree guards	-	10	-	-	-	-
Machine Operating Expense	15	13	9	11	13	13

APPENDIX TABLE E

Estimated Annual Inputs Per Acre for Young Peach Orchards

Inputs	Year before planting	Year of planting	Age 1 to 5	Age 6 to 10	Age 11 to 15	Age 15 & older
	Hr.	Hr.	Hr.	Hr.	Hr.	Hr.
Labor						
Land clearance (removal of brush, stones, etc.)	6	-	-	-	-	-
Plowing and fitting land	6	-	-	-	-	-
Planting trees	-	20	2	-	-	-
Thinning	-	-	5	15	21	23
Fertilizing and seeding	2	2	2	2	2	2
Hand hoeing	-	20	12	-	-	-
Cultivating or mowing	-	4	4	4	4	4
Spraying	-	4	8	11	12	12
Pruning	-	4	9	12	18	23
Management and miscellaneous	-	3	2	2	3	3
Total hours	14	57	46	46	60	67
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Materials Expenses						
Nursery stock (108 trees per acre)	-	91	4	-	-	-
Fertilizer for cover crop	18	9	9	9	9	9
" for trees	-	-	4	8	13	17
Lime	9	-	-	-	-	-
Cover crop seed	6	3	3	3	3	3
Spray material	-	6	20	30	35	35
Mouse bait	-	3	3	-	-	-
Tree guards	-	12	-	-	-	-
Machine Operating Expenses	15	16	11	13	14	14

APPENDIX TABLE F

Estimated Annual Inputs Per Acre for Young Plum Orchards

Inputs	Year before planting	Year of planting	Age 1 to 5	Age 6 to 10	Age 11 to 15	Age 15 & older
	Hr.	Hr.	Hr.	Hr.	Hr.	Hr.
Labor						
Land clearance (removal of brush, stones, etc.)	6	-	-	-	-	-
Plowing and fitting land	6	-	-	-	-	-
Planting trees	-	20	2	-	-	-
Fertilizing and seeding	2	2	2	2	2	2
Hand hoeing	-	20	12	-	-	-
Cultivating or mowing	-	4	4	4	3	3
Spraying	-	6	8	10	11	12
Pruning	-	3	5	8	10	11
Management and miscellaneous	-	3	2	2	3	3
Total hours	14	58	35	26	29	31
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Materials Expenses						
Nursery stock (108 trees per acre)	-	103	-	-	-	-
Fertilizer for cover crop	18	9	9	4	3	3
" for trees	-	-	4	8	13	17
Lime	9	-	-	-	-	-
Cover crop seed	6	3	3	3	-	-
Spray material	-	8	13	20	25	27
Mouse bait	-	3	3	-	-	-
Tree guards	-	12	-	-	-	-
Machine Operating Expenses	15	16	9	10	12	12

APPENDIX TABLE G

Estimated Yields from Young Orchards, as a Percentage of Mature Production[1]

Age	Apples	Tart cherries	Sweet cherries	Peaches	Pears	Plums
(years)			(Percent)			
1	0	0	0	0	0	0
2	0	0	0	10	0	0
3	0	10	0	20	0	0
4	0	20	0	35	0	10
5	0	30	15	50	0	20
6	10	40	20	65	10	30
7	20	50	25	80	20	50
8	30	65	30	90	30	60
9	40	80	40	100	40	75
10	50	95	50	100	50	90
11	60	100	60	100	60	95
12	70	100	70	100	70	100
13	80	100	85	100	80	100
14	90	100	95	100	90	100
15	100	100	100	90	100	100

[1]These estimates were made after consultation with R. P. Larson of the Michigan State University Horticulture Department.

BIBLIOGRAPHY

Barraclough, S. L. and E. M. Gould, Economic Analysis of Farm Forest Operating Units, Harvard Forest Bulletin 26, 1955.

Black, J. D., et al., Farm Management, MacMillan, New York, 1947

Cromarty, W. A. and R. A. Shaw, Economic Relationships in Red Cherry Marketing, 1947-1958, Michigan State University Agricultural Economics Department Mimeograph 763, 1959.

Dominick, B. A., Jr., Costs and Returns in Producing Sour Cherries, 1957, Cornell University, B. A. D. Mimeograph 57:139, 1958.

_____, Costs and Returns in Producing Sweet Cherries, 1957, Cornell University, B. A. D. Mimeograph 57:137, 1958.

French, B. C., The Long-Term Price and Production Outlook for Apples in the United States and Michigan, Michigan State University Agricultural Experiment Station, Technical Bulletin 255, 1956.

Garman, C. G., How to Make a Fruit Farm Pay, Cornell University, Extension Bulletin 1013, August 1958.

Gaston, H. P., et al., "Experiments in Harvesting Cherries Mechanically," Michigan State University Agricultural Experiment Station Quarterly Bulletin, Volume 41, No. 4, May, 1959.

_____, and J. H. Levin, Handling Apples in Bulk Boxes, Michigan State Agricultural Experiment Station, Special Bulletin 409, 1959.

_____, et al.,"Mechanical Harvesting of Michigan Grown Fruits," Annual Report of the Michigan State Horticultural Society, December, 1958.

Gavett, E. E., Labor Used for Fruits and Tree Nuts, United States Department of Agriculture, Agricultural Research Service, Statistical Bulletin 232, 1958.

Gillette, D. G. and B. C. French, "Costs of Packing Apples in Michigan," Michigan State University Agricultural Experiment Station, Quarterly Bulletin, Volume 40, No. 2, November 1957.

Herrick, J. E., Jr., and S. W. McBirney, Handling and Storage of Apples in Pallet Boxes, United States Department of Agriculture, Agricultural Marketing Service Bulletin 236, 1958.

James, L. M., Production and Marketing of Plantation Grown Christmas Trees in Michigan, Michigan Agricultural Experiment Station, Special Bulletin 423, 1959.

Johnson, G. L. and C. B. Haver, Decision-Making Principles in Farm Management, Kentucky Agricultural Experiment Station, Bulletin 593, January, 1953.

Kearl, C. D., Cash Crops and Fruit Costs and Returns from Farm Cost Accounts, (1958 and 1959 editions), Cornell University Agricultural Experiment Station, Agricultural Economics Research Bulletins 6 and 31.

Levin, J. H. and H. P. Gaston, "A Bulk Box Dumper for Handling Fruit", Michigan State Agricultural Experiment Station Quarterly Bulletin, Volume 39, No. 4, May 1957.

_____, and H. P. Gaston, Equipment Used by Deciduous Fruit Growers in Handling Bulk Boxes, United States Department of Agriculture, Agricultural Research Service Publication 42-20, 1958.

_____, and H. P. Gaston, Fruit Handling with Fork-Lift Trucks, Michigan State Agricultural Experiment Station, Special Bulletin 379, 1953.

_____, et al., "Mechanizing the Harvest of Red Tart Cherries," Michigan State University Agricultural Experiment Station Quarterly Bulletin, Volume 42, No. 4, May 1960.

MacCharles, J. M., Peach Production Costs, Ontario Department of Agriculture, Toronto, 1958.

McBirney, S. W. and A. Van Doren, Pallet Bins for Harvesting and Handling Apples, Washington Agricultural Experiment Station, Stations Circular 355, 1959.

Michigan Department of Agriculture, Michigan Agricultural Statistics, July, 1959.

Mighell, R. L., Planning the Farm Business on Three Dairy-Fruit Farms in Massachusetts, Massachusetts Agricultural Experiment Station, Bulletin 275, 1931.

Nielson, J. M., Application of the Budget Method in Farm Planning, unpublished Ph. D. thesis, Harvard University, Cambridge, 1953.

Podany, J. C., Costs of Packing Michigan Peaches in 1957, United States Department of Agriculture, Agricultural Marketing Service, Marketing Research Report 290, 1958.

Salter, L. A., "Cross-sectional and Case-grouping Procedures in Research Analysis," Journal of Farm Economics, February, 1942.

Stanton, B. F., et al., Variability in Apple Production Costs and Returns, Cornell University Agricultural Experiment Station, Agricultural Economics Research Bulletin 17, May, 1959.

United States Department of Commerce, Bureau of the Census, 1954 Census of Agriculture, Volume 1 - Part 6, Washington, D. C., 1956.

Wheeler, R. G., Fruit Farming Today, Michigan State University Agricultural Economics Mimeographs 713 (1958) and 749 (1959).

_____, and J. D. Black, Planning for Successful Dairying in New England, Harvard Press, Cambridge, 1955.

_____, and E. F. Lord, "The Southwestern Michigan Fruit and Vegetable Farm Business, 1957, Part I - Farm Costs and Returns," Michigan State University Agricultural Experiment Station Quarterly Bulletin, Volume 40, No. 4., May 1958.

_____, and E. F. Lord, "The Southwestern Michigan Fruit and Vegetable Farm Business, 1957, Part II - Crop Costs and Returns," Michigan State University Agricultural Experiment Station Quarterly Bulletin, Volume 41, No. 1, August, 1958.

_____, and D. J. Ricks, The Southwestern Michigan Fruit and Vegetable Farm Business, 1958, Michigan State University Agricultural Economics Department Mimeograph 760, April, 1959.

Woodworth, H. C. and G. F. Potter, Studies in Economics of Apple Orcharding, New Hampshire Agricultural Experiment Station, Bulletin 323, 1940.

Wright, K. T. and Stanley Johnson, Peach and Cherry Costs in Michigan, Michigan State University Agricultural Experiment Station, Circular Bulletin 201, 1946.

_____, and Walter Toenjes, Apple and Pear Costs in Michigan, Michigan State University Agricultural Experiment Station, Circular Bulletin 202, 1946.

APPENDIX TABLE E

Estimated Annual Inputs Per Acre for Young Peach Orchards

Inputs	Year before planting	Year of planting	Age 1 to 5	Age 6 to 10	Age 11 to 15	Age 15 & older
	Hr.	Hr.	Hr.	Hr.	Hr.	Hr.
Labor						
Land clearance (removal of brush, stones, etc.)	6	-	-	-	-	-
Plowing and fitting land	6	-	-	-	-	-
Planting trees	-	20	2	-	-	-
Thinning	-	-	5	15	21	23
Fertilizing and seeding	2	2	2	2	2	2
Hand hoeing	-	20	12	-	-	-
Cultivating or mowing	-	4	4	4	4	4
Spraying	-	4	8	11	12	12
Pruning	-	4	9	12	18	23
Management and miscellaneous	-	3	2	2	3	3
Total hours	14	57	46	46	60	67
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Materials Expenses						
Nursery stock (108 trees per acre)	-	91	4	-	-	-
Fertilizer for cover crop	18	9	9	9	9	9
" for trees	-	-	4	8	13	17
Lime	9	-	-	-	-	-
Cover crop seed	6	3	3	3	3	3
Spray material	-	6	20	30	35	35
Mouse bait	-	3	3	-	-	-
Tree guards	-	12	-	-	-	-
Machine Operating Expenses	15	16	11	13	14	14

APPENDIX TABLE F

Estimated Annual Inputs Per Acre for Young Plum Orchards

Inputs	Year before planting	Year of planting	Age 1 to 5	Age 6 to 10	Age 11 to 15	Age 15 & older
	Hr.	Hr.	Hr.	Hr.	Hr.	Hr.
Labor						
Land clearance (removal of brush, stones, etc.)	6	-	-	-	-	-
Plowing and fitting land	6	-	-	-	-	-
Planting trees	-	20	2	-	-	-
Fertilizing and seeding	2	2	2	2	2	2
Hand hoeing	-	20	12	-	-	-
Cultivating or mowing	-	4	4	4	3	3
Spraying	-	6	8	10	11	12
Pruning	-	3	5	8	10	11
Management and miscellaneous	-	3	2	2	3	3
Total hours	14	58	35	26	29	31
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Materials Expenses						
Nursery stock (108 trees per acre)	-	103	-	-	-	-
Fertilizer for cover crop	18	9	9	4	3	3
" for trees	-	-	4	8	13	17
Lime	9	-	-	-	-	-
Cover crop seed	6	3	3	3	-	-
Spray material	-	8	13	20	25	27
Mouse bait	-	3	3	-	-	-
Tree guards	-	12	-	-	-	-
Machine Operating Expenses	15	16	9	10	12	12

APPENDIX TABLE G

Estimated Yields from Young Orchards, as a Percentage of Mature Production[1]

Age	Apples	Tart cherries	Sweet cherries	Peaches	Pears	Plums
(years)			(Percent)			
1	0	0	0	0	0	0
2	0	0	0	10	0	0
3	0	10	0	20	0	0
4	0	20	0	35	0	10
5	0	30	15	50	0	20
6	10	40	20	65	10	30
7	20	50	25	80	20	50
8	30	65	30	90	30	60
9	40	80	40	100	40	75
10	50	95	50	100	50	90
11	60	100	60	100	60	95
12	70	100	70	100	70	100
13	80	100	85	100	80	100
14	90	100	95	100	90	100
15	100	100	100	90	100	100

[1]These estimates were made after consultation with R. P. Larson of the Michigan State University Horticulture Department.

BIBLIOGRAPHY

Barraclough, S. L. and E. M. Gould, Economic Analysis of Farm Forest Operating Units, Harvard Forest Bulletin 26, 1955.

Black, J. D., et al., Farm Management, MacMillan, New York, 1947

Cromarty, W. A. and R. A. Shaw, Economic Relationships in Red Cherry Marketing, 1947-1958, Michigan State University Agricultural Economics Department Mimeograph 763, 1959.

Dominick, B. A., Jr., Costs and Returns in Producing Sour Cherries, 1957, Cornell University, B. A. D. Mimeograph 57:139, 1958.

_____, Costs and Returns in Producing Sweet Cherries, 1957, Cornell University, B. A. D. Mimeograph 57:137, 1958.

French, B. C., The Long-Term Price and Production Outlook for Apples in the United States and Michigan, Michigan State University Agricultural Experiment Station, Technical Bulletin 255, 1956.

Garman, C. G., How to Make a Fruit Farm Pay, Cornell University, Extension Bulletin 1013, August 1958.

Gaston, H. P., et al., "Experiments in Harvesting Cherries Mechanically," Michigan State University Agricultural Experiment Station Quarterly Bulletin, Volume 41, No. 4, May, 1959.

_____, and J. H. Levin, Handling Apples in Bulk Boxes, Michigan State Agricultural Experiment Station, Special Bulletin 409, 1959.

_____, et al.,"Mechanical Harvesting of Michigan Grown Fruits," Annual Report of the Michigan State Horticultural Society, December, 1958.

Gavett, E. E., Labor Used for Fruits and Tree Nuts, United States Department of Agriculture, Agricultural Research Service, Statistical Bulletin 232, 1958.

Gillette, D. G. and B. C. French, "Costs of Packing Apples in Michigan," Michigan State University Agricultural Experiment Station, Quarterly Bulletin, Volume 40, No. 2, November 1957.

Herrick, J. E., Jr., and S. W. McBirney, Handling and Storage of Apples in Pallet Boxes, United States Department of Agriculture, Agricultural Marketing Service Bulletin 236, 1958.

James, L. M., Production and Marketing of Plantation Grown Christmas Trees in Michigan, Michigan Agricultural Experiment Station, Special Bulletin 423, 1959.

Johnson, G. L. and C. B. Haver, Decision-Making Principles in Farm Management, Kentucky Agricultural Experiment Station, Bulletin 593, January, 1953.

Kearl, C. D., Cash Crops and Fruit Costs and Returns from Farm Cost Accounts, (1958 and 1959 editions), Cornell University Agricultural Experiment Station, Agricultural Economics Research Bulletins 6 and 31.

Levin, J. H. and H. P. Gaston, "A Bulk Box Dumper for Handling Fruit", Michigan State Agricultural Experiment Station Quarterly Bulletin, Volume 39, No. 4, May 1957.

_____, and H. P. Gaston, Equipment Used by Deciduous Fruit Growers in Handling Bulk Boxes, United States Department of Agriculture, Agricultural Research Service Publication 42-20, 1958.

_____, and H. P. Gaston, Fruit Handling with Fork-Lift Trucks, Michigan State Agricultural Experiment Station, Special Bulletin 379, 1953.

_____, et al., "Mechanizing the Harvest of Red Tart Cherries," Michigan State University Agricultural Experiment Station Quarterly Bulletin, Volume 42, No. 4, May 1960.

MacCharles, J. M., Peach Production Costs, Ontario Department of Agriculture, Toronto, 1958.

McBirney, S. W. and A. Van Doren, Pallet Bins for Harvesting and Handling Apples, Washington Agricultural Experiment Station, Stations Circular 355, 1959.

Michigan Department of Agriculture, Michigan Agricultural Statistics, July, 1959.

Mighell, R. L., Planning the Farm Business on Three Dairy-Fruit Farms in Massachusetts, Massachusetts Agricultural Experiment Station, Bulletin 275, 1931.

Nielson, J. M., Application of the Budget Method in Farm Planning, unpublished Ph. D. thesis, Harvard University, Cambridge, 1953.

Podany, J. C., Costs of Packing Michigan Peaches in 1957, United States Department of Agriculture, Agricultural Marketing Service, Marketing Research Report 290, 1958.

Salter, L. A., "Cross-sectional and Case-grouping Procedures in Research Analysis," Journal of Farm Economics, February, 1942.

Stanton, B. F., et al., Variability in Apple Production Costs and Returns, Cornell University Agricultural Experiment Station, Agricultural Economics Research Bulletin 17, May, 1959.

United States Department of Commerce, Bureau of the Census, 1954 Census of Agriculture, Volume 1 - Part 6, Washington, D. C., 1956.

Wheeler, R. G., Fruit Farming Today, Michigan State University Agricultural Economics Mimeographs 713 (1958) and 749 (1959).

_____, and J. D. Black, Planning for Successful Dairying in New England, Harvard Press, Cambridge, 1955.

_____, and E. F. Lord, "The Southwestern Michigan Fruit and Vegetable Farm Business, 1957, Part I - Farm Costs and Returns," Michigan State University Agricultural Experiment Station Quarterly Bulletin, Volume 40, No. 4., May 1958.

_____, and E. F. Lord, "The Southwestern Michigan Fruit and Vegetable Farm Business, 1957, Part II - Crop Costs and Returns," Michigan State University Agricultural Experiment Station Quarterly Bulletin, Volume 41, No. 1, August, 1958.

_____, and D. J. Ricks, The Southwestern Michigan Fruit and Vegetable Farm Business, 1958, Michigan State University Agricultural Economics Department Mimeograph 760, April, 1959.

Woodworth, H. C. and G. F. Potter, Studies in Economics of Apple Orcharding, New Hampshire Agricultural Experiment Station, Bulletin 323, 1940.

Wright, K. T. and Stanley Johnson, Peach and Cherry Costs in Michigan, Michigan State University Agricultural Experiment Station, Circular Bulletin 201, 1946.

_____, and Walter Toenjes, Apple and Pear Costs in Michigan, Michigan State University Agricultural Experiment Station, Circular Bulletin 202, 1946.