

LABOR USE FOR MICHIGAN AGRICULTURE
1959 WITH PROJECTIONS FOR 1970-75

Thesis for the Degree of Ph. D.
MICHIGAN STATE UNIVERSITY
Joachim Gustav Elterich
1964



This is to certify that the

thesis entitled

LABOR USE FOR MICHIGAN AGRICULTURE
1959 WITH PROJECTIONS FOR 1970-75

presented by

Joachim Gustav Elterich

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Agricultural Economics

Major professor

Date November 25, 1964



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OCT 25 1999





ABSTRACT

LABOR USE OF MICHIGAN AGRICULTURE 1959 WITH PROJECTIONS FOR 1970-75

by Joachim Gustav Elterich

Farm labor receives comparatively low returns on Michigan farms and plays a principal but rapidly decreasing role in agricultural production.

The objectives of the study were: (1) to analyze changing labor use for the main enterprises of Michigan's agriculture, (2) to predict labor use for Michigan agriculture for 1970-75 under alternative assumptions with respect to the adoption of existing and perfection of technologies in the developmental stages, (3) to use these alternate predictions (a) to estimate the seasonal and local distribution of the demand for labor on Michigan farms, and (b) to subdivide the agricultural labor force into its permanent and seasonal components.

Michigan was divided into six labor use regions. The regional enterprise size was determined from data contained in the Census of Agriculture, 1959. Monthly labor requirements for that year per basic unit (acre or head of livestock) were obtained from USDA, Experiment Station and other relevant publications. This permitted estimation of labor use data by region and enterprise. By aggregating regional enterprise labor use data, total labor use for the state and by region were obtained. Assuming two alternate levels of technological advance (medium and high) in the enterprises considered for 1970-75, the projected labor use for the target period were computed in a similar way.



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Further, estimates were made as to how many hours were worked per month in 1959 and will be worked in 1970-75 by each of the following types of farm labor: operator and unpaid family, permanently hired and seasonally hired labor. Data by types of farm labor were obtained from the Census and the Michigan Employment Security Commission for 1959 while projections were developed for 1970-75. Thus, labor use 1970-75 by components of the farm labor force was established.

From 1959 to 1970-75, total labor requirements of Michigan agriculture will most likely be reduced by one third. None of the regions is expected to have higher labor needs. The number of operators will fall by about one fifth, the number of family workers by over one fourth, while the number of permanently hired labor on farms is expected to decline very little. The largest reductions of about 50 percent are anticipated for seasonal hired workers.

Generally, labor use will be reduced more for the months with peak requirements than in the off-season periods. In spite of the continued trend towards specialization in production on the farm level, the seasonal labor demands will be less pronounced due to labor saving technologies. The peak labor requirements will shift from July-August to September for the state as a whole.

By 1970-75, all four enterprise groups will use less labor. The livestock enterprises will show reductions of about one quarter rather evenly distributed over the year. Field crop enterprises will need one fourth to one third less labor in the spring and summer but as much or more labor during the balance of the year. It is expected that fruit enterprises will register sizable reductions of one third in spring and fall and of one half in the middle of the year.

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Vegetable enterprises will show labor savings between one quarter and one half during the summer and fall.

It is expected that operators will carry over three fourths of the work load on Michigan farms by 1970-75 instead of a little above two thirds as in 1959. Year round hired help will also carry some more of the work load while the family members share of the work load will drop.

LABOR USE FOR MICHIGAN AGRICULTURE
1959 WITH PROJECTIONS FOR 1970-75

By

Joachim Gustav Elterich

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

1964



ACKNOWLEDGEMENTS

The author wishes to express his gratitude for the guidance and assistance which he received during the course of his graduate study and the development of the thesis from various members and fellow students of the Department of Agricultural Economics. Sincere thanks are extended to Dr. Glenn Johnson for providing incentive and encouragement throughout my stay at Michigan State University.

In absentia of Dr. Johnson, I received good advice from Drs. Vernon Sorenson, John Brake, and James Nielson. To all of them, but especially to the latter, I feel very indebted for help in critical phases of the thesis.

Professor Boger, as chairman of the Department of Agricultural Economics provided the necessary financial assistance without which my studies would have been impossible. I certainly appreciate this assistance.

My gratefulness goes also to the patient Mrs. A. King and Mrs. C. Thomas in the Computer Center, and to Mrs. Ann Ryan in the Department, who all contributed essentially to the final product.

Privately expressed thanks go to my wife for her endurance, typing, and editing of the study.

The author is to be blamed for any errors in this thesis.

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CHAPTER I

INTRODUCTION

The Michigan and U. S. agricultural economies are presently involved in major adjustments to changing underlying relationships of demand and supply for agricultural products and inputs. Many inter-related problems arise in the wake of these reorganizations. In order to work toward a solution to the problem, much attention has been devoted to the product dimension of agricultural markets but little research has been done until recently in the factor markets of the farm sector. This thesis is designed to fill a void in knowledge about the labor market of Michigan's agriculture.

Changes in U. S. Agriculture

Due to institutional interferences and imperfect knowledge of producers about future prices, stockpiles have resulted from excesses of production over disappearance. For some essential items these stockpiles could supply the entire U.S. population for one year without additional production. Agriculture has been able to expand production rapidly where demand and prices have called for expansion. That was and is possible because of the very rapid technological advances for agriculture which may have been even greater than for manufacturing in recent decades. However, adjustments to lower prices or demand have been very inadequate regarding the returns to the factors of production. This rigidity of production in the face of lower prices seems due to overcommitment of

durable assets resulting from errors in organizing individual farms. Among those assets are not only equipment, structures, and real estate, but also human beings who have committed themselves to farm production at an early age.

Importance of Labor

Although the importance of farm labor as a percentage of that input has declined from 56 percent in 1940 to 29 percent in 1959, it is still the most important factor.¹ Empirical findings reveal some of the past and future trends or developments which beset studies of that kind.

In a recent study, Bob Jones² investigated labor flows for U.S. agriculture over the past 45 years. He found a regression analysis of the influence of opportunity costs especially useful in explaining the intersectoral flow of younger or prospective farmers, although the opportunity costs in farming for them differ only slightly from those outside farming. He also points out that labor use has declined more sharply on smaller farms than on larger ones. Rising wage rates outside farming lead to a reduction of entry and to a lesser extent to a withdrawal of those already committed to agriculture. Discriminatory hiring practices in industry appear to limit the off-farm work opportunities.

Jones also investigated the causes of overcommitted farm labor. Relative income constitutes an important factor influencing those in farming to decide to remain employed in agriculture. There seems to be

¹U.S.D.A., ARS, Neg. 60(10) 9004.

²Jones, B.F., An Analysis of Labor Flows Between the Farm and Non-farm Sectors, 1917-62, with Emphasis on Specific Credit and Manpower Policies, Unpublished Ph.D. Dissertation, Mich. State Univ., 1964.

evidence that prospective farmers tend to overestimate product prices and hence incomes in farming before entering, thus contributing to the over abundance of labor on farms. Jones continues that even if farmers would evaluate correctly expected incomes for the immediate future, they would also require (1) perfect foresight of the long term trends in farm and nonfarm incomes, or (2) possibilities to adjust previous decisions. The trends in farm and nonfarm incomes are attributed to economic development. With the consumer spending progressively less of his income on farm products unexpected (by farmers) declines of farm incomes relative to non-farm incomes can be expected "unless adjustments in resource use occur at precisely the right pace." His study also emphasizes the fact that entry into farming is very easy and that at times public policies (draft deferments, credit, and educational policies) have hindered occupational mobility of persons in farming or even encouraged people to enter agriculture. It is a fact that in the United States people have left farming at an annual rate of three-quarters of a million during the past decade. Still the resources employed in farming, especially labor and capital have depressed product prices to levels that give unsatisfactory returns to some engaged in farming. Especially older farmers and farm workers have low earnings on the farm, but their potential off-farm earnings are even lower.³

Econometric investigations into the labor market of agriculture on the national and regional level were undertaken by Stanley Johnson and Heady⁴

³Ibid., Chapter VIII. This entire reference examines the excess commitment of labor to U.S. agriculture.

⁴Johnson, S.S., and Heady, E.O., Demand for Labor in Agriculture, Department of Economics and Sociology and Center for Agricultural and Economic Adjustment, Iowa State University CAEA Report 13 T, Ames, Iowa, 1962. Heady, E.O., and Tweeten, L.G., Resource Demand and Structure of Agricultural Industry, Iowa State University Press, Ames, Iowa, 1963, Chapter 8,9.

and Edward Schuh.⁵ The Iowa study established supply and demand functions and their elasticities for hired and family labor for the United States and sub-regions by employing a number of regression techniques for different time periods.

Johnson's investigation tested the major hypotheses that the demand for hired labor was responsive to changes in the wage rate and also to the prices of agricultural commodities. The results supported the view that the demand for labor is responsive to both of these variables. Specifically, the responses of demand for hired labor seem more pronounced during prosperity than during depression periods. This suggests that the business cycle and employment opportunities outside the farm sector weigh heavily in the responsiveness of the demand for hired farm labor. There is hardly any difference between the long and short run elasticity of demand for labor regardless if product prices or wages change. This is interpreted by the small lag in the adjustment of demand for hired labor following permanent price or wage differentials. The coefficients of adjustments of the demand for labor due to changes in product prices or wages have increased since the beginning of the century indicating changes of structure in the agricultural labor market, especially with respect to the mobility of farm labor. One would expect a clear relation of substitutability between farm equipment prices and farm wage rates on logical and theoretical grounds. However, the estimating equations indicate farm equipment and labor to be in a complementary relationship. This is probably caused by the degree of aggregation that submerges changes in relative prices which

⁵Schuh, G.E., An Econometric Investigation of the Market for Hired Labor in Agriculture, Production Economics Paper 6104, Purdue University, Mimeo, March 1961, and unpublished Ph.D. thesis with the same title, University of Chicago, 1961.

would lead to the marginal substitution between capital and labor.

The Theil-Basman method of simultaneous solution modified by an autoregressive feature was used in the Iowa research to estimate the supply functions for family and hired labor. But the coefficients for the farm wage rate and the nonfarm wage rate were statistically not significant at the 10 percent probability level for the family function, while the coefficient of the farm wage rate was not significant for the hired labor supply function. Multicollinearity in the lagged dependent variable and the time variable probably caused further distortion in estimating the autoregressive least squares equations.

Predictions of the U.S. family and hired farm labor force were made by the Iowa researchers for the years 1958-59 and 1965, based on empirically derived demand functions with different estimating equations. A growth model, a la Hicks, was employed to arrive at long-run predictions for 1975. It is anticipated that by then the man-hour requirements for U.S. agriculture will have fallen by 60 percent from the 1957-58 level. The labor requirements in 1965 are expected to be 30 percent below those of 1957-58.⁶

The study by Schuh was concerned only with the market for hired labor in agriculture and employed variables similar to those used by the Iowa economists for their demand and supply equations. S. Johnson and Schuh both used distributed lag models.⁷ The significance of the regression coefficients varies from equation to equation, but the coefficient of determination is relatively high for all models reported. This is not quite

⁶Johnson and Heady, op. cit., pp. 67 ff.

⁷Ibid., pp. 4-6 and 11.

as virtuous as it may seem, since, as Meinken noted, time series used in a correlation analysis where the lagged dependent variable is included as an independent variable, will furnish, eo ipso, high coefficients of determination.⁸ Schuh's estimating procedures provide short-run elasticities of the same range as the Iowa study. However, his long-run elasticities are much larger since his coefficients of adjustments are smaller than S. Johnson's. Schuh did not use time as a trend variable and did not employ an autoregressive transformation, two factors which could account for most of the difference of the studies.

Another interesting result of Schuh's investigations is the quantitative determination of the disequilibrium over time in the farm labor market. He argues that due to the lags of adjustments of the hired farm labor force which were in 1959 longer than three years, the discrepancy between the long run and actual level of employment grew to 16 percent. This happened, in spite of good farm employment opportunities which generated then a heavy pull on farm labor.⁹ Schuh argues further that "if the farm prices decline by three percent per year, as they did from 1950-1957, a 4.6 percent reduction in the hired labor force is required each year"¹⁰ to achieve equilibrium in the farm labor market. He emphasizes that this is a continuing process and not isolated shocks, and that transfer of labor out of farming is necessary to bring about an equilibrium. But due to institutional, sociological, and educational barriers - the non-farm sector has definite demands with respect to occupational skills and

⁸Meinken, K.W., "Discussion: Distributed Lags and Measurement of Supply and Demand Elasticities," J. Farm Econ., 40:591-606, 1958

⁹Bonnen, J.T., and Black, J.D., A Balanced U.S. Agriculture in 1965. National Planning Association, Special Report No. 42, April 1956.

¹⁰Clark, C., "Afterthoughts on Paley," Rev. Econ. Stat., 36:267-273, 1954.

educational achievements - the movements towards equilibrium slowed down.

Another facet in the puzzle of the problems in U.S. agriculture is that while labor is generally overcommitted in agricultural production severe labor shortages occur at certain times and in specific places making necessary extensive employment of domestic migrant and even foreign workers.

Other studies, dealing mainly with national agricultural product markets in the future, furnish, as a by-product, estimates of the demand for labor in the long run. Black and Bonnen¹¹ made educated guesses about the future agricultural labor force while others employed an extension of linear trends to determine it.¹² While Colin Clark set faith in a labor force of about 3.5 million by 1975, Black arrived at 8.4 million workers in U.S. farming. The estimates of Daly for that year are 5.5 million,¹³ a figure which probably will be reached by the mid-sixties.

The Problem Defined

The conditions sketched for the U.S. agriculture are also relevant for the Michigan farm sector, since Michigan is an integral part of the U.S. economy and an important segment of U.S. agriculture.

It is well documented by various studies that the labor earnings in farming are low compared to other occupations with similar skills, work, risks, and investments. There are, first, the farm account studies

¹¹Daly, R.F., and Barton, G.I., Prospects for Agriculture in a Growing Economy, in Problems and Policies of American Agriculture, Iowa State Univ. Press, Ames, Iowa 1959, pp. 28-46.

¹²Schuh, G.E., The Long Run Equilibrium in the Hired Farm Labor Force, Prod. Econ. Paper No. 6106, Purdue Univ., Aug. 1961, pp. 2 ff.

¹³Ibid., p. 6.

2. The second part outlines the procedures for handling financial data. It details the steps involved in collecting, processing, and analyzing financial information to ensure its reliability and validity.

3. The third part addresses the issue of budgeting and financial planning. It provides guidelines for setting realistic budgets and monitoring financial performance against these targets.

4. The fourth part focuses on the management of financial risks. It identifies potential risks and offers strategies to mitigate them, ensuring the organization's financial stability.

5. The fifth part discusses the role of internal controls in preventing fraud and errors. It highlights the need for a robust system of checks and balances to safeguard the organization's assets.

6. The sixth part covers the reporting requirements for the organization. It specifies the format and content of financial reports and the frequency of reporting.

7. The seventh part provides information on the audit process. It explains the scope of the audit and the responsibilities of the auditors and the management.

8. The eighth part discusses the importance of financial literacy and training for all employees. It encourages the organization to invest in training programs to enhance the financial skills of its staff.

9. The ninth part concludes the document by summarizing the key points and reiterating the commitment to financial integrity and transparency.

The following table provides a summary of the financial data for the period covered by this report.

Category	Item	Value
Revenue	Item A	1000
	Item B	2000
	Item C	3000
Expenses	Item D	500
	Item E	1500
	Item F	2500
Profit	Item G	500
	Item H	500
	Item I	500

The total revenue for the period is 6000, and the total expenses are 4500, resulting in a total profit of 1500.

for Michigan which compute residually the labor earnings of cooperating farms. In spite of significantly longer working hours, earnings on these farms have averaged only one half to one third in recent years to those of workers classified as operatives, craftsmen, sales or clerical workers and self-employed managers.¹⁴ Typical farms, as synthesized by the U.S.D.A., confirm those findings for Michigan, showing for 1960 residual returns of 10 to 31 cents per hour to farm operators and their families on livestock farms.¹⁵ Further evidence is compiled by Cobb-Douglas function studies on several Michigan farm types giving the marginal value productivity of labor. The marginal earnings of labor per month during the fifties ranged from minus \$21 to \$274 on the farm types investigated.¹⁶ Those results are endorsed by the studies for Michigan reported in U.S.D.A. Tech. Bull. 1128.¹⁷ There the annual residual labor income per worker moved between \$658 and \$1182 on account keeping farms, which are comprised of above average farms.

The conclusion from those findings is that too much labor is employed in the production of farm products in Michigan in view of the prices the economy pays for the farm products in relation to opportunity costs and relative to other inputs. One could hypothesize about ways that would lead to increased labor returns to permit Michigan agriculture

¹⁴Kyle, L.R., "Michigan Farm Business Report for 1962," Research Report #13, Dept. Agr. Econ., Mich. State Univ., May 1964. Elterich, J., Johnson, G., and Call, D., Perspective on Michigan's Farm Labor Problems, Dept. Agr. Econ., Mich. State Univ., 1963, pp. 27-42.

¹⁵Farm Costs and Returns, U.S.D.A., ERS, Agr. Inf. Bull. 230, Oct. 1962.

¹⁶Elterich, et al., op. cit., pp. 31 f.

¹⁷Strand, Hedy, Seagraves, Productivity of Resources Used on Commercial Farms, U.S.D.A. Tech. Bull. 1128, Nov. 1955, p. 37.

to compete with other industries in the state. Several fruits and vegetables in whose production Michigan ranks high nationally, require above average amounts of labor in narrowly defined critical periods. Since existing technologies and practices are not sufficient to handle the accruing workload during all seasons, Michigan has a highly fluctuating demand for farm labor that cannot be satisfied by the local labor pool or intra-state migrants. Seasonal workers from other states and even countries are necessary to fill the gap between supply and demand for farm labor in specified regions and periods.

The nonrenewal of P.L. 78 and P.L. 414 governing the admission of foreign nationals (Mexicans and British West Indians) will have grave repercussions upon the labor supply for some of Michigan's field operations. This will be due not only to the direct effects of nonavailability of those foreign farm workers, but also to the secondary effects caused by a diminishing stream of domestic migrants from the South who will turn to other states, primarily those guaranteeing longer work or higher wages. The introduction of the Minimum Wage Law (Act 154, Public Acts of 1964, Michigan) for \$1.25 by 1967, including agricultural establishments of more than four employees hired longer than 13 weeks consecutively,¹⁸ and the attempts of unionization of farm workers, put the spotlight on the farm labor market for the years ahead.

Therefore, it appears worthwhile to give attention to the labor market as one facet of the intricate agricultural adjustment problem. An analysis of the future demand and supply of farm labor in Michigan should help those concerned with agricultural adjustments. Improved knowledge

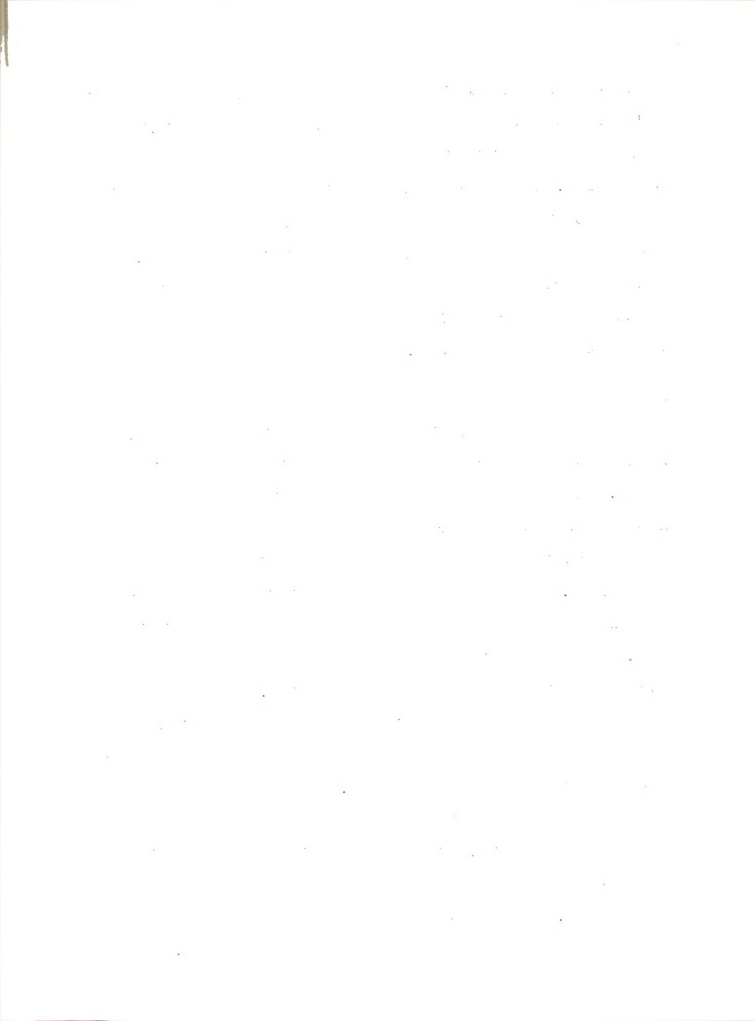
¹⁸Public Acts of 1964, Act. 154 State of Michigan, Mimeo from Agr. Expt. Sta., Mich. State Univ.

of the seasonal and local distribution of the labor requirements of Michigan's farm sector seems necessary in order to cope with the existing problems of labor deficiencies in some periods and underemployment in other periods. The author is addressing himself to the problems arising from technological developments and their repercussions on the aggregative labor needs of the most important branches of Michigan agriculture. Detailed background material on the agricultural labor situation in Michigan is contained in the publication entitled "Perspective on Michigan's Farm Labor Problems" cited previously.

Objectives of the Study

The present investigation has as its objectives (1) to analyze the changing labor requirements for the main enterprises of Michigan's agriculture. (2) To predict labor requirements for Michigan agriculture for 1970-1975 under alternative hypotheses with respect to the adoption of existing technology and the perfection of technologies in the developmental stages. (3) To use these alternate predictions (a) to assess the seasonal and regional distribution of the demand for labor on Michigan farms, and (b) to distribute the seasonal distribution of the agricultural labor force by its permanent and seasonal fractions.

The study can thus be classified as a macro investigation, attempting to assess the potentials of Michigan agriculture with respect to man-hour requirements in the decade ahead. The thesis can serve as a first approximation to the interdepartmental research "Project 80" at Michigan State University, which has as its objective the prediction of supply and demand conditions for the long run in agricultural product and factor markets. Extension personnel may find these projections useful in advising farmers as to how to organize their farms accordingly.

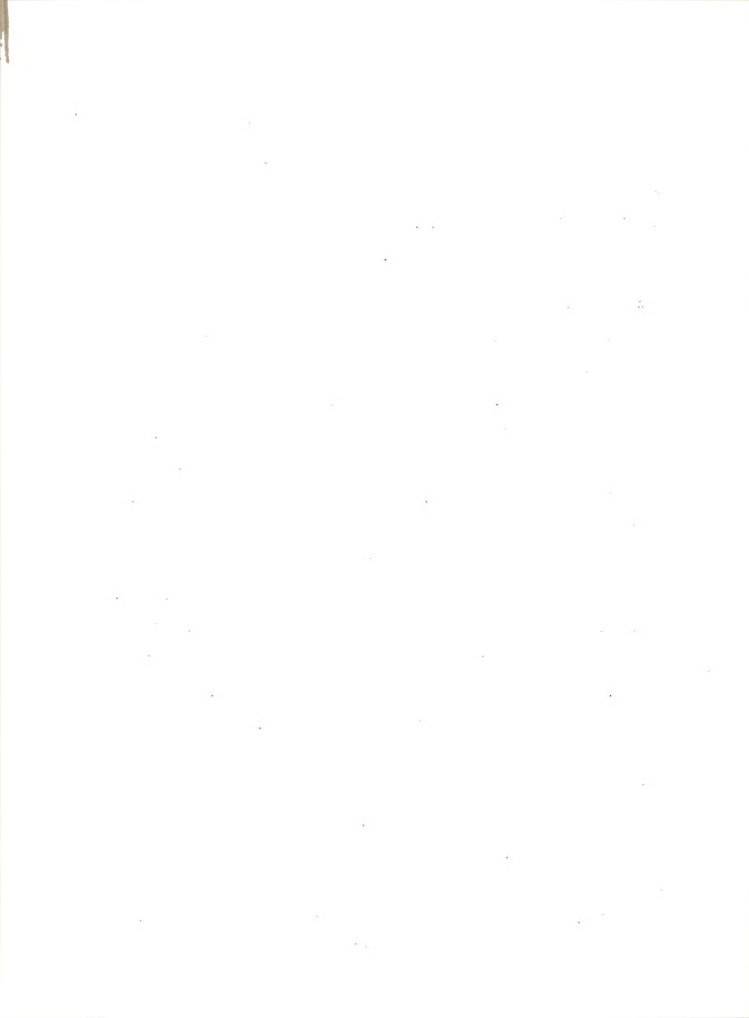


Researchers may utilize the predictions to assess the way in which upcoming changes in the size of a particular enterprise will fit into the regional or temporal distribution of the work load. The study should also assist the Farm Placement Section of the Michigan Employment and Security Commission and the U.S. Department of Labor to establish long range plans for seasonal farm labor.

Method of Research

The writer considered whether the models and procedures applied in the Iowa and Schuh study could be used successfully for the Michigan Agricultural labor market. But dissatisfaction with the historically based measure of technological progress, derived from time series data, gave the author convincing arguments to abstain from such undertakings, and to pursue a different line of attack. Besides the objections given above, the studies are annual and regional while the interest in the present study focuses on a more detailed investigation of the seasonality of labor needs by enterprises and groups of enterprises at state and substate levels. Thus, the present study is confined to the state of Michigan, which is subdivided into six regions in which specific enterprise combinations prevail. The map on page 12 conveys the necessary detail.

Most of the farm enterprises were considered. The regional and state labor requirements for any month in 1959 were determined by multiplying the average labor inputs for that month per basic unit, with the number of units in a particular region. The basic unit is either acre or head of livestock. Aggregating the labor requirements for all the enterprises in a region for a month results in the total work load of that region. The 1970-1975 period was chosen as the target period. It was decided to project for each enterprise, individually, the per unit



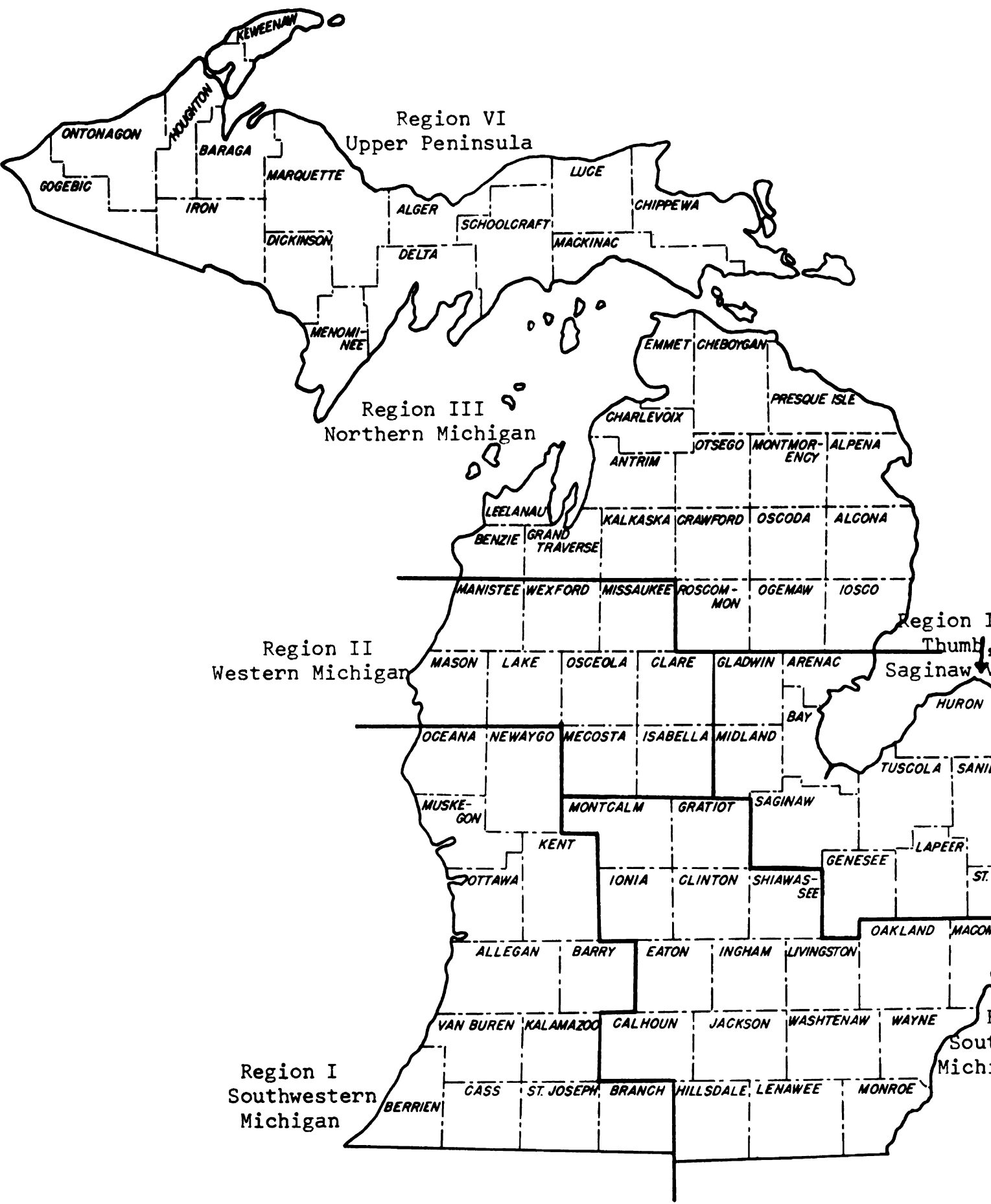
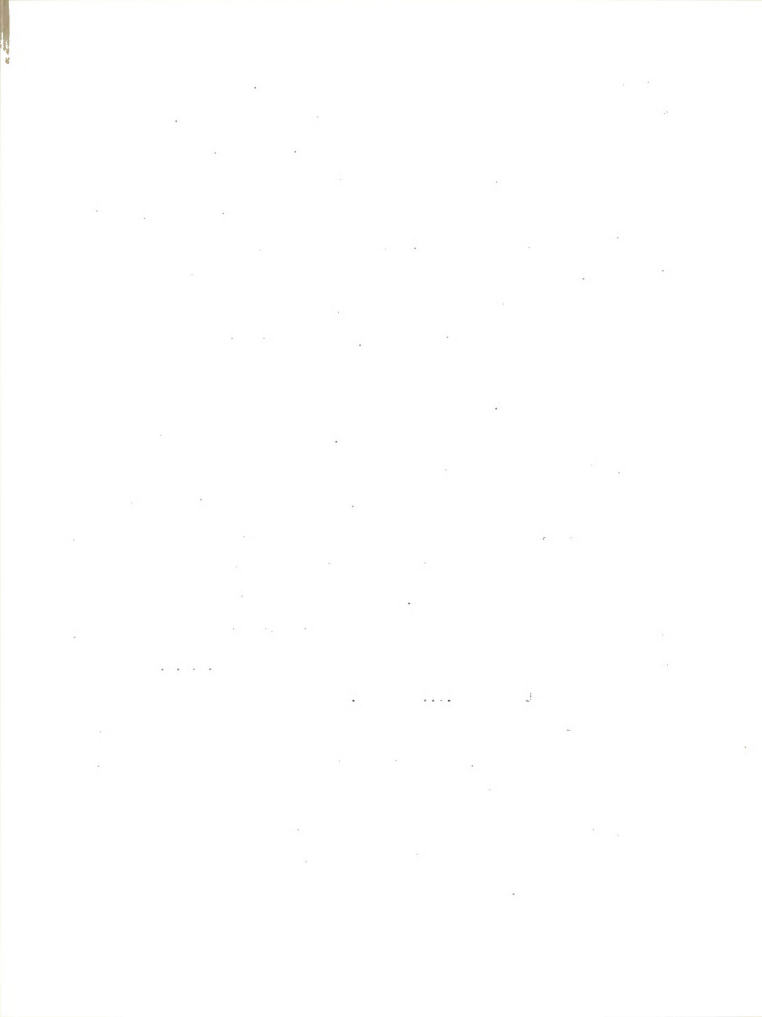


Figure I. The six labor use regions and their boundaries in Michigan



labor requirements and the regional enterprise sizes. These projections were used to arrive at the target period man-hour requirements. The same procedure was followed for 1959 with given data. Further, estimates were made as to how many hours per month were worked in 1959 and will be worked in 1970-75 for each of the following types of farm labor: operator, unpaid members of the operator's family, permanent hired labor and seasonally hired labor. By multiplying the number of persons of a particular type of labor by the hours this type works during a month, the total number of hours labored by this group is obtained. The contributions of a particular type of labor can then be calculated for any month and region considering the total use of labor. Cohort analysis performed on operators gave a good indication of their number by 1970-75. In view of the findings of Jones previously discussed judgment was made as to the size of the family labor and hired labor force by that time. Given those magnitudes for a region and month, the need for seasonal labor for 1970-75 can be determined.

For the regional enterprise size in 1959, the Census of Agriculture served as the source for the data. Long range projections on the national and state level gave indications as to enterprise size in the target period. Most of the 1959 labor requirements are in line with the U.S.D.A. figures contained in the "Labor used...." series. The synthesized figures for 1959 and 1970-75 were derived from knowledge obtained from studies of experiment stations, theses, and consultation with scientists of the field. The information concerning the composition and size of work force came from the Census, the Michigan Agricultural Statistic, the Farm Placement Section of the Michigan Employment Security Commission, theses and experiment station publications.



Sequence of Presentation

The second chapter presents the method for determining the regional sizes of the major farm enterprises for 1959 and for arriving at similar estimates for the 1970-75 period. Chapter three investigates 1959 labor requirements for the major enterprises. It also gives the reasons and quantitative changes of these enterprises for the reduced labor demands anticipated for the 1970-75 period under alternative hypotheses with respect to the speed of adoption and perfection of available technologies.

Chapter four discusses the monthly distribution of the work load for 1959 in the six regions and the changes that the two alternative levels of technological advances considered in chapter three will bring about during the 1960's. An attempt is made in chapter five to attribute for the six regions definite shares to different types of farm labor in 1959: operator, family, permanently hired, and seasonally hired labor. Given the results from cohort analysis and specific assumptions concerning hired and family labor, the need for seasonal labor during 1970-75 is established. A sixth chapter summarizes the findings, explores their implications and their limitations and, finally, considers possible future developments in the refinement of such studies.

1. The first part of the paper discusses the importance of the study of the history of the United States. It is argued that a knowledge of the past is essential for a full understanding of the present. The author points out that the United States has a long and complex history, and that it is important to understand the events and people that have shaped the nation.

2. The second part of the paper discusses the role of the federal government in the United States. It is argued that the federal government has a responsibility to protect the rights of its citizens and to promote the general welfare. The author points out that the federal government has a long history of intervention in the lives of its citizens, and that it is important to understand the reasons for this intervention.

3. The third part of the paper discusses the role of the states in the United States. It is argued that the states have a responsibility to protect the rights of their citizens and to promote the general welfare. The author points out that the states have a long history of intervention in the lives of their citizens, and that it is important to understand the reasons for this intervention.

4. The fourth part of the paper discusses the role of the courts in the United States. It is argued that the courts have a responsibility to protect the rights of its citizens and to promote the general welfare. The author points out that the courts have a long history of intervention in the lives of its citizens, and that it is important to understand the reasons for this intervention.

5. The fifth part of the paper discusses the role of the people in the United States. It is argued that the people have a responsibility to protect the rights of their citizens and to promote the general welfare. The author points out that the people have a long history of intervention in the lives of their citizens, and that it is important to understand the reasons for this intervention.

6. The sixth part of the paper discusses the role of the media in the United States. It is argued that the media has a responsibility to protect the rights of its citizens and to promote the general welfare. The author points out that the media has a long history of intervention in the lives of its citizens, and that it is important to understand the reasons for this intervention.

7. The seventh part of the paper discusses the role of the economy in the United States. It is argued that the economy has a responsibility to protect the rights of its citizens and to promote the general welfare. The author points out that the economy has a long history of intervention in the lives of its citizens, and that it is important to understand the reasons for this intervention.

8. The eighth part of the paper discusses the role of the environment in the United States. It is argued that the environment has a responsibility to protect the rights of its citizens and to promote the general welfare. The author points out that the environment has a long history of intervention in the lives of its citizens, and that it is important to understand the reasons for this intervention.

9. The ninth part of the paper discusses the role of the culture in the United States. It is argued that the culture has a responsibility to protect the rights of its citizens and to promote the general welfare. The author points out that the culture has a long history of intervention in the lives of its citizens, and that it is important to understand the reasons for this intervention.

10. The tenth part of the paper discusses the role of the education in the United States. It is argued that the education has a responsibility to protect the rights of its citizens and to promote the general welfare. The author points out that the education has a long history of intervention in the lives of its citizens, and that it is important to understand the reasons for this intervention.

CHAPTER II

THE DETERMINATION OF THE PRESENT AND ESTIMATION OF FUTURE REGIONAL ENTERPRISE SIZES

This chapter is concerned with the estimation of enterprise sizes by regions within the state and the projections of similar data for the target period, 1970-75.¹

General Considerations

It was decided to include farms as defined by the U.S. Census of Agriculture in 1959, i.e., to consider units above 10 acres if their sales of agricultural products for a year usually exceeded \$50, or units with less than 10 acres but with agricultural sales of above \$250 per annum.²

The study includes all the important crop, vegetable, fruit, and livestock enterprises of Michigan farms in the calculations in order to obtain a realistic picture of labor requirements. Nurseries, forestry, greenhouse, and flower producing enterprises are omitted from our considerations. The combination of some of the enterprises here and later into one (e.g., wheat and rye) seems justified in light of the smaller computational burden without hurting the value of the results of the study,

¹It should be mentioned that in the discussion a distinction is made between the enterprise size (e.g., wheat or dairy) within a firm and the enterprise size (e.g., wheat or dairy) of a region. The latter refers to the extent of an enterprise in one of the geographical defined areas of Michigan, and will be identified as "regional enterprise size."

²U.S. Bureau of the Census, United States Census of Agriculture 1959, Michigan Vol. I, Part 13, p. xiv. From now on referred to as "the Census."

since in seasonal and temporal respects, the labor needs are very similar, if not identical, and technological changes apply to both enterprises in a similar manner.

The unit of measurement for crop and vegetable enterprises is the acre harvested, as reported in Table 11 of the Census of Agriculture for 1959, by counties. The area dimension is given the choice over the yield dimension since it is argued that one acre with low yields, with the probable exception of fruits, generally requires almost the same labor input as an acre of the same crop enterprise with high yields. The same argument applies for all the other sectors of the farm business, regardless of whether the unit is acre or head of livestock.

The size of the regional enterprises are determined for each region by aggregating the county data of the Census. These data are the only ones available on the county basis which give either complete enumerations or estimates based on representative samples in which a fair amount of confidence can be placed. The time of enumeration does not interfere with most of the data used in this thesis.

The Projections of the Enterprise Sizes

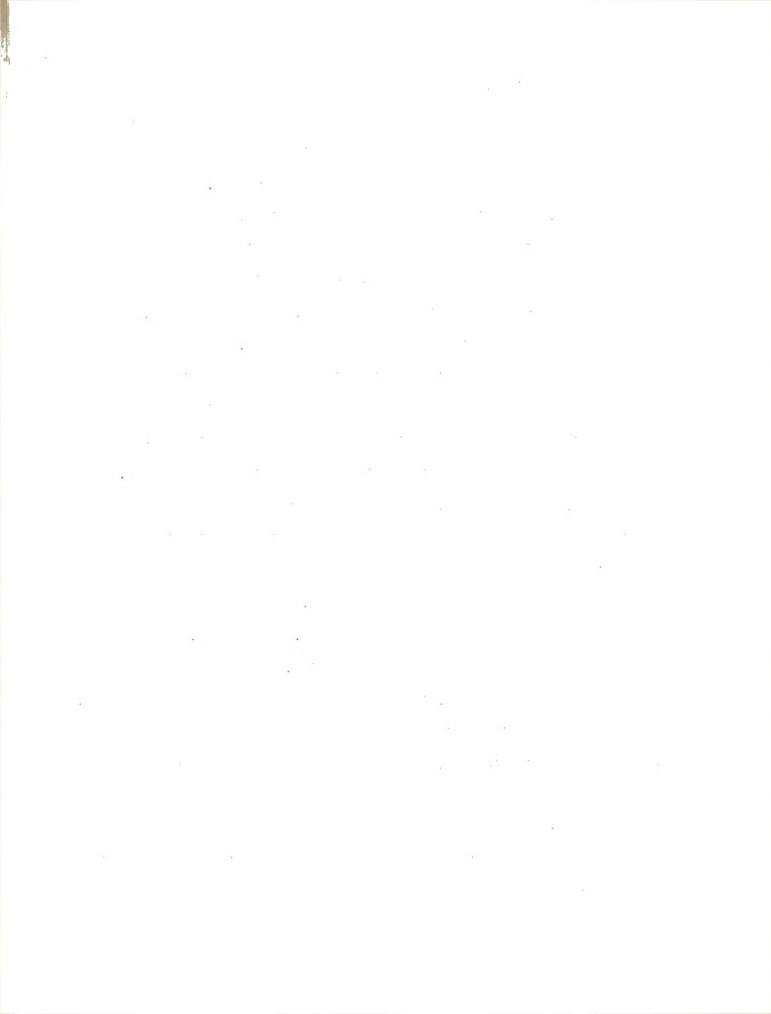
The computations of labor requirements for the target period of 1970-75 presuppose some estimates as to the extent of the enterprises by that date. The estimates are based on the following assumptions:

- (1) Excluded are abnormal effects external to the agricultural sector of the economy such as major wars, deep long lasting depressions, severe unemployment above 10 percent of the labor force, the effects of inflationary and deflationary price movements, and abnormal weather conditions.

- (2) Institutional influences on the farm sector such as government production controls, price supports, and surplus disposal plans are extended without major change from the 1964 level throughout the period under consideration.
- (3) Laws, regulations, educational institutions, and credit availability are assumed to undergo no serious changes from the arrangements known to the writer in mid-1964, such as to influence the pricing, production, import and export, and sale of agricultural inputs and outputs.
- (4) The prices and their relationships for farm commodities and factors in the production of them will remain relatively unchanged in their current trends and their regulated levels respectively with the exception of farm labor.

It is assumed, as in the past, that population growth is one of the major determinants of the demand side, while income and its distribution and consumers' preferences generally change more slowly over time and appear to have less immediate influence on the demand. Import-export conditions are more volatile and more difficult to predict. Supposedly, the possibilities are, on the whole, not very encouraging. The estimated demand for total farm output by 1975, is given at 35 percent above the 1958 level.

On the supply side, aside from the above mentioned change in the acreage available in Michigan, and an assumed 10 percent improved feed efficiency by 1975, over 1958, the yields are expected to increase for several reasons: (1) technological change will provide improved methods of production and processing, (2) the adoption of all kinds of progressive practices will be facilitated via extension, (3) the price relationships between inputs and outputs are assumed to be such that they encourage



expanded use of such practices which will, at the same time, save labor.

Consideration is given to the land available in each region for farming since especially in areas I, IV, and V, urbanization takes its heavy toll from farmland.^{3,4} Continuous cropping of some farm products is expected to become more widespread, thus allowing the proportion of those crops in the state-wide "mix" to increase. Market, rotational, climatic, soil restrictions and probable yield changes are considered. The interactions between these factors have been accounted for as much as possible as the scope of this thesis permitted.

Assumptions regarding the availability of farm labor, the adoption and production of existing and nearly developed technologies, and the skills and managerial abilities of farmers will be discussed in Chapter III.

To cope economically and efficiently with rising wage rates, farmers may reduce labor requirements by substituting capital for labor within the existing group of production methods. In the long run farmers may follow a more complicated method of introducing new labor saving technologies. Technologies of this kind are currently being perfected, mainly harvesting equipment for fruits and vegetables which is of paramount importance for Michigan agriculture. Still another way to reduce labor requirements is to relocate production on farms, in regions, and even in sections of the economy with lower labor requirements or with cheaper labor. As a result of these labor saving adjustments,

³Michigan State Univ. Agr. Expt. Sta. and Mich. Conservation Needs Committee, An Inventory of Michigan Soil and Water Conservation Needs, pp. 45-48, Oct., 1962.

⁴Mich. Dept. of Agr., Michigan Agricultural Statistics, 1961.

U.S. farm output per man has doubled since 1947-49. At the same time the man-hours worked have declined by about 40 percent.

It seems appropriate to comment in general terms on the extent of the capital labor substitution as it has occurred and is likely to occur on Michigan farms. The expanded use of capital in substitution for labor is demonstrated in a rough way by two sets of data: in four selected townships average capital use per farm expanded by about 50 percent from 1954 to 1959.⁵ Account keeping farms in Michigan have also been expanding their use of capital. In 1960, e.g., dairy and general farms in the south central portion of the state increased their machinery investment by over \$1,000, while total investment was expanded by \$8,850 and nearly quadrupled from 1947 to 1960. "Farms in the Thumb area experienced a growth of total investment of 435 percent" and of 324 percent for machinery investment from 1947 to 1960.⁶

For the same areas (regions IV and V as defined in this thesis) Lard recommends, for all types and sizes of farms, to increase several times the credit use for investments designed to achieve a more profitable farm production and reduce at the same time the input of labor.⁷

⁵Wirth, M.E., and Nielson, J.M., Resource Ownership and Productivity on Michigan Farms, Agr. Expt. Sta., Mich. State Univ., Spec. Bull. 435, Aug. 1961, pp. 13 and 28.

⁶Elterich et. al., op. cit., pp. 43-45, esp. Table 4.1 based on Farming Today, Dept. Agr. Econ., Mich. State Univ., 1961, AEC 809, 810, 812, 814, 819, Table 1 and Table 2 and AEC 810.

⁷Lard, C., Profitable Reorganizations of Representative Farms in Lower Michigan and Northwestern Indiana with Special Emphasis on Feed Grains and Livestock, Ph.D. Dissertation, Mich. State Univ., 1963, pp. 22-28, 111-126.

Brake confirms such findings for several types of farms in the Thumb area. He contends that extensive credit use (\$14-65,000 depending upon size and type of farm, reorganization and credit availability) can be profitable.⁸ In Michigan over one fifth of new loans was spent on new machinery and nearly one third went to purchase land or improve real estate in 1961.⁹

Additional evidence for strongly expanded credit use for mechanization and farm size adjustment is given by Buller for fruit farms. Those farms predominate in counties of regions I to III. Items to be financed besides operating expenses, land and storage facilities are power pruners and lifts, mechanical harvestors, and tractors. The credit used for these items ranges from \$12,000 to \$22,400 depending on the net worth of the farms.¹⁰

The actual projections of the enterprise sizes in the state of Michigan were conducted in the following manner: given the assumptions above, present trends were extrapolated, considering long range outlook publications on the national level from Daly,¹¹ Rogers and Barton,¹²

⁸Brake, J.R., "Financing Michigan Farms: the Thumb," Research Report 1, Agr. Expt. Sta., Mich. State Univ., Oct. 1963.

⁹Wirth, M.E., and Brake, J.R., "The Michigan Farm Credit Panel - Cash Flows and Use of Credit - 1961," Research Report 8, Agr. Exp. Sta., Mich. State Univ., May 1965, pp. 4,5.

¹⁰Buller, O., Profitable Adjustments on Selected Michigan Tree Fruit Farms, Ph.D. Dissertation, Mich. State Univ., 1964, pp. 55-68 and 76-79.

¹¹Daly, R.F. "The Long Run Demand for Farm Products," Agricultural Economics Research, Vol. 8, No. 3, 1956.

¹²Rogers, R.O., and Barton, G.T., Our Farm Production Potential 1975, Agr. Information Bull. 233, USDA, ARS, Sept. 1960.

and Ferris,¹³ and Michigan's relative position within the U. S. For some crop and livestock products, but especially in fruit and vegetable enterprises, Michigan ranks among the foremost producers in the nation, thus actively influencing the price of those commodities not supported institutionally. For other farm products Michigan's farm sector is a price taker, i.e., it does not influence the prices it receives for its products. Therefore, reference is made to the position Michigan's farm sector occupies in some of the enterprises which help to explain the variations in the enterprise size depending on whether or not the price costs prospects are favorable. It should be emphasized that the predicted change of Michigan enterprise sizes does not necessarily conform in magnitude or even in direction with the national forecasts. If the arguments in favor of a different result appeared convincing the future extent of a particular enterprise in Michigan was forecast accordingly. The competitive position of Michigan's farm sector in the midwest was considered. However desirable, a detailed analysis of interregional competition, is beyond the scope of this thesis.

The predictions of the regional enterprise sizes were trends extrapolated from past changes, as long as that seemed logical, if only predictions on the state level were available. The crosschecks included those with the latest available statistics¹⁴ and literature.¹⁵

¹³Ferris, J., "A Long Range Outlook for Livestock and Crops," Dept. Agr. Econ., Mich. State Univ. (Mimeograph) July 1962.

¹⁴See material cited in fn. 3 and 4, USDA, Stat. Rep. Service, Livestock Slaughter, 1963, April 1964. Meat Animals 1962-63, April 1964, - Field and Seed Crops, May 1964, - Vegetable Processing and for Fresh Market, Annual Summary, 1963, Dec. 1963, - Commodity Situation Reports of the USDA, 1964, - Crop Production, CrPr 2-2 and 2-4.

¹⁵Wright, K.T., Changes in Feed-Grain Production and Livestock Numbers in Michigan, Mich. State Univ., Agr. Expt. Sta. Spec. Bull. 407, April 1956. Hill, L.D., and Dennis, C.C., The Feed Manufacturing Industry and Michigan Agriculture, Dept. Agr. Econ., Mich. State Univ., Spec. Bull. 444, 1963.

Table 2.1. State and regional enterprise sizes, Michigan, 1959

Enterprise	Region						State*
	Southwest Michigan	Western Michigan	Northern Michigan	Saginaw Valley	Thumb	Southern Michigan	
(Thousands of acres)							
Crops							
Corn (grain)	461.2	66.4	16.7	278.6	850.2	.8	1673.9
Corn (silage)	46.5	23.9	19.7	73.9	95.2	7.0	266.2
Wheat and Rye	228.9	53.8	30.3	355.2	452.5	2.3	1123.0
Oats	156.0	57.1	58.5	221.1	312.9	53.8	859.4
Barley	26.2	2.1	3.6	15.1	33.6	1.0	81.6
Soybeans	27.5	.5	...	24.4	172.1	...	224.5
Dry beans	3.2	12.6	.3	360.0	118.2	...	494.3
Potatoes	5.0	2.6	7.9	11.3	14.3	4.8	45.9
Sugar Beets	...	.1	...	65.7	6.1	...	71.9
Seeds	27.7	5.9	4.3	16.3	37.5	3.7	95.4
Hay	322.4	187.0	204.1	394.8	515.8	174.2	1798.3
Grass silage	9.8	4.9	4.1	9.6	22.0	2.2	52.6
Pasture	418.7	245.9	256.9	387.7	641.3	140.5	2091.0
Vegetables							
Asparagus	10.2	...	.2	.1	.4	...	10.9
Beans	3.3	3.1	.6	2.6	2.2	.5	12.3
Cabbage	1.9	...	.1	1.9	1.7	.1	5.7
Cantaloupe	1.3	...	...	.5	1.0	...	2.8
Carrots	1.8	...	.3	1.2	.7	...	4.0
Celery	2.0	...	...	...	.7	...	2.7
Sweetcorn	2.4	.2	1.0	2.9	7.7	.1	14.3
Cucumber	6.0	2.1	.4	7.4	9.4	...	25.3
Lettuce	.2	...	...	.6	.3	...	1.1
Onions	4.0	...	...	.4	2.8	...	7.2
Peas	.7	.1	...	2.1	.8	.1	3.8
Tomatoes	6.2	...	.1	1.0	7.0	...	14.3
Peppers	.5	...	...	.2	1.0	...	1.7
Mint	1.0	...	...	.2	5.0	...	6.2
Fruits							
Apples, bearing	34.9	2.6	6.6	3.6	11.4	.6	59.7
Apples, nonbearing	9.0	.7	.9	.9	2.5	.1	14.1
Cherries, tart, bearing	18.9	3.7	18.8	.3	.5	...	42.2
Cherries, tart, nonbearing	5.0	1.0	3.5	...	.1	...	9.6

Table 2.1. State and regional enterprise sizes, Michigan, 1959 (continued)

Enterprise	Region						State
	Southwest Michigan	Western Michigan	Northern Michigan	Thumb Saginaw Valley	Southern Michigan	Upper Peninsula	
	(Thousands of acres)						
Fruits (continued)							
Cherries, sweet, bearing	1.6	.5	3.8	...	...	...	5.9
Cherries, sweet, nonbearing	1.0	.5	2.6	...	...	...	4.1
Grapes, bearing	21.9	...	...	.1	.3	...	22.3
Grapes, nonbearing	1.0	...	...	...	...	...	1.0
Peaches, bearing	17.7	.6	.5	.4	1.8	...	21.0
Peaches, nonbearing	8.3	.2	.3	.1	.6	...	9.5
Pears, bearing	7.8	.7	.5	.1	.5	...	9.6
Pears, nonbearing	2.8	.2	.3	...	.1	...	3.4
Plums, bearing	2.0	.2	.6	.1	.2	...	3.1
Plums, nonbearing	1.2	.1	.4	...	.1	...	1.8
Strawberries	4.7	.9	1.3	.4	.7	.5	8.5
Raspberries	6.6	.3	.5	.3	.3	...	8.0
Blueberries	4.8	...	...	.2	...	...	5.0
							23
							</

Table 2.2. Projections of the state and regional enterprise sizes, Michigan, 1970-75

Enterprise	Region						State*
	Southwest Michigan	Western Michigan	Northern Michigan	Saginaw Valley	Southern Michigan	Upper Peninsula	
Crops	(Thousands of acres)						
Corn (grain)	484.0	69.7	16.7	305.8	978.0	.8	1855.0
Corn (silage)	62.8	29.9	23.6	114.5	152.5	8.4	391.7
Wheat and Rye	232.0	56.0	31.7	364.2	463.8	2.3	1150.0
Oats and Buckwheat	93.0	34.0	32.0	134.0	190.0	38.0	521.0
Barley	8.0	1.0	1.0	6.0	13.0	.5	29.5
Soybeans	54.0	1.0	...	48.0	345.0	...	448.0
Beans	5.0	18.0	...	500.0	165.0	...	688.0
Potatoes	5.0	2.0	5.0	10.0	13.0	4.0	39.0
Sugar Beets	...	...	...	89.0	8.0	...	97.0
Seeds (legume grass)	27.7	5.9	4.2	16.3	37.4	3.7	95.2
Hay	242.0	150.0	163.0	305.0	413.0	131.0	1404.0
Grass silage	9.1	4.6	4.0	9.0	20.0	2.0	48.7
Pasture	300.0	183.0	200.0	290.0	480.0	110.0	1563.0
Vegetables							
Asparagus	10.2	3.4	.2	.1	.4	...	10.9
Beans	3.6	...	.7	2.9	2.4	.5	13.5
Cabbage & cauliflower	2.0	...	.1	1.9	1.7	.1	5.8
Cantaloupe	1.3	...	...	.6	1.0	...	2.9
Celery	2.0	...	...	.7	...	...	2.7
Carrots and beets	1.8	...	...	1.5	1.0	...	4.6
Sweet corn	2.4	...	.3	2.9	7.7	.1	14.3
Cucumber, squash	4.5	1.5	1.0	6.0	8.0	...	20.2
Lettuce	.2	...	.2	.7	.3	...	1.2
Onions	4.0	...	...	.5	2.8	...	7.3
Peas	1.4	...	...	4.4	1.6	.2	7.8
Peppers	.5	...	...	.2	1.0	...	1.7
Tomatoes	6.0	...	...	1.0	7.0	...	14.0
Mint	1.0	...	...	...	4.0	...	5.0
Fruits							
Apples, bearing	38.4	2.9	7.0	4.0	12.5	.6	65.3
Apples, nonbearing	10.0	.8	1.0	1.0	3.0	.1	14.8
Cherries, tart, bearing	20.0	4.0	17.0	.2	.5	...	41.7
Cherries, tart, nonbearing	5.0	1.0	3.5	...	.1	...	9.6

Table 2.2. Projections of the state and regional enterprise sizes, Michigan, 1970-75 (continued)

Enterprise	Region						State
	Southwest Michigan	Western Michigan	Northern Michigan	Thumb Saginaw Valley	Southern Michigan	Upper Peninsula	
	(Thousands of acres)						
Fruits (continued)							
Cherries, sweet, bearing	2.2	1.0	4.6	...	...	...	7.8
Cherries, sweet, nonbearing	.6	.3	1.2	...	...	...	2.1
Grapes, bearing	24.1	...	...	.1	.3	...	24.5
Grapes, nonbearing	1.0	...	...	...	...	...	1.0
Peaches, bearing	20.0	.6	.6	.3	1.8	...	23.3
Peaches, nonbearing	8.0	.2	.2	.1	.6	...	9.1
Pears, bearing	9.0	.8	.9	.2	.5	...	11.4
Pears, nonbearing	3.0	.3	.3	.1	.1	...	3.8
Plumbs, bearing	2.4	.3	.8	.1	.2	...	3.8
Plumbs, nonbearing	.8	.1	.3	...	.1	...	1.3
Strawberries	5.0	1.1	1.6	.4	.8	.7	9.6
Raspberries	7.0	.3	.6	.3	.4	.1	8.7
Blueberries	5.0	...	...	.2	.1	...	5.3

The writer discussed with members of the Departments of Agricultural Economics, Crops, Animal Husbandry, and Horticulture, the realism of the estimates in view of the projected demand (income and price elasticities) and supply conditions. It goes without saying that the factor and product price conditions are closely interrelated. No intricate analysis of the variables involved was performed, since this is not within the scope of the thesis. The writer relied instead on the experience and knowledge of experts in the fields and his own personal judgment. The present and target period regional enterprise sizes are found on Tables 2.1 and 2.2 on previous pages.

Crops

General Remarks

To obtain regional enterprise sizes for crops in 1959, the acreages of the respective counties are added as reported in the Census County Table 11.¹⁶ The data provided give the acreages of crops harvested and not those of the planted area. This may introduce a downward bias into our calculations of the regional labor requirements. The discrepancy between crops planted and harvested cannot be determined for all crops from the data available. In 1959, millions of acres were classified as either crop failure or idle crop land. Besides, no indication is given as to which crops failed and when they were abandoned. The predictions account for the fact that 1 million acres of cropland are not harvested and another million acres are left idle by 1970-75. An increase in idle cropland seems to be the trend in the high wage, industrialized areas of the western world, particularly Michigan. Therefore, it was decided to consider only the areas harvested.

¹⁶Op. cit., pp. 202-222.

Total crop production projected to cover the needs during the first half of the next decade is about 25 percent above the 1958 level.¹⁷ Variations between individual crops are introduced for several reasons: (1) for some of the crops, a considerable surplus is produced at present, thus requiring smaller changes by 1970-75, (2) increased yields will have a decisive influence upon the needed acreage of a particular crop, (3) others will be in great demand due to the taste changes of consumers, e.g., toward red meats, processed fruits and vegetables, and due to higher incomes and a population of 215 million, (4) substitutability between crops in production and consumption will affect the percentage increase of production. This substitution may be due to regional comparative advantages and hence lower costs of production or higher yields. One way to lower costs would be to increase the labor efficiency in the production. (5) Fluctuation in the U.S. import-export balance will also have its influences on the demand for particular products. On the other side, a net loss of 680,000 acres from 1958 will occur for crop land by 1975 in Michigan, due to reforestation and urbanization. Pastures will show a net loss of 181,000 acres in the same period.¹⁸ Substantial increases in yields are required and are possible for all feed grains, soybeans, and forage crops. In Michigan, nearly three fourths of the acreage of the cropland is accounted for by those items, indicating the crucial importance of their yield increases with further shifts of consumption to livestock products. At the same time it should be pointed out

¹⁷Rogers and Barton, Our Farm Production, op. cit., p. 3.

¹⁸An Inventory...op. cit., p. 5.

that the expected 10 percent increase in feed efficiency assists in balancing the demand and supply for feed grains and forage crops.

Future Regional Enterprise Sizes for Crops

Michigan stands in tenth place with regard to production and acreage of corn on the national level. The cultivation of corn for grain will continue to increase due to its relative profitability as a feed grain. An expansion of about 11 percent in acreage is expected during this decade on the state level in spite of an estimated increase in yield of 10 bushels. The increased acreage will be concentrated in the south central and southeastern part of the lower peninsula (15 percent) and the Thumb area (10 percent) where drainage projects have made many acres available for corn production. This area will coincide with a pronounced expansion of the livestock enterprises in areas IV and V. Slight increases of about 5 percent are projected for areas I and II, while the rest of the regions will not show significant changes.¹⁹

The superiority of corn silage over alfalfa hay has and will greatly enhance the cultivation and feeding of corn silage to the increased cattle operations.²⁰ Big gains of about 50 percent of the corn

¹⁹Within the feed grains the rotational weight in Southern Michigan will be about 3/4 to 4/5, depending upon if soybeans can be grown or not.

²⁰Hoglund, C.R., "Evaluating the Economics of Alternative Forage Crops for the Farm Business," Dept. Agr. Econ., Michigan State Univ., Mimeo 873, Aug. 1962, p. 3.

silage acreage of 1959 for the livestock inventories are expected by 1970-75 in areas IV and V, while the additions in the other areas move between one fifth and one third. The estimated expansion of corn cultivation for grain and silage is supported by Lard's findings for the Thumb area.²¹

Michigan ranked tenth and ninth nationally in the production of wheat and rye in 1963. A slight upward expansion of the acreage is expected by 1970-75 for all the regions except VI since export demand, which accounts now for about one half of the wheat production nationally, will increase further if farmers obtain the vigorous government subsidies now received.²² A slight decrease of demand per capita is expected to come from the domestic market since the income elasticity of demand for bread grains is negative. At best a slight increase in the acreage is anticipated since the estimated yield will be about seven bushels higher than in 1959. Rogers and Barton estimate a small negative change in the acreage of wheat for 1975 on the national level.²³ Since that figure contains hard and soft wheat and most of the surpluses have accumulated in hard wheat, the figure does not apply to the same extent for soft wheat, which is grown here nearly exclusively and which had, due to extensive exports, much closer ratios of production to disappearance than hard wheat in recent years.

Although oats is still very important in Michigan's farm production - Michigan ranks eighth nationally - the competition for its land

²¹Lard, C., loc. cit.

²²Ferris, "A Long-Range Outlook..." op. cit., pp. 18-21

²³Op. cit.

by corn and wheat has been very strong. The national outlook is for hardly any changes in the acreage devoted to oats. But Michigan farmers seemed to consider the other two grains superior; the acreage of oats has declined slowly in the past decade. The rotational weight for oats in the feed grains will decline to less than 10 percent in the southern part of Michigan. The acreage for 1970-75 will probably amount to only 60 percent of the 1959 acreage, with the largest relative reductions concentrated in area III and the smallest in areas IV and V.

The acreage of barley has dropped 50 percent in recent years in Michigan. The farmers abandoning barley cultivation have replaced it with the more profitable corn. Large reductions of barley cultivation of about 60 percent are expected to be distributed over all areas. The largest reductions will be in areas I and III, the smallest in II, where the competition from oats seems to be less severe. The annual increments in yields of .28 bu./acre forecast for barley will also help to explain the reduction of the acreage.²⁴ By contrast the national acreage in 1975 is projected to increase by 3-6 percent from 1955-58 and the income demand elasticity is assumed to be slightly positive (.1) probably due to the use of barley as a raw material in meat and beer production.²⁵

The large expansion of soybean cultivation has had its influences upon Michigan as well. Although forecasts at the national level give only a small positive acreage change between 1958 and 1975, it is expected that the large recent expansion in soybean cultivation in Michigan

²⁴Egbert, A.C., and Heady, E.O., Regional Adjustments in Grain Production, USDA in cooperation with Iowa Agriculture and Home Economics Experiment Station Center for Agricultural and Economic Adjustment, Tech. Bull. 1241, Supplement, p. 17.

²⁵Rogers and Barton, "Our Farm Production...", op. cit.

will continue. That has taken place mainly in the southern and the central region of the lower peninsula and in the Thumb. It will be possible to produce soybeans north of this area since varieties have been developed which will produce grain there. While soybeans accounted for 25 percent of the cropland in southeastern counties in 1959, the proportion in all other areas did not exceed 5 percent. In those areas a doubling is easily possible by 1970-75. The exceptional prospects for soybeans are related to the good export markets and to Michigan's favorable shipping position with respect to the growing domestic feed grain economy and also to the increased use of oil for food and industrial purposes. Daly anticipates exports to double from 1960 to 1975.²⁶

Michigan is the primary producer of dry beans in the country. Although the income elasticity is estimated at -.2 and hence a declining per capita demand is expected with increasing income, population expansion and the fact that the beans are still a favorite for the increasing number who are going camping indicate that total demand for beans will hold up very well. Government food programs and exports have also maintained demand.²⁷ Most of the increases in demand will come from those sources in the future. This will be reflected in an expansion of the acreage of over one third from the 1959 level by 1970-75. The bulk of the additional beans will be grown in the Thumb-Saginaw Valley and the Central Region.

With the expansion of corn silage production, a contraction of

²⁶Daly, R.F., "Agriculture in the Years Ahead," Talk presented at the Southern Agricultural Workers Conference, Atlanta, Georgia, Feb. 3, 1964, App. Table 4.

²⁷Daly, "The Long Run Demand for Farm Products," op. cit.

seven percent in the grass silage acreage is forecast for 1970-75. Most of the reduction (10 percent) is expected for the area where corn silage will expand most or where the cattle number will decline, i.e., V and VI, while lesser reductions are expected for regions II and III where corn does not have such favorable conditions for cultivation.

The acreage of pasture of all kinds was reduced by over 26 percent between 1954 and 1959 due to urbanization abandonment, and the substitution by corn silage, grain, and concentrate feeding. It is anticipated that this development will continue to the target period though probably not quite as fast, since some of the land is natural pasture. More than the average reductions in acreage will come in the Upper Peninsula, while lesser reductions will take place in area III.

Predictions on the national level indicate little change in the area devoted to hay making. Contrary to the national outlook, the trend in Michigan since 1944 has been to reduce rather drastically the acreage for hay. It is anticipated that one fourth of the 1959 area used for hay production will be devoted to other uses, and the productivity per acre increased noticeably. Corn, silage and beans are considered the biggest competitors for those areas. The reductions in acreage will be largest in the Upper Peninsula, the Thumb, and southeastern Michigan.

The national position of Michigan in the production of seeds (clover, alfalfa) has been subject to wide variations. In clover seeds, Michigan is among the top ten producers. Due to the small areas involved and the volatile situation, the predictions are for no change by 1970-75.

In potato production, Michigan ranks about tenth in the nation. Potato consumption is subject to two countering forces: the income elasticity is negative but the demand has been developing fairly well for

potatoes in processed form. The net effect will result in hardly any change in national acreage, especially if possible higher yields are taken into consideration. But Michigan potatoes have had and are expected to have a hard time competing with products from Idaho and Maine. Therefore, a decrease of 15 percent in the acreage is expected from 1959 to 1970-75. Most of the reduction is foreseen for regions II, III and VI.

Michigan holds seventh place in the U.S. in the production of sugar beets. National and international policy play a very important role in the determination of the beet sugar production allocated to Michigan. The uncertain situation has prompted the processors to close down many plants and operate only a handful of high volume refineries. An expansion of about one third of the acreage of 1959 seems possible and likely in view of the better situation on the world market and the increased cultivation of the last few years. Most of the additional acreage will come from the Saginaw Valley - Thumb area since an expansion in that area is possible in view of the easy adjustment in the rotation and the potential of existing processing plants. Prohibitive transportation costs would not allow too much expansion of the acreage outside this area of present cultivation.²⁸

Vegetables

General Considerations

The per capita consumption of vegetables will increase somewhat in the future. The consumption of processed (frozen, canned, dried) vegetables will increase at the expense of fresh. With per capita increase

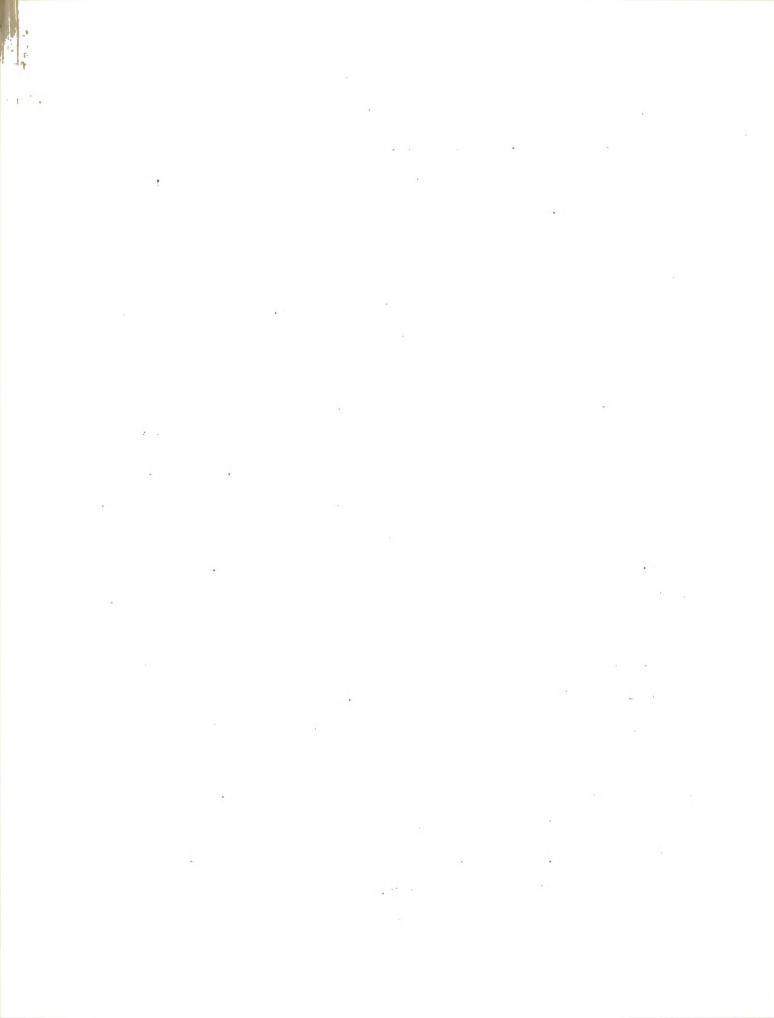
²⁸ Young, R., An Economic Study of the Eastern Beet Sugar Industry, unpublished Ph.D. dissertation, Mich. State Univ., 1963, Ch. IV and V.

of 10 percent in consumption (the income elasticity of demand for most of the vegetables is positive and highest for the frozen kind) and population growth total production needs to increase by approximately 40 percent by 1975.²⁹ Most of this increase will be from higher yields on existing areas. The prices for vegetables are subject to wide swings. In some commodities, Michigan is so prominent a producer that it determines to a large extent the price for the produce. For others the price is determined outside the state. Generally, prices for vegetables have stood up better in the face of the common price decline for other farm products.

Two principal considerations can be made considering the production of vegetables. (1) An undetermined number of Mexican Nationals do not possess the crossing-cards required for entry into the United States. Therefore, it is difficult to assess the impact on the seasonal labor supply caused by the exclusion of those Mexicans now coming under provisions of Public Law 78 into this country. However, assuming that a substantial part of the Braceros cannot return and perform the stoop labor which they usually do, a considerable number of these tasks will have to be mechanized. Many activities will be mechanized by 1970, thus reducing drastically the need for stoop laborers. This will make it possible to expand the acreage of crops traditionally requiring stoop labor. It appears that mechanizing stoop labor activities (possibly on a custom hire basis if the enterprise size of the firm does not warrant investing in the specialized equipment) will be rewarding since, in the authors opinion, not many U.S. citizens can be enticed to perform stoop labor for an extended period even when given double wages.

²⁹Ferris, "A Long Range...", op. cit., p. 21.

(2) This leads to another consideration connected with the introduction of the minimum wage rate in Michigan and other fruit and vegetable producing states. First of all, not many Michigan farmers will be subject to this law, since few employ more than four workers for more than three months. If it is assumed that states competing with Michigan in the production of fruits and vegetables do not pass minimum wage legislation as Michigan did, these states may obtain a comparative advantage in the production of vegetables requiring much labor. This may hurt the larger producer of such crops employing more than four workers for more than three months, thus probably leading to a reduction of acreages in those crops. Smaller producers may, however, expand their production of those crops simultaneously with the contraction of the larger suppliers if their farm organization and labor availability allow it. However, the other states may follow suit and pass similar minimum wage legislation. As this is likely in view of the competition on the seasonal farm labor market. The comparative advantage is not expected to change. Very often Michigan is in a different seasonal group in the production of vegetables, thus not competing directly on the fresh market with states such as California, Texas, and Florida which take advantage of seasonal and topographical conditions and economies to scale. With the increased importance of processed foods, the states mentioned offering longer periods of employment and higher wages may more easily attract seasonal workers from the labor pool in the southern states than the distant Michigan. States on the eastern seaboard will have the seasonal labor sources of Puerto Rico readily accessible. Michigan, as a highly industrialized state, has a comparatively high industrial wage rate. But since the markets for farm and nonfarm labor appear to be separated Michigan farm wages are not on a



very high level on the national scale. When industrial workers are employed, they normally do not consider farm work as a means of earning money but rather prefer receiving unemployment benefits.

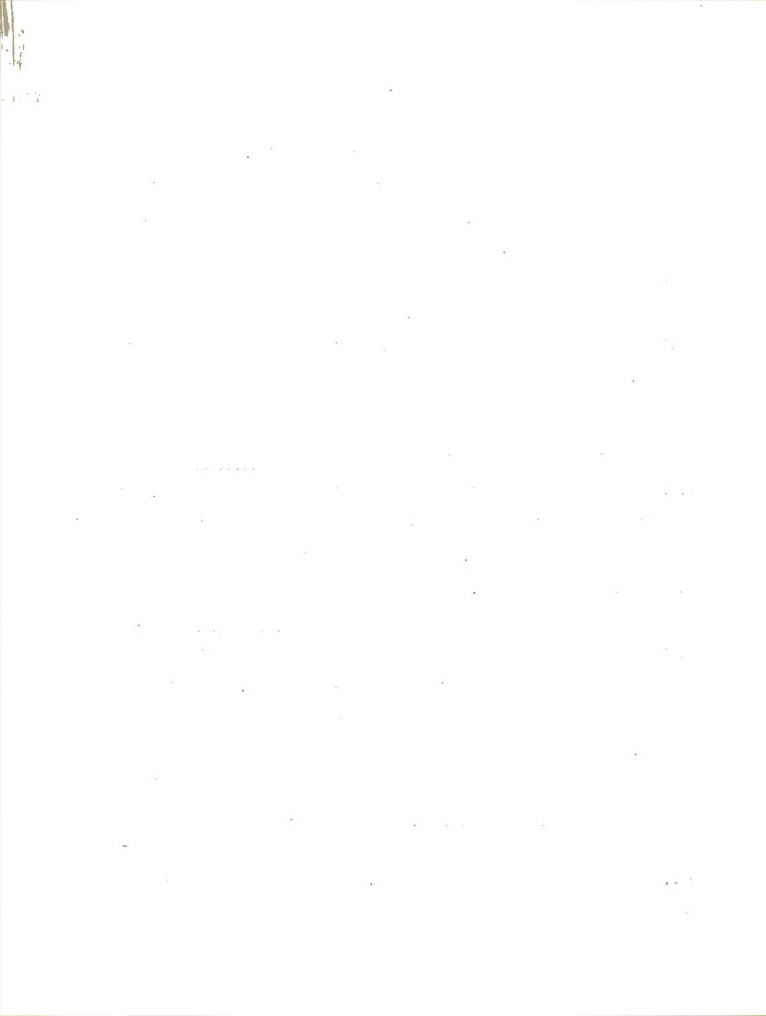
In spite of all the negative arguments it is believed that Michigan will, in general, keep its place as the major fruit and vegetable producer of the Midwest. This is mainly based on (1) the fact that the bulk of the producers are relatively small family farmers and hence not subject to minimum wage legislation, and (2) the likely adoption of labor saving technologies applicable by 1970, as will be discussed in the third chapter.

Future Regional Enterprise Size of Vegetables

Michigan is among the five major producers of asparagus in the U.S. Although the consumption of asparagus is expected to increase, soil and climatic conditions and farm organization set natural limits to the expansion of its cultivation. No major changes in the area devoted to this vegetable are foreseen.

Michigan ranks high among the producers of snap and lima beans. It is anticipated that demand will be such that a 10 percent increase in the acreage planted over 1959 will take place by 1970-75. The gains in area will be proportionately distributed over all the present production regions.

As for several other vegetables, Michigan is one of the leading producers of cabbage and cauliflower in the nation. Although the group of the vegetables to which cabbage belongs has a negative income elasticity, the acreage has expanded since 1959. Nevertheless, no major change from the 1959 acreage is forecast for 1970-75, except that the Upper



Peninsula will double it's small acreage.

Michigan is a foremost producer of cantaloupes. An expansion of the acreage took place in recent years. It is expected that the demand for this product will be fairly good and hence will, by 1970-75, warrant an expansion in area planted. The expanded acreage will occur in the traditional regions, i.e., the southwestern and central part of the state.

Carrots and red beets produced in Michigan fill an important place in the national production. While the acreage for red beets has remained fairly stable, the acreage for carrots has nearly doubled during the past seven years due to favorable price development in spite of significantly higher yields. In view of this development and a positive income elasticity which may partly reflect taste changes, the area for the target period is anticipated to be 15 percent above the 1959 level, with a marked increase in areas IV and V.

Michigan is the principal producer of late celery in the U.S. It is estimated that yields increased 60 percent from 1948 to 1959. With the demand for salad ingredients continuing strong, celery cultivation could expand very rapidly in Michigan since the soil conditions seem to be favorable for a successful expanded production.

Sweet corn from Michigan has been supplied to the nation to a large extent. In 1961, sweet corn production reached a high of 16,000 acres in Michigan, but with higher yields per acre, the areas devoted to sweet corn have been declining some during the last two years. It is anticipated that the acreage in 1970-75 will lie between the 1959 and the Present acreage, since consumer demand seems to be fairly steady at Present levels and with given prices.

It is a well known fact that Michigan is the No. 1 producer of

pickling cucumbers. Increased yields for both pickling and slicing cucumbers decreased the acreage by over one third from 1957 to 1962. A leveling off seems to be indicated and the forecast is for an essentially unchanged acreage for cucumbers and squash, assuming that the harvest can be done mechanically or that enough labor is available for it. In recent years larger pickles have been harvested, since this saves labor. The larger pickles are then sliced for processing purposes to replace small pickles. They can be marketed at a substantially lower price.

The consumption of lettuce in the U.S. has been fairly stable. Following the national trend of higher consumption and Michigan's production a 9 percent expansion appears justified. It is not anticipated that the expansion in acreage of recent years will continue.

After Texas and California, Michigan is the nation's third producer of onions. Increased yields have made up for the decreasing acreages during the past decade. It is expected that with the potential in processed onions, the acreage in Michigan can be held at the level prevalent at the beginning of this decade.

Although Michigan does not play a large role in the green pea production for processing, the acreage harvested has about doubled since 1959. It is not expected that the expansion of pea cultivation will continue at the present rate, but rather that it will consolidate at the present level.

Green peppers play a minor role in Michigan's vegetable production. The acreage devoted to their production is not expected to deviate much from the 1959 level, since prices have not moved favorably compared to other vegetables.

Michigan is an important supplier of fresh market tomatoes. While

1. The first part of the report is a general
introduction to the subject of the study.
It discusses the importance of the study and
the objectives of the research. The second part
is a literature review of the subject. It
discusses the work of other researchers in the
field and identifies the gaps in the literature.
The third part is a description of the methodology
used in the study. It discusses the data sources,
the data collection methods, and the data analysis
techniques. The fourth part is a presentation of
the results of the study. It discusses the findings
of the research and compares them with the findings
of other researchers. The fifth part is a
discussion of the implications of the study. It
discusses the practical applications of the findings
and the limitations of the study. The sixth part
is a conclusion. It summarizes the findings of the
study and provides recommendations for further research.

the prices for fresh market tomatoes lost ground (30 percent during the last six years), tomatoes for processing have given the producer a fairly stable return. This, coupled with increasing yields for processing but fewer contracted acres and decreasing yields for fresh market tomatoes, help to explain the slight reduction in area for tomatoes expected by 1970-75.

Mint production has been reduced to 45 percent of the 1956 level. Still, Michigan is a major U.S. producer. Rising cultivation costs and depressed prices due to a synthetic oil from orange skins, which is a substitute for low grade mint oil, lead to the reduction in acreage. Yields have been rising for peppermint. The present slump is expected to be partly recovered. Such indications were evident in 1963. With reduced costs of production due to chemical weed control, the acreage in 1970-75 is anticipated to be not too much below the 1959 level.

Fruits

General Considerations

Nine percent of the cash receipts of Michigan farmers came from the sale of fruit in 1962. This indicates the importance of this group of enterprises which covers less than 2.5 percent of the cropland area.

A strong annual increase of the demands for fruit appears to be certain for the years ahead. According to Daly, the per capita consumption will rise by 36 pounds from 1960 to 1975, with most of the increase in citrus fruit.³⁰ Accounting also for the rising population, the increase in consumption may reach 50 percent during this period, continuing

³⁰Ferris, "A Long Range...", op. cit., p. 23. Daly, "Agriculture...", op. cit., Table 3, Appendix.

an established trend. More of the fruits will be consumed in processed form, fewer in fresh condition. The income elasticity of demand for processed fruit is positive, the one for fresh fruit negative, reflecting the changing taste of the consumer.³¹ Since Michigan is an important fruit supplier for the nation, the current trends will have their repercussions upon Michigan fruit growers.

Future Regional Enterprise Size of Fruits

The small fruits

Strawberry production has increased in Michigan in spite of a reduction of acres harvested and fairly steady prices. About two thirds are consumed as fresh berries. It is expected that some of the lost acreage will again be replanted in strawberries by 1970, increasing the 1959 acreage by 15 percent. Relatively high prices and lower costs of production through decreased labor inputs will contribute to the expansion. Other factors contributing to the expansion are Michigan's transportation and processing advantages over those of some neighboring states.³² Above average additions to the 1959 area are anticipated, especially in areas II and III and for the Upper Peninsula where Houghton County is expecting an important increase in acreage.

Following the trend, some increases of raspberry acreage are expected along with simplifications and cost reductions in production.

³¹Ferris, "A Long Range...", op. cit., p. 23.

³²Daly, R.F., Agriculture in the Years Ahead, op. cit., Appendix, Table 1, Dennis, C.C., and Sammet, L.L., "Interregional Competition in the Frozen Strawberry Industry," Hilgardia, Univ. of Calif., Berkeley, Calif., 31:583-602, 1961.

1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the study and the objectives of the research. It also provides a brief overview of the methodology used in the study.

2. The second part of the report is a detailed description of the study area. It includes information about the location of the study area, the population of the study area, and the characteristics of the study area.

3. The third part of the report is a description of the data collection process. It includes information about the sources of data, the methods used to collect data, and the time period over which data was collected.

4. The fourth part of the report is a description of the data analysis process. It includes information about the statistical methods used to analyze the data and the results of the analysis.

5. The fifth part of the report is a conclusion and summary of the findings of the study. It discusses the implications of the findings and provides recommendations for future research.

6. The sixth part of the report is a list of references. It includes a list of all the sources of information used in the study, including books, articles, and other documents.

7. The seventh part of the report is an appendix. It includes any additional information that is relevant to the study, such as maps, tables, and figures.

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Regions VI, III and II may experience the most marked proportional changes.

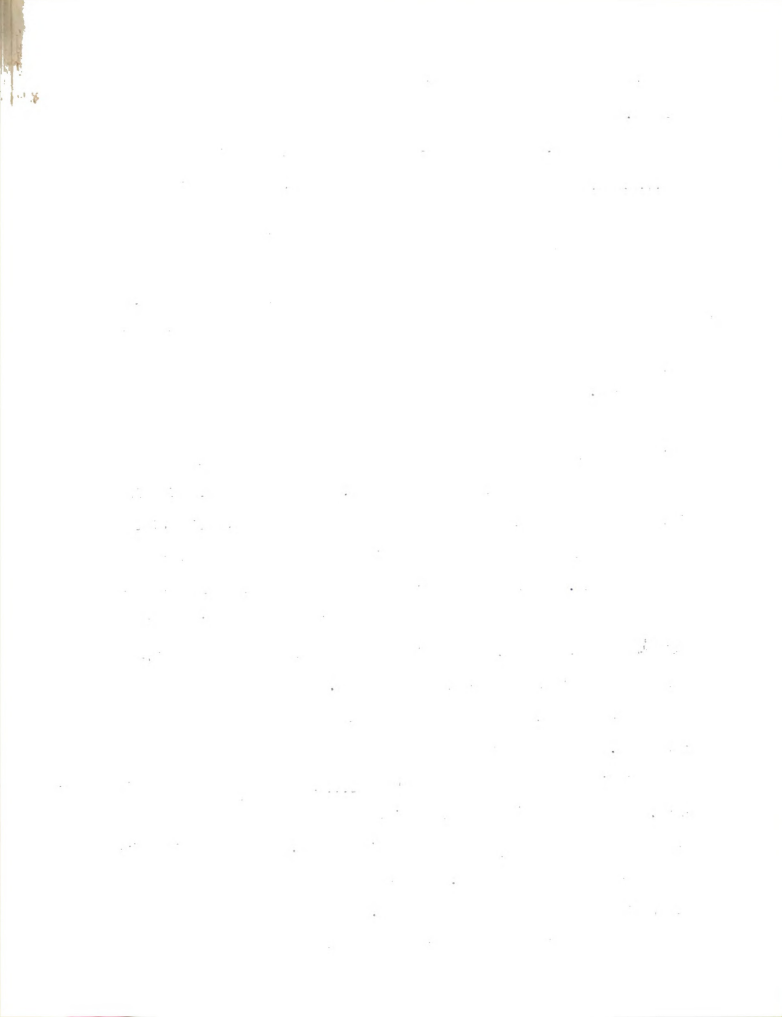
No changes, in excess of 5-7 percent, are expected in the acreage of blueberries since the recent expansion in cultivation has fairly exhausted the most favorable soils for this crop.

Tree fruits

Since only the number of fruit trees is reported in the census, a conversion (division by an appropriate state average number of trees per acre) into acres has been made to determine the labor requirements of these fruits.

Between the last two agricultural census enumerations, tree fruits occupied a significantly higher percentage of the cropland in nearly all the counties along Lake Michigan. Aside from that, gains in yields have accrued consistently in all fruits with the exception of tart cherries to hold production figures up in spite of decreases in acreage for some fruits. Fluctuating yields have kept prices generally very unstable for fruits, since Michigan supplies a significant portion of the nation's fruits, however, fruit prices have held up better on the average than prices of other farm products since 1953. There has been a noted trend in new plantings toward dwarf trees, due to their labor saving properties.

Michigan ranks third in commercial apple production on the national scene. After a decline during the 50's, acreage increased somewhat in recent years in spite of widely fluctuating prices. Also yields have improved considerably since 1947. An average expansion in acreage of 10 percent is expected from 1959 to 1970-75. In view of the nonbearing acres in 1959, the increase will come proportionately in all areas except



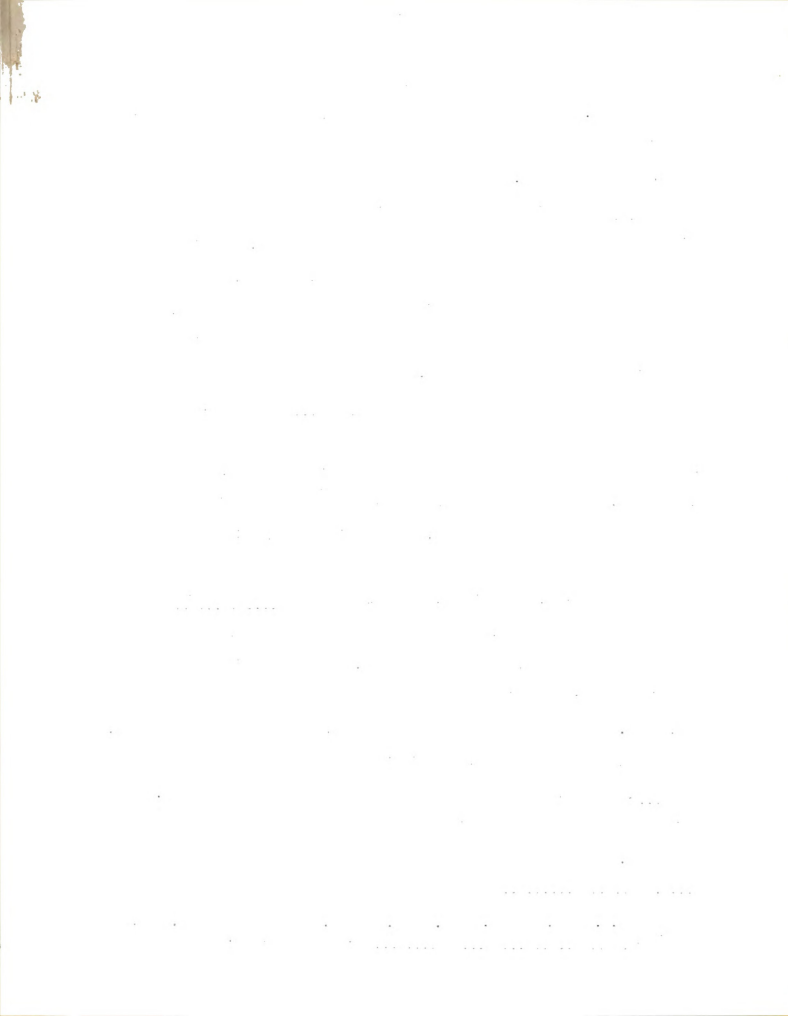
for region III and the Upper Peninsula for which no significant changes are predicted. From the information available, the Kent County area may experience an expansion of its apple acreage due to many newly established dwarf tree orchards.³³

Pear production has become more important in recent years for Michigan, perhaps since prices have been inching upward. Judging from the nonbearing orchards and a sample of age distributions, the bearing pear acreage will be nearly one fifth larger by 1970-75 than 1959. Area III should gain relatively much, while all the other regions will not change their acreage significantly.

Michigan is the nation's foremost tart cherry producer. After a 40 percent expansion in tart cherry orchards during the 1950's, the acreage has remained fairly stable and no drastic changes are expected for the future. Regions I and II will expand their acreages slightly, while region III will contract a little. Demand will be satisfied from the areas of existing orchards and projected yield increases of about 40-50 percent for 1970-75. Relatively, the orchards with sweet cherries have expanded most in Michigan, although the value of production has been very unstable due to a widely fluctuating price. Yields have increased and relatively strong additions to the orchards are forecast for regions II, I and III. The expansion for the state is assumed to be about 30 percent.

Although Michigan is the nation's second most important supplier of plums, this fruit is the least important tree fruit in the state. Prices per ton and acres committed to plums have risen somewhat simultaneously. For southwestern Michigan, a 20 percent expansion is forecast

³³U.S. Dept. of Agr. Mich. Dept. of Agr., Kent County Coop. Ext. Service, Kent County Area Fruit Tree Survey, 1963, Table 6.



for 1970-75. By then, area III will also have a more important acreage in plums.

Peaches are still a very important fruit for Michigan but unstable yields due to frosts have sent the value of production down and some growers have cut their acreages. To judge from the planting of nonbearing orchards, a slight expansion in the acreage is expected by 1970-75.

During the preceding decade, grape production increased by 74 percent in spite of smaller acreage. However, widely varying yields have influenced prices adversely. The forecast for 1970-75 is for less than a 10 percent expansion of the 1959 acreage, occurring exclusively in the traditional "grape belt" of Michigan.

Livestock

General Considerations

Rogers and Barton predict a 45 percent increase for the United States in the total demand for livestock for 1975 from the 1958 level for the U.S. They also speculate on an improvement of the feed efficiency of 10 percent during the same period.³⁴ But the generalities end here since consumers preferred nonfat-solids dairy products, beef, veal, lamb and poultry over pork, mutton, eggs and dairy products containing much fat. The predictions of future demand are ordered accordingly with beef leading the expansion, while mutton trails the list. The demand projections differ because of different assumptions made with respect to the substitutability of meat products, different price estimates, and different income elasticity of demand. However, all forecasts agree that the increased demand for animal products will call for increased production of pasture, forage, and feed grains as was indicated in the first

³⁴Buller, O., op. cit., pp. 3f.

1. The first part of the report discusses the general situation of the company and the results of the previous year. It mentions that the company has achieved a steady growth in sales and has managed to maintain a strong position in the market. The report also highlights the challenges faced by the company, such as increasing competition and rising costs of raw materials.

2. The second part of the report focuses on the financial performance of the company. It provides a detailed analysis of the income statement, balance sheet, and cash flow statement. The financial data shows that the company has achieved a significant increase in profit and has a healthy cash flow. The report also mentions that the company has successfully managed its debt and has a strong financial position.

3. The third part of the report discusses the company's strategic initiatives and future plans. It mentions that the company is planning to expand its operations into new markets and is investing in research and development to develop new products. The report also mentions that the company is planning to improve its operational efficiency and is implementing various cost-saving measures.

4. The fourth part of the report discusses the company's human resources and organizational structure. It mentions that the company has a strong team of experienced professionals and is committed to providing a supportive work environment. The report also mentions that the company is planning to hire new staff to support its expansion plans.

5. The fifth part of the report discusses the company's environmental and social responsibilities. It mentions that the company is committed to reducing its carbon footprint and is implementing various measures to improve its environmental performance. The report also mentions that the company is committed to social responsibility and is supporting various community development projects.

6. The sixth part of the report discusses the company's risk management and internal controls. It mentions that the company has a robust risk management framework in place and is regularly reviewing its internal controls. The report also mentions that the company is planning to implement various measures to improve its risk management and internal controls.

7. The seventh part of the report discusses the company's corporate governance and transparency. It mentions that the company is committed to high standards of corporate governance and is regularly reporting on its performance. The report also mentions that the company is planning to implement various measures to improve its corporate governance and transparency.

8. The eighth part of the report discusses the company's overall performance and outlook. It mentions that the company has achieved a strong performance in the previous year and is optimistic about its future prospects. The report also mentions that the company is planning to continue its growth and is committed to providing a high level of service to its customers.

9. The ninth part of the report discusses the company's financial projections and budget for the next year. It mentions that the company is planning to achieve a steady growth in sales and is expecting a significant increase in profit. The report also mentions that the company is planning to maintain a strong financial position and is committed to managing its debt.

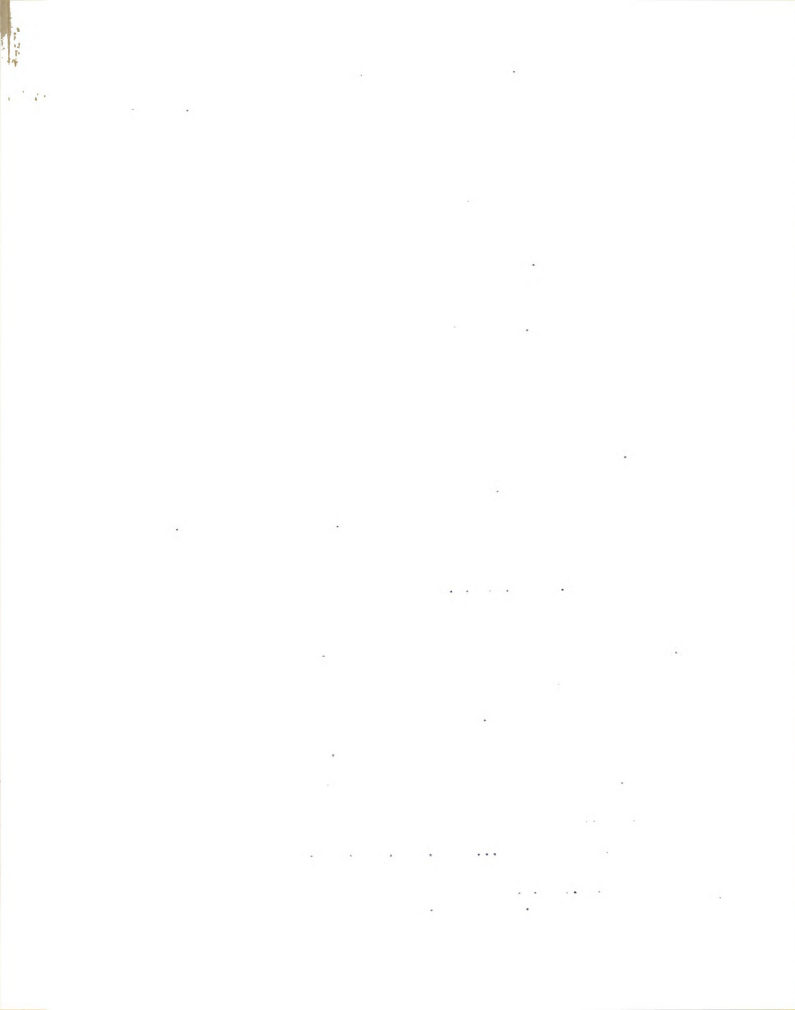
10. The tenth part of the report discusses the company's conclusion and recommendations. It mentions that the company has achieved a strong performance in the previous year and is optimistic about its future prospects. The report also mentions that the company is planning to continue its growth and is committed to providing a high level of service to its customers.

section of this chapter. At the same time, the combination of crops grown is determined by and in turn alters the labor requirements. Inasmuch as technological progress is not evenly distributed over all commodities and the input-output relationships for different farm products do not change proportionately, production is expected to shift towards those commodities which assure the farmer of the highest net profit or satisfy his ends best. In this respect, a much faster increase of man-hour efficiency is expected in the production of livestock and its products than in the past. This in turn may mean a much greater willingness on the part of farmers to expand production for those commodities. It also implies that the product prices need not change as much as they would if no relative cost reductions for livestock enterprises were to take place. Livestock products are reported to be more responsive to economic forces than crops. Technological changes have reportedly shifted the supply function for livestock by 1.4 percent each year.³⁵ In the short run, supply responses for livestock products have an elasticity of between .1 and .2, i.e., a one percent increase in the prices of livestock products above feed prices increases output by 1 to 2 percent.³⁶ It seems reasonable to assume that long-run responses are stronger than short-run responses to the variations in the livestock product/feed price relations. This completes the general discussion for the livestock economy at the national level.

Next, expectations are discussed for 1970-75 with respect to the

³⁵Daly, "Agriculture...", op. cit., pp. 4ff.

³⁶Petit, M., Ph.D. thesis (in preparation concerning the feed grain livestock economy) Mich. State Univ.



size of individual regional livestock enterprises in Michigan. With the exception of the hog enterprise, where the number of litters is used, the unit of measure for size of the livestock enterprise is head. It is felt that cattle numbers were as representative for the entire year as could be expected at the time the census was taken in October and November. This is before farmers sell all of their marketable beef holdings and when in-shipments from the range states compensate for earlier marketings. The same argument can be made for the sheep numbers.

Future Regional Enterprise Sizes of Livestock Enterprises.

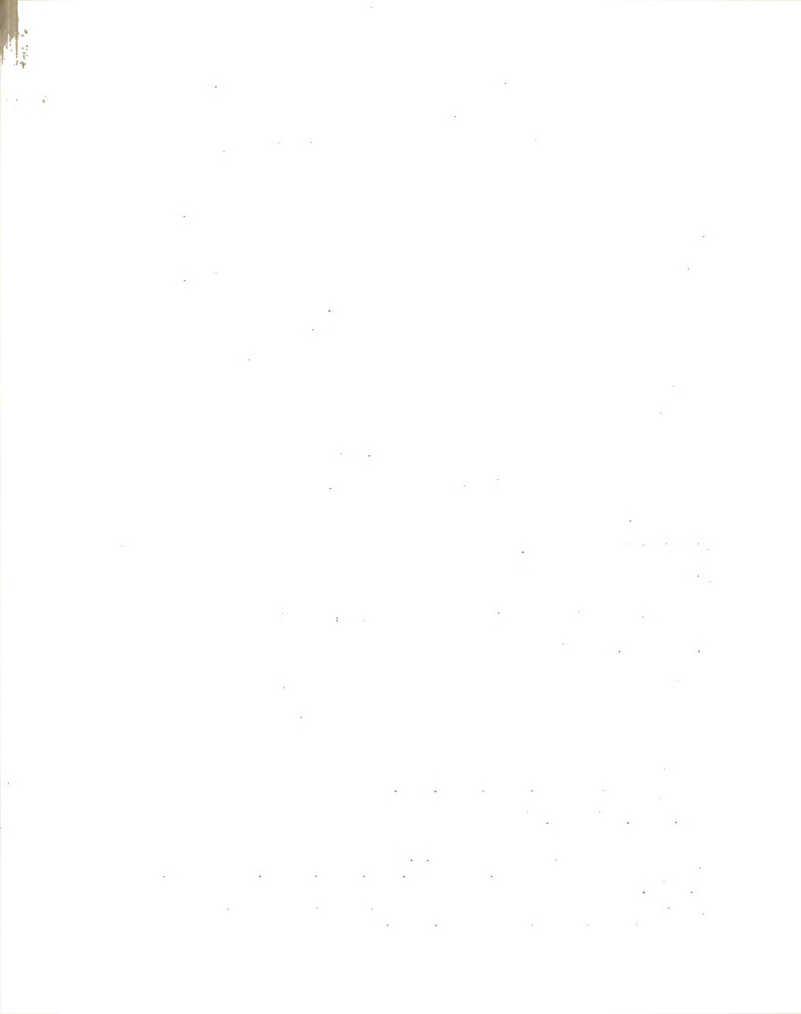
Cattle enterprises

The dairy enterprise is the only Michigan livestock enterprise which ranks among the top 10 in the nation. Most of the dairy cows are located in south central Michigan and the Thumb. Higher production per cow and larger but fewer herds indicate increased interfarm specialization in this enterprise. An interregional study of the Lake States indicates that the largest increase for milk production is expected for Michigan.³⁷ During the 50's Michigan increased its milk production by 3.1 percent. Michigan is becoming more and more a fluid milk producer.³⁸ Hoglund predicts that there will be, by 1970, only 12,000 full-time dairy operators in Michigan, that the herds with less than 20 cows will

³⁷Univ. of Minn., Agr. Expt. Sta., Equilibrium Analysis of Income-Improving Adjustments on Farms in the Lake States Dairy Region, 1965, Tech. Bull. 246, Oct. 1963.

³⁸Irwin, G.D., and Bonnen, J.T., "Can Michigan Dairymen Compete?", Michigan Farm Economics, No. 250, Dept. Agr. Econ., Mich. State Univ., No. 1963.

_____, "How Dairying Has Fared in Michigan," Mich. Farm Econ., No. 249, Dept. Agr. Econ., Mich. State Univ., Oct. 1963.



disappear fast, that herds with 20-30 cows will reduce in number while those with 30-50 cows will increase in number. A slower growth of herds with more than 50 cows is also predicted.³⁹ The future reduction of dairy cows will be most pronounced (up to one fourth) in areas VI, III, and I, in that order, while the remaining regions will show reductions in cows of 15 percent between 1959 and 1972.⁴⁰

The beef cow enterprise is under the influence of the consumers' preference. The per capita consumption has risen and an income elasticity of demand is relatively high at .67.⁴¹ The quality of the beef has been improved. Simultaneously, the competitive position of the beef enterprise among other farm and livestock enterprises has advanced. Under those circumstances, a 50 percent increase over 1960 in beef production is expected for 1975. Greater feed efficiency, an increasing proportion of beef relative to dairy cattle, a higher percentage of calves saved, a decline of losses by death and earlier maturity of slaughter cattle all contribute to the conclusion that a 40 percent higher beef cattle inventory by 1975 would suffice to supply the increased demands at fairly stable prices. This implies about a 3 percent yearly increase in beef cattle numbers necessary to meet rising demands.⁴²

³⁹Hoglund, C.R., Trends and Prospects for the Dairy Business, Agr. Econ. Mimeo 944, Mich. State Univ., March 1964.

⁴⁰Lard, op. cit., p. 146. McKee, D., The Competitive Position of the Dairy Enterprise in Farming, Thumb Area of Michigan, Dept. Agr. Econ., Mich. State Univ., Mimeo 861, Feb. 1962, pp. 100.

⁴¹Daly, "Agriculture...", op. cit., Appendix Table 1.

⁴²Ferris, "A Long Range...", Op. cit., p. 9.



Following the national trend, the beef enterprise has also expanded in Michigan. This enterprise is concentrated in the southern half of the lower peninsula. There it will replace some of the dairy enterprise on many farms and may suit part-time farmers much better. Further, beef production will be profitable and the cropping system will allow further additions to the corn acreage without great difficulties. Since most of the lower half of the southern peninsula is a feed surplus area, it is felt that beef enterprises could make use of this feed and supply Michigan with more homegrown cattle. According to Lard, it is profitable for all types and sizes of farms in the Thumb and South Central area to increase significantly the credit use (5 to 10 times) and expand greatly the beef feeding enterprise.⁴³ The beef cow herds doubled in size during the 50's. The estimate calls for a 67 percent expansion of beef cows from 1959 by 1970-75. The biggest relative gains are anticipated in regions I, II, V, and VI, while region III will register the least additions.⁴⁴

The heifer enterprise is under the influence of two countering forces. On one side the numerical contraction of the dairy enterprise does not require as much replacement stock. On the other side, expansions of the beef enterprise are expected to offset reduced replacement needs in the dairy business. This and the different culling age in both enterprises were accounted for when the projections for heifers were made. In the target period, approximately 5 percent more heifers than in 1959 will

⁴³Lard, op. cit., pp. 128-140.

⁴⁴Learn, E.W., Rex, R.W., Herder, R.J., "Upper Midwest Agriculture: Alternatives for the Future," Upper Midwest Economic Study, Study Paper No. 6, Dec. 1962, p. 48.

be on Michigan farms. Only insignificant variations in the growth between regions are expected.

During the past decade, steers have increased over 50 percent, due in part to the shift in consumer demand away from pork. Sixty-five percent more steers than in the base period are expected on Michigan farms by 1970-75. The optimal organization of representative farms in regions IV and V calls for an increase in their production of meat products (especially beef) and utilization of their locally produced feed grain surplus instead of selling it.⁴⁵ The beef enterprise is superior to the hog enterprise especially if it is organized as a short fed dry lot system. The present organization is, however, predominantly long fed drylot. Above average relative increases are anticipated for areas V and IV, while below average additions are foreseen for areas VI and III. Reasons for the uneven distribution involve variations in the forage base and proximity to markets.

The hog and sheep enterprises

The hog enterprise seems to be best and most simply represented by the number of litters farrowed during the course of the year. In Michigan spring and fall farrowing are almost equal. Per capita consumption of pork has declined in the U.S. for about 15 years in spite of rising incomes. It is concluded that, by 1975, 30 percent more pork will be needed than in 1950. It should not prove difficult at all to achieve this under the present feed grain situation and the economic production potential. The number of sows in Michigan has declined since 1947. However, larger litters and lower mortality have offset the decline in sow

⁴⁵Lard, op. cit., pp. 145 f and p. 148.

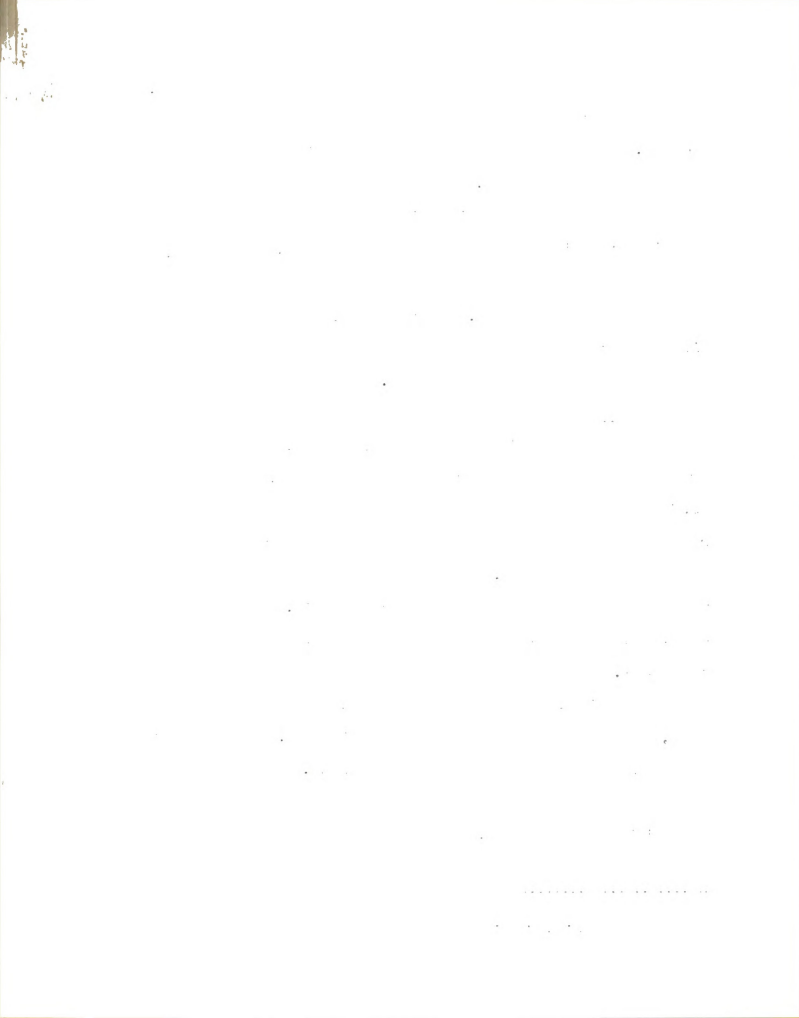
numbers to such an extent that marketings have stayed fairly constant. Most of the sows farrowed are located in the corn belt area of lower Michigan. The numbers have decreased since 1948 in all regions with the smallest decline in region I.

It is assumed that Michigan will move more toward the beef than to pork to use it's surplus production of feed grains.⁴⁶ Therefore, the projection calls for only a 17 percent expansion of the number of litters farrowed from 1959 to 1970-75. Above average additions to the number of litters are predicted for regions III, V, and II, while areas IV and I are expected to show below average gains.

The sheep enterprise is subject to the influences of (1) alternative production possibilities open to the operator, (2) the wool market and (3) the changing demand for mutton and lamb. Although some studies have indicated a positive income elasticity of demand for lamb, recent developments in the mutton market are depressed prices supposedly due to a decline in demand. Nationally, the consumption of lamb and mutton is expected to increase by 15 percent by 1975. Gains in the productivity of sheep production would necessitate a smaller increase of the sheep flock.

In Michigan, the number of sheep has declined slowly in recent years, due to low returns compared to other livestock. A decline of 29 percent in the head count is projected for 1970-75. Regions II and IV are expected to reduce their holdings the most while the least reductions are anticipated for area III.

⁴⁶Lard, op. cit., p. 148



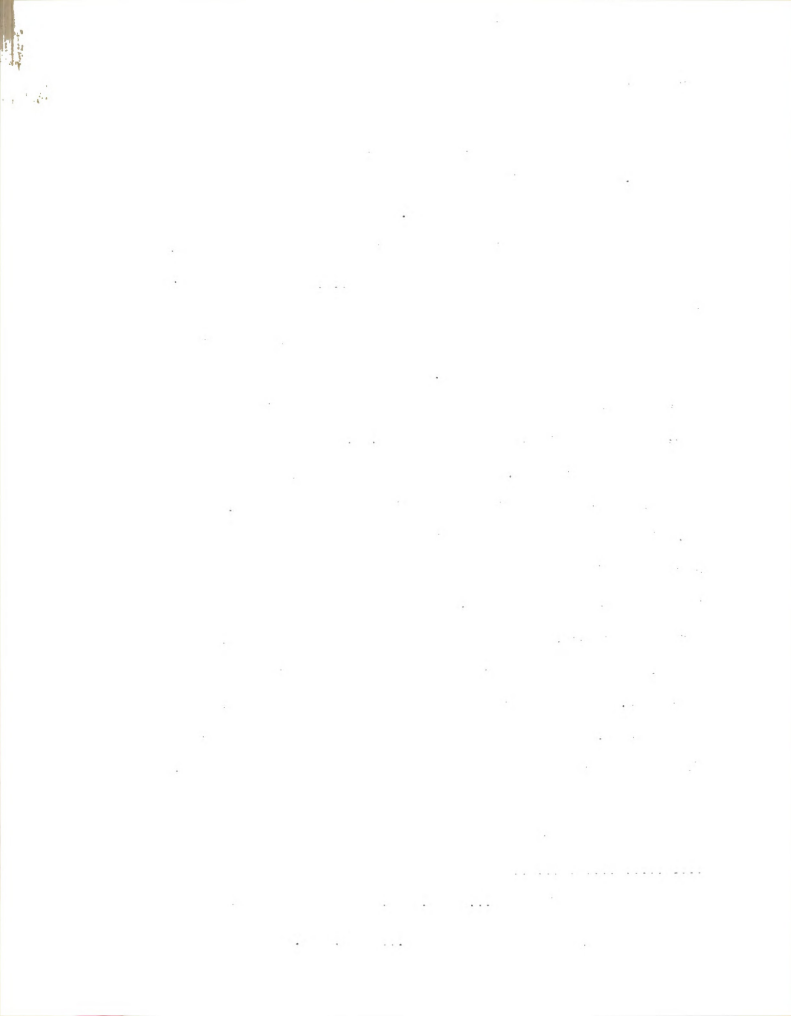
Poultry enterprises

The number of layers can be well represented by the number of chickens of above four months, since broilers are usually marketed by that time. The statistics on broiler sales can be taken to indicate the regional size of the broiler business. The regional turkey enterprise size is measured by the number of turkeys and turkey fryers raised.

Since the average number of eggs per layer in Michigan increased only 10 percent during the past seven years, while the reduction of the number of layers amounted to nearly 30 percent in the same period, egg production declined by 23 percent. While data from the Michigan State consumer panel indicates a low positive income elasticity of demand for eggs, other data reveal that it is minus .65,⁴⁷ which is confirmed by other empirical evidence. In spite of lower prices, the per capita consumption declined by 17 percent during the past 10 years. Though this trend in per capita consumption will most likely continue in the decade ahead population increases are likely to lead to an increase of 20 percent in egg production by 1975.⁴⁸ Depressed prices due to higher production efficiency, cost reductions, and lower demand levels, will tend to reduce the numbers of layers in Michigan in the years ahead by about 15 percent. Sizeable reductions are predicted for regions V, II and IV, in that order, while new operations in Alpena and Grand Traverse counties will increase numbers in region III, two and one half fold by 1970. There is speculation that the Upper Peninsula may produce some specialized cage operations.

⁴⁷Daly, "Agriculture...", op. cit., Appendix Table 1.

⁴⁸Ferris, "A Long Range Outlook...", op. cit.



Nationally, broiler consumption has advanced rapidly in recent decades. Contributing factors were lower prices made possible by cost reductions due to expanded operations and technological advances. Further expansions in consumption are predicted, although at a slower rate. Some estimate a per capita consumption of 45 pounds of poultry meat by 1975, calling for nearly a 50 percent increase in production over 1959. It is not expected that Michigan will share in this expansion on the national level, since producers in southeastern states appear to be economically able to outproduce Michigan farmers. No significant changes are anticipated by 1970-75 in the number of broilers for Michigan. However, regional changes will take place. Region I and perhaps the Upper Peninsula will gain several percent, while other areas such as IV, V, and III will lose up to one fourth of the broiler production they had in 1959.

What has been said for broilers applies generally as well for turkey production, especially the pronounced trend toward specialization. A six percent increase of the production figure is predicted for the state. The lion's share of this expansion will fall to region I, while all the other regions, with the exception of probably area III, will experience no major changes.

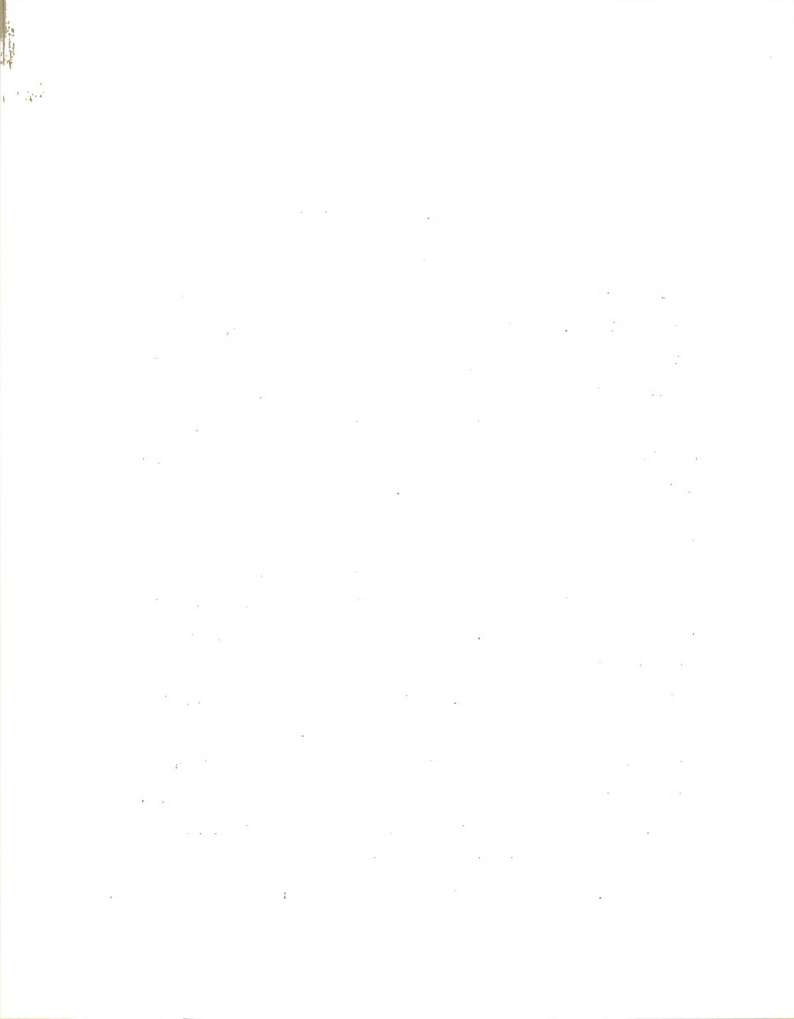
CHAPTER III

THE ESTIMATION OF THE MONTHLY LABOR USE FOR ENTERPRISES, 1959 and 1970-75

This chapter will describe the way in which the labor use data were established for 1959 and for the 1970-75 period for the particular enterprises considered. It will, further, give the sources used, and the data employed in forming the monthly labor needs of the enterprises for direct or manual activities and for indirect or overhead tasks. The seasonality of the work load in Michigan's farm enterprises is investigated. Special attention is given to the way in which technological changes and economic conditions will alter future labor use.

The Determination of 1959 Labor Use

Labor requirements for 1959 on a per-unit basis (namely acre of crop or head of livestock) are to be established for all the enterprises to be discussed subsequently. The monthly distributions of labor requirements are derived from particular activities usually performed for a specific enterprise in Michigan. It is believed that those synthesized figures best represent the conditions for Michigan. The use of new equipment and equipment sizes, cultivation practices and varieties introduce variations with respect to timing and to time needed to perform a task. Further, enterprise and farm size, soil, and locational differences are expected to widen variation in labor requirements per unit (acre or head of livestock). The labor coefficients are to be considered average values.

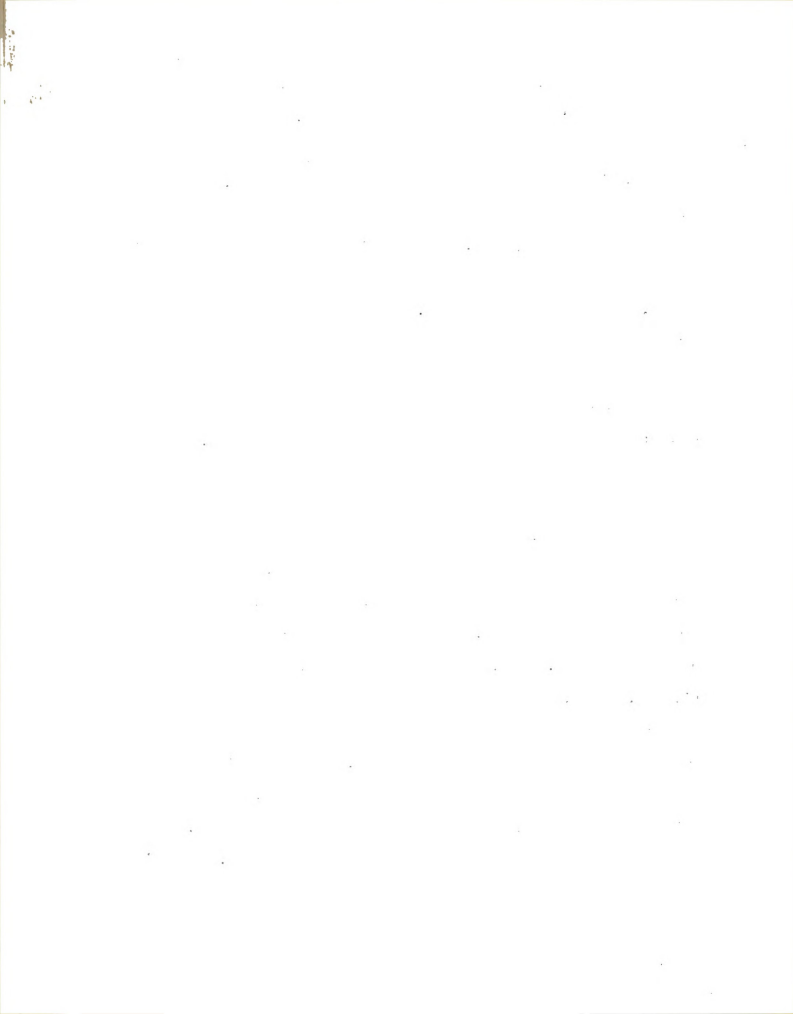


No specific estimating procedure was followed; hence, if average values were not available single estimates had to suffice. It was much more difficult to estimate future machinery use, since a variety of systems, equipment, sizes and different field efficiencies were used. But again, average values were taken, if they were available; otherwise other statistical values were employed. The variations in timing of activities due to abnormal weather conditions in a particular year do not, supposedly, change the overall results. The writer is conscious of the oversimplification of this procedure but the macro analytical level of the present work and lack of data do not allow further disaggregation.

The man-hour requirements of each enterprise have two main components: direct or manual labor and indirect or overhead labor. Direct labor often has to be done within a particular limited time interval, while some of the overhead labor can be delayed to slack periods in the need for direct labor.

Direct labor includes time spent in cultivating, harvesting, storing and marketing crops, or in feeding, caring for and selling livestock and livestock products. Indirect labor includes overhead labor and management time. Thus, time used to construct, repair or maintain buildings, fences, roads and land improvement or service machinery and equipment is allotted in proportion to the enterprise making use of it, and may be classified as overhead farm labor. Management time includes such items as planning the farm business, keeping books and correspondence, visits to county agents, dealers, markets, fairs and exhibitions. Those components are included in a monthly lump sum per enterprise.

The multiplication of the per unit total labor requirement of an enterprise in a particular month by the respective size of that

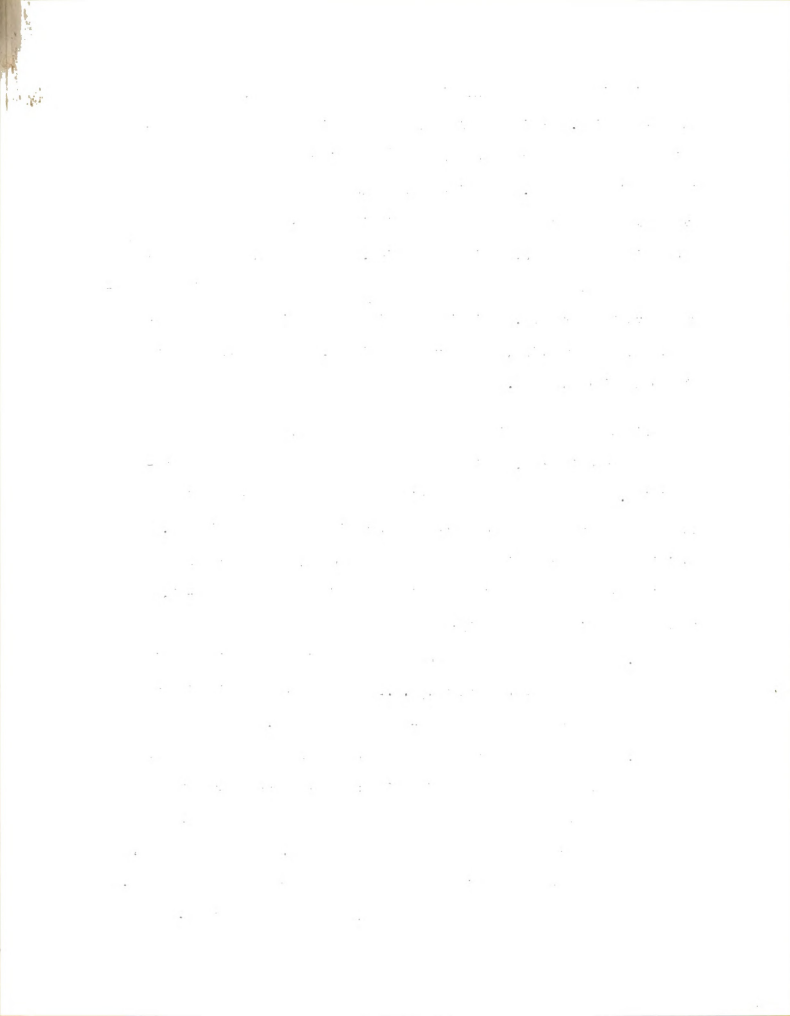


enterprise in a region results in the regional labor requirements for that enterprise. Adding up all the labor requirements for all enterprises in a region gives the total labor requirements of a regional area in a particular month. The difference between total hours of labor available and the time for direct and indirect work accounted for by enterprises represents, besides idle time, time spent on crops that later on turned out to be crop failures and hence were not included in the acreage harvested category. Omissions of minor enterprises such as flower and vegetable gardening, greenhouse activities, forestry work and errors also help fill this gap.

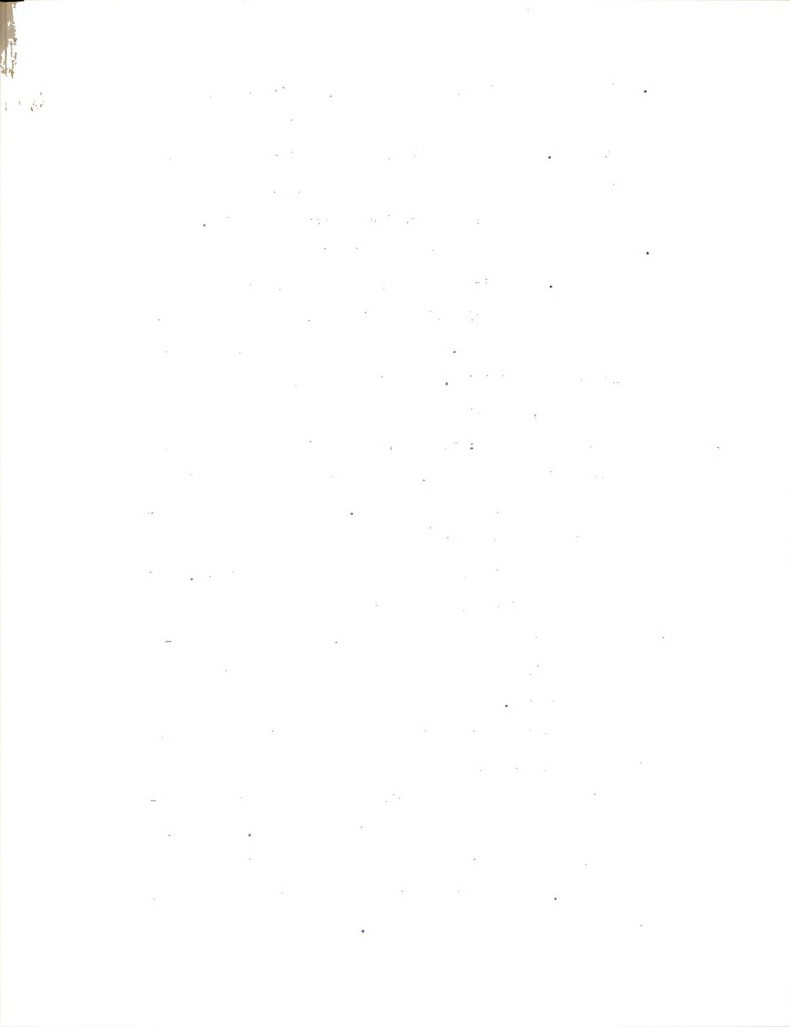
Assumptions for Alternative Estimates of Labor Use, 1970-75

All predictions, estimates and measurements involved some subjectivity. The danger of subjectivity may be lessened by spelling out the assumptions made by the person constructing a set of estimates. In addition to the assumptions stated with respect to current labor needs and with regard to enterprise size in the target period of 1970-75, the following considerations apply:

1. The trend towards larger farm units since 1945 will continue stronger in the future, i.e., the average farm size is expected to be between 150-160 acres by 1970.
2. There is a pronounced drift toward a higher degree of specialization and concentration of most of the enterprises within and between farms and regions as witnessed by a decline of the number of farms of almost every type. But there is a concurrent expansion of the size of enterprises in each farm. These trends are presumed to continue more vigorously.



3. Simultaneously with this development, machine use and other capital investments will become more profitable than they have been. This will be due to the relatively faster increase of wages than of capital costs and due to economies to scale which will make machine use more attractive.
4. The hourly wages for farm labor will increase by 2-3 percent per annum. This is more than in the past and will be caused by minimum wage legislation in Michigan, attempts of unionization of farm labor, and the pull exerted by nonfarm employment possibilities. In spite of an increased national labor force, a smaller absolute number of people will want to pursue farm work; this will be especially true for family members of farm operators. Migratory seasonal labor will not be available to the present extent. The prices of other inputs will continue to increase generally as in the past but prices of other inputs will decrease relative to labor. This, combined with interstate competition between producers and downward pressures on product prices, will force the adoption of available technology and labor saving techniques upon the farm sector. Another facet of the adjustment process in agriculture is the incentive to farmers and implement manufacturers to perfect existing and to develop labor saving machinery and systems which will enable the producer to perform more efficiently the activities considered. Further, a continued interest in specialization of production will be generated. This specialization will take place among farms, among regions as among industries.



5. In spite of a higher average age of Michigan farm operators, the remaining hard core of farmers promises to contain a higher percentage of commercial managers and operators. These will be the better trained, more skilled agribusinessmen who can be expected to better exploit the possibilities of maximizing profits. This tendency will be promoted by the increased efforts of better equipped and trained extension personnel of the Experiment Station, USDA, and other public or private organizations connected with the farm sector. Due to higher educational levels, improved mass communication media and better adult education programs, the managerial abilities of the farm operator are expected to improve. This will influence the overall organization of the farm unit as well as the organization of labor used and promote earlier, more effective adoption of new technologies. Specifically, the diffusion process is expected to shorten considerably, i.e., the general acceptance of technological changes released for practical application will be less than 10 years, as compared to 15 years in the past. It should be emphasized that the planning of all the activities to be done and their interaction in different enterprises of a farm will have a tremendous impact on the man-hour requirements per enterprise. The timeliness and coordination of jobs will have as important effects as the acquisition of new automated equipment. It is further assumed that the skill of the permanent farm labor force will improve. Unfortunately, the same assumption would be less valid for the seasonal farm labor force which will still be recruited from the lower range of the

1871. 1872. 1873. 1874. 1875. 1876. 1877. 1878. 1879. 1880.

1881. 1882. 1883. 1884. 1885. 1886. 1887. 1888. 1889. 1890.

1891. 1892. 1893. 1894. 1895. 1896. 1897. 1898. 1899. 1900.

1901. 1902. 1903. 1904. 1905. 1906. 1907. 1908. 1909. 1910.

1911. 1912. 1913. 1914. 1915. 1916. 1917. 1918. 1919. 1920.

1921. 1922. 1923. 1924. 1925. 1926. 1927. 1928. 1929. 1930.

1931. 1932. 1933. 1934. 1935. 1936. 1937. 1938. 1939. 1940.

1941. 1942. 1943. 1944. 1945. 1946. 1947. 1948. 1949. 1950.

1951. 1952. 1953. 1954. 1955. 1956. 1957. 1958. 1959. 1960.

1961. 1962. 1963. 1964. 1965. 1966. 1967. 1968. 1969. 1970.

1971. 1972. 1973. 1974. 1975. 1976. 1977. 1978. 1979. 1980.

1981. 1982. 1983. 1984. 1985. 1986. 1987. 1988. 1989. 1990.

1991. 1992. 1993. 1994. 1995. 1996. 1997. 1998. 1999. 2000.

2001. 2002. 2003. 2004. 2005. 2006. 2007. 2008. 2009. 2010.

educational groups in the nation and from the unemployed.¹

Those developments suggest also the need for an accelerated labor-capital substitution and changed input-output coefficients.

6. According to agricultural engineers, there will be further development of existing technology more towards the push-button type and less of the past movement toward larger units of field equipment. At the farm yard, the layout of buildings will be changed according to the results and knowledge of time and motion studies and advances in materials handling techniques.
7. The perfection of existing types of machinery and the successful application of technologies to related activities entered as considerations in determining further labor necessities.
8. Modern methods of crop production in general--minimum tillage and tandem operations in field work--will become more prevalent in the decade ahead.
9. The preceding three assumptions and assumptions 1 and 2 subsume an increased availability of funds from saving or credit.
10. The widespread application of presently nonexistent technologies with revolutionary effects in farming is excluded.

Future labor use is estimated under two alternative sets of assumptions. One estimate assumes a moderate rate of adoption and development of technologies. Thus, it presupposes a favorable interpretation of the

¹Cowhig, J.D., Education and Earnings of Hired Farm Working Force of 1960, USDA, ERS, Agr. Infor. Bull. 262, May 1962.

above assumptions, specifically with respect to the quality of future farm managers compared with those present by operating farms. The alternative estimates impose a faster rate of development and adoption of technologies, vastly improved abilities of the average operator and his workers and the establishment of an environment conducive to such results.²

The general overhead time, which is expected to increase relatively in the years ahead, is added to each of the future estimates, representing a moderate and high level of management and technology.

The Sources of Data

Information of labor use for 1959 is based on secondary data from (1) numerous studies made by the Experiment Stations of Michigan State University and of neighboring states, (2) USDA publications, and (3) the Department of Agricultural Economics. The writer adapted them, as he saw fit, to represent statewide conditions if such figures applied to local situations. The labor requirements for all enterprises with the exception of the livestock enterprises were synthesized from the addition of all the usual activities connected with a particular enterprise. Thus, the data presented were cross-checked and, in addition, reviewed and discussed with staff members of the departments of the applied and technical agricultural sciences who also assisted in filling the voids in the published literature.

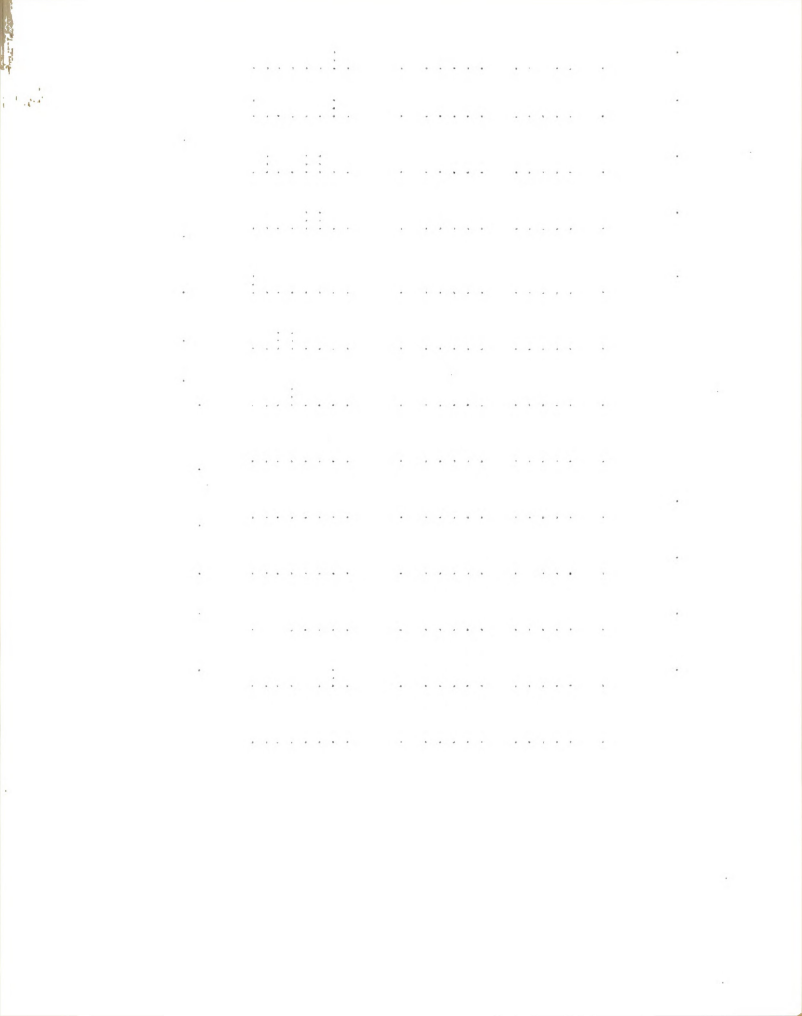
The labor use estimates were synthesized from data on the various activities involved in producing each product. Seasonal estimates of labor use for each particular enterprise are a by-product of the effort.

²The projected changes in the labor demands are reported in the text in percent reductions, while the absolute values are given in the tables. The larger numerical value refers to the faster technological advance, while the lower one to the slower technological change.

Table 3.1 Overhead labor by enterprise and month

Enterprise	Yearly												
	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Per Unit	hours per unit												
Crops: (per acre)													
Corn, grain	2.4	.13	.13	.17	.21	.20	.22	.22	.24	.29	.24	.19	.15
silage & small seeds	5.8	.30	.31	.42	.51	.51	.53	.54	.58	.69	.58	.47	.36
Small grains	1.4	.07	.08	.10	.12	.12	.13	.13	.14	.17	.14	.11	.09
Beans (soy, dry)	1.8	.10	.10	.13	.16	.15	.17	.17	.18	.21	.18	.14	.11
Potatoes, sugar beet	7.1	.3	.3	.3	.6	.8	.8	.8	.5	.8	.8	.7	.4
Hay	.9	.05	.05	.06	.08	.08	.08	.08	.09	.11	.09	.07	.06
Livestock (per head unless stated otherwise)													
Dairy cows	26.0	1.4	1.4	1.9	2.3	2.2	2.4	2.4	2.6	3.1	2.7	2.1	1.6
Beef cows, heifers	10.2	.54	.55	.73	.90	.86	.94	.95	1.02	1.21	1.04	.82	.64
Steers	5.6	.30	.30	.40	.49	.47	.52	.52	.56	.67	.57	.45	.35
Sheep	2.2	.12	.12	.16	.19	.18	.20	.20	.22	.26	.22	.18	.14
Hogs (per litter)	40.0	2.12	2.16	2.88	3.52	3.36	3.68	3.72	4.00	4.76	4.08	3.20	2.52
Layers, broilers, Turkeys (per 100)	29.0	1.54	1.57	2.09	2.55	2.44	2.66	2.70	2.90	3.45	2.96	2.32	1.83
Vegetables & Fruits (per acre)													
Small fruits & vegetables	10.0	.4	.5	.6	.8	1.1	1.1	1.1	1.1	1.0	1.0	.8	.5
Apples	17.0	...	1.0	1.3	1.3	2.3	1.3	.4	2.8	3.8	2.8	...	...
Cherries, tart	13.0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	...	...	.4	1.4
Cherries, sweet	13.0	.9	1.4	1.4	.9	1.4	.9	2.4	2.4	...	...	.4	.9
Plums	13.0	1.4	1.4	1.4	1.4	1.4	...	...	1.5	1.6	1.5	.5	.9
Pears	13.0	.8	.8	.9	.9	.9	.9	...	1.5	2.8	1.6	.9	1.0
Peaches	13.5	1.0	1.0	.9	.9	.9	.9	.9	2.5	2.5	...	1.0	1.0
Grapes	12.0	.9	.9	.9	.9	.9	.9	.9	...	2.4	2.4	...	.9

Sources: For crops, livestock, vegetables based on information from the "Detailed Cost Report" for Central Illinois, 1958 and 1959. Dept. Agr. Econ., Univ. of Ill., AERR-32, April 1960 and AERR-42, April 1962. For fruits, computed from data of Orland Buller, Dept. Agr. Econ., Mich. State Univ.



Here again, the publications to be referred to later were used extensively as guides.

Information concerning the time spent on overhead activities was difficult to obtain. The only references that came to the attention of the writer are Michigan data, provided in mimeographed form by Earle Gavett of the ERS, USDA, and the farm account data collected and evaluated by the Illinois Agricultural Experiment Station.³ This information was sketchy, but of use. Computations of the overhead labor use were made separately for each enterprise and then added to the direct labor requirements to obtain a total labor use for an enterprise. Table 3.1 reports the overhead labor by enterprise and month.

Crops

The crop enterprises include: corn for grain (including popcorn) and for silage, the small grains (wheat, together with rye, barley, and oats), soybeans, dry edible beans, potatoes, sugar beets, all hays and legume and grass seeds combined. The activities are for the month in which they are usually performed and the sum reported for all activities performed in each month. There were sources containing general or yearly labor requirements and their projections, and others giving the monthly

³Mueller, A.G., and Forrest, R.L., Detailed Cost Report for Heavy Till Soils, Central Illinois, 1958. Dept. Agr. Econ., Univ. of Ill., A.E.R.R. 32, April 1960. Hinton, R.A., and Mueller, L.G., Detailed Cost Report for Central Illinois, 1959 and 1960. Dept. Agr. Econ., Univ. of Ill., A.E.R.R. 48, Dec. 1961.

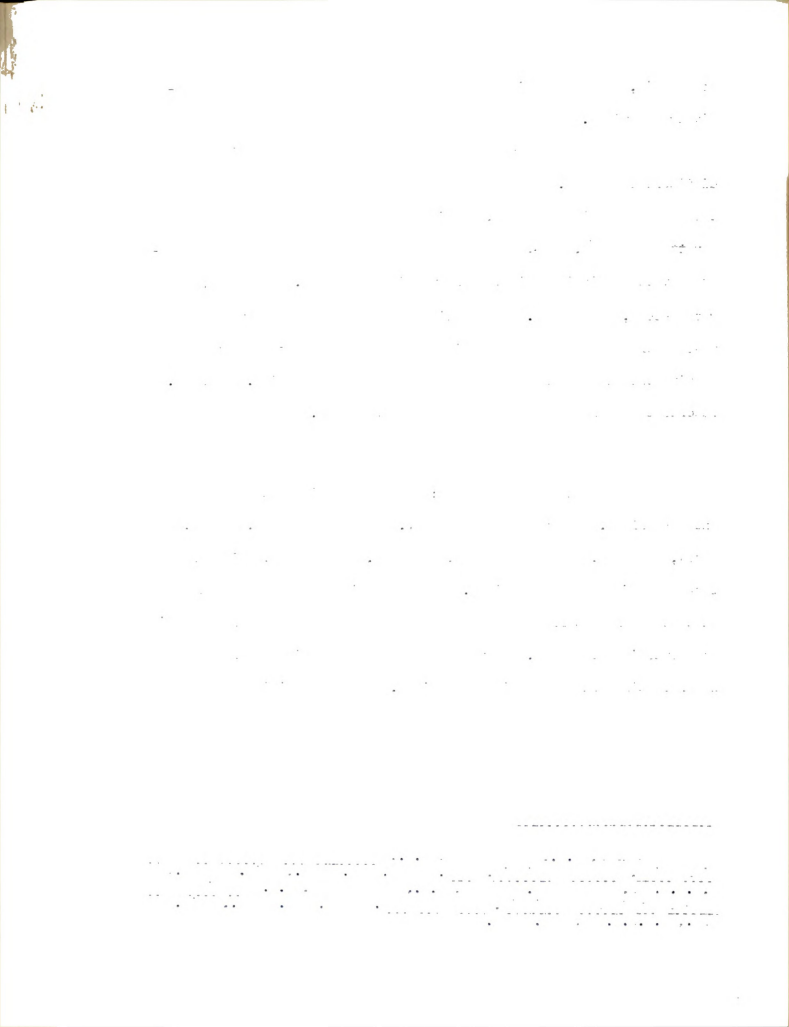


Table 3.2 Direct labor use per acre, month and year in crops, for Michigan, 1959 and 1970-75 under alternate assumptions with respect to technological advance

Enterprise and Nature of Estimate	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						hours							
Corn Grain	'59	8.0			1.4	1.8	1.4	.2			1.2	2.0	
	'70-5L	5.0			.7	1.0	.7	.1			1.0	1.5	
	'70-5h	4.0			.6	.8	.5	.1			.7	1.3	
Corn Silage	'59	11.5			1.6	1.6	1.0	.3		5.5	1.5		
	'70-5L	9.1			.9	1.2	.6	.4		4.5	1.5		
	'70-5h	7.8			.6	1.0	.4	.3		4.2	1.3		
Wheat & Rye	'59	4.5			.1			1.8	.4	1.5	.7		
	'70-5L	4.0			.1			1.6	.4	1.3	.6		
	'70-5h	3.5			.1			1.5	.3	1.1	.5		
Oats	'59	4.5			1.5	.5		.5	2.0				
	'70-5L	4.0			1.4	.4		.4	1.8				
	'70-5h	3.5			1.2	.3		.4	1.6				
Barley	'59	4.5			1.4	.5	.2	1.5		.8	.1		
	'70-5L	4.0			1.3	.4	.2	1.4		.6	.1		
	'70-5h	3.5			1.2	.3	.2	1.3		.4	.1		
Soybeans	'59	6.1			1.3	1.5	1.0	.6		1.0	.7		
	'70-5L	4.4			1.0	1.0	.6	.3		.9	.6		
	'70-5h	4.0			.9	.9	.5	.2		.9	.6		
Beans	'59	10.1			.9	1.2	1.7	1.2	1.5	1.5	1.1	1.0	
	'70-5L	7.8			.8	1.0	1.4	1.0	.8	1.0	1.0	.8	
	'70-5h	6.1			.7	.9	.9	.5	.8	.9	.9	.5	

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Table 3.2. Direct labor use per acre, month and year in crops, for Michigan, 1959 and 1970-75 under alternate assumptions with respect to technological advance (continued)

Enterprise and Nature of Estimate ¹	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						hours							
Potatoes													
'59	54.0												
'70-5L	34.0	1.0	9.0	10.0	3.0	6.0	6.0	10.0	9.0				
'70-5h	25.0	2.0	6.0	8.0	3.0	2.0	2.0	6.0	5.0				
Sugar beets													
'59	49.2												
'70-5L	31.8												
'70-5h	20.4												
Seeds (legume grass)													
'59	10.0												
'70-5L	7.5	1.1											
'70-5h	6.2	.6											
Hay													
'59	6.5												
'70-5L	5.9	.3											
'70-5h	4.0	.2											
Grass Silage													
'59	10.0												
'70-5L	8.5	.4											
'70-5h	6.3	.3											
Pasture													
'59	.5												
'70-5L	.5	.4											
'70-5h	.5	.4											

¹'59 refers to 1959 estimates. '70-5L refers to 1970-75 projections, assuming moderate technological advance. '70-5h refers to 1970-75 projections, assuming rapid technological advance.

distribution for one or several enterprises.⁴ Material reporting the time used in performing certain activities with specific equipment in a particular area or type of farm in a certain year,⁵ and figures pertaining to time spent on overhead tasks⁶ were assembled. These serve as guides in establishing statewide average values for the crops mentioned. Consultations with professional workers of the field rounded out the efforts to arrive at fairly reliable data. The monthly distributions of the direct labor needs are reported in Tables 3.2 for all crops on the previous pages.

General Changes Expected in Field-Crop Activities and Practices

It is expected that the trend towards fully mechanized machinery will continue. This equipment is not necessarily expected to increase in size, but will be more of the push-button type with hydraulically powered

⁴McElroy, Hecht and Gavett, Labor Used to Produce Field Crops, Estimates by States, 1959, USDA, ERS, Stat. Bull. 346. Soil Conservation Service, "Technical Guide," Mich. Sec. V-C, April 1962.
 Brake, J.R., et. al., (eds.) Michigan Farm Management Handbook, Mich. State Univ., Dept. Agr. Econ., Mimeo 929, Sept. 1963.
 Nielson, J.M., "Application of the Budget Method in Farm Planning," Ph.D. dissertation, Harvard Univ., 1953.
 Taylor, H.H., Farm Enterprise Input-Output Data, Farm Prod. Econ. Div., ERS, USDA, March 1963. Sources reported herein.
 Dept. Agr. Econ., Univ. of Ill., Farm Management Manual, A.E. 3792, Sept. 1963.
 Suter, R.G., Farm Management Props, Dept. Agr. Econ., Purdue Univ., 1961.
 Dept. Agr. Econ., Cornell Univ., Farm Management Handbook, A.E. Ext. 212, Dec. 1962.

⁵"Cost Planning for Farm Machinery," Doane Agricultural Digest, Doane Agricultural Service, Inc., 1960. Young, R., op. cit., Lard, C., op. cit. Vollmar, G.J., and Blosser, R.H., Crop Economics for Ohio, Agr. Ext. Service, Ohio State Univ., Bull. 423. Junis, F., former Grad. Asst., Mich. State Univ., private communication concerning crop activities on South Central and Thumb farms, 1962-1972.

⁶See footnote 3, page 60.

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8. The eighth part is a list of tables.
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11. The eleventh part is a list of
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20. The twentieth part is a list of
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equipment and automatic hitches. Therefore, savings at turning points are expected to be noticeable and hence a higher field efficiency will result. The power output of tractors is generally sufficient enough today to attach bigger and heavier machinery. More power during the preparation of the plant bed or the planting and fertilizing operation will reduce labor requirements. Activities which now require 3 to 4 operations will, in the future, be done in one or two. Further, the well propagated practices of minimum tillage will find still more widespread acceptance which will lower labor use. More labor may be required per acre, in spite of more efficient equipment, to control insects and pests. Pre-emergent selective herbicides will play an increasing role in fighting weeds and will find more applicability each year as their efficiency and selectivity is improved and as wage rates rise. This development and improved machine cultivating will contribute to the so-called "silent layoff," the elimination of some of the previously seasonally hired help. It is expected that in the future irrigation will be used more widely for crops and vegetables, thus increasing the labor needs per acre. The labor needs may be reduced for other activities due to irrigation, since the plants will outgrow weeds, thus reducing the number of sprays or of cultivations. On the other hand, increased yields may call for higher labor inputs during harvest time.⁷

Discussion of Significant Changes in Labor Requirements for Individual Crops

Most of the reduction in labor demands for the small grains will

⁷In this context it may be added that a measure of labor inputs per unit of output (bushel, ton liveweight, pound) may be superior to the one considered in the present study. However, data restrictions did not permit us to pursue this line of evaluation.

result from adoption of minimum tillage practices during planting. Fifteen to 30 percent of the labor requirements for those activities can be saved while, during the harvest, only 10-17 percent savings are expected. Depending upon which of the alternate assumptions concerning technological advance is made the direct labor requirements for small grains will drop at least 11 percent, or possibly, 25 percent. Direct and overhead labor demands will fall by 8.5-17 percent per acre from 1959 to 1970-75.

Large reductions in the labor requirements for seedbed preparation and cultivation of corn are expected. Minimum tillage, larger equipment, and tandem operations can cut the labor needs in half for planting and cultivating operations while four-row rotary hoes could decrease man-hour requirements by 40 percent for cultivation. Since the harvest operations of corn for grain are in an off-season period with respect to labor requirements, (Oct.-Nov.), the use of picker-shellors and four-row corn pickers will increase only slowly in spite of a considerable expansion of corn cultivation.⁸ The harvest operations are expected to require 20-30 percent less labor by 1970-75 than in 1959. The direct labor input per acre of corn will likely decline by 44 percent, while the total labor inputs will only decline by 35 percent by 1970-75.

Corn silage is harvested 1-2 months earlier. It requires different machinery including a field chopper and blower to fill the silo. Presently available but unused equipment can reduce these labor requirements by 30-52 percent. Total labor requirements per acre including overhead are

⁸Davis, V.W., Economic Considerations in Choosing a Corn Harvesting Method, Dept. Agr. Econ., Univ. of Ill., AERR-63, March 1963.

expected to decline 28-35 percent from the 1959 requirements by 1970-75.

Bean operations will be shortened due to tandem operations during harvest time and minimum tillage. Also larger equipment and a higher field efficiency will reduce labor needs. Most of the labor cutbacks should occur in the hand hoeing activities for dry beans which could be replaced by herbicides to reduce the number of cultivations from 3 to 1. Thus, the decline of direct labor in field beans will range between 25 and 40 percent during this decade. Considering overhead tasks, the 1970-75 forecast for total labor used per acre is one-fifth to one-third lower than for 1959. The arguments for field beans apply to soybeans, with the exception that hardly any hand hoeing is practiced anymore. Thus, the manual labor demands for soybeans will decline by 27-34 percent, while the overall labor requirements will go down by 20-27 percent from 1959 to 1970-75.

The labor peak for potatoes occurs during harvest (September and October). Cultivation and planting operations are spread over several months. Minimum tillage practices should reduce the preharvest labor time by 25-30 percent. However, more widespread irrigation (30-40 percent) and more sprays will tend to increase time spent on preharvest operations much more. Irrigation seems to be profitable in view of the 50 percent increase in yields over nonirrigated lands.⁹

Most of the reductions in labor requirements are expected during the harvest since new, fully mechanical harvesters have steadily increased in number. A good prediction for the use of potato harvesters

⁹Hoglund, C.R., Economics of Irrigation Potatoes in Montcalm County, Mich. State Univ., Agr. Econ. No. 708, March 12, 1958.
Pincock, M.G., Costs and Returns in Producing Muck Potatoes, 1958, Dept. Agr. Econ., Cornell Univ., A. E. Res. 21, June 1959.

is difficult, since the harvest in the late fall occurs at a time when the supply of seasonal farm hands is tapering off and there is some possibility that potato acreages will decline further. Under these circumstances, a 35 to 60 percent reduction in harvest labor requirements per acre seems possible. For all the activities of raising and selling potatoes, 26-45 percent less direct labor per acre will be necessary by 1970-75. The reduction from 1959 in direct and indirect labor used should amount to 23-40 percent.

The harvest of sugar beets occurs during the fall slack period and does not create undue difficulties in view of the present degree of mechanization. But hoeing, thinning, and weeding call for much hand labor in June and July, a busy period in other enterprises. Recent changes in technology and cultivation in sugar beet fields include: minimum tillage, tandem operations, tile drainage, segmented or monogerm seeds and space planting, pre-emergent herbicides, machine thinning, fully mechanized harvesting with 2-row equipment, and faster and more efficient delivery to the sugar refinery. Some of those operations are on custom basis which help eliminate a large amount of hand work without increasing capital investment. Monogerm seed and pre-emergence herbicides alone doubled the acreage one man could handle from 1960 to 1963.¹⁰ Stoop labor thinning has been converted to a long handled hoe activity. In order to fully employ such crews, beet growers do not need to stagger plantings, which cover now only three weeks while previously they were spaced over a period of six weeks in order to have sufficient help at hand for thinning.¹¹

¹⁰Personal correspondence. Frakes, Draher and Seller, "How to Grow Sugar Beets with No Labor," Mich. Sugar Beet Comp., Saginaw, Mich. (undated).

¹¹Mich. Employment Security Commission, Farm Labor Report, 1962, p.28.

In spite of some discouraging trials, the mechanical beet thinner is expected to make its inroads into Michigan fields during this decade. There is a low probability that extensive irrigation will become profitable for sugar beets. Custom planting, thinning, and harvesting will prove economical to many growers. Others with high acreages will acquire their own labor saving equipment for planting, spacing and harvesting.¹² It is expected that most of the above mentioned practices will be adopted by nearly all growers by 1975. This will lead to reductions in direct labor (1) of 35-46 percent from 1959 to 1970 for establishing activities, (2) of 27-30 percent for hoeing, thinning, and cultivating activities, and (3) of 41-45 percent for harvesting.

More attention will be given by the farmers to hay, legume and grass seed crops since 50 percent increases in yield are possible with proper cultivation and fertilization. If farmers make hay three times from the field, as is assumed, labor requirements per acre are not expected to decline in the decade ahead.¹³

Pastures include both cropland used only for pasture and native pasture that is not woodland. Pastured cropland has labor requirements for establishing pasture that are virtually zero since the seeding is usually done simultaneously with small grains and does not require special effort. For simplicity, this labor was included on the basis of

¹²Blosser, H.R., Costs and Returns from Sugar Beets in Ohio, Dept. Agr. Econ., Ohio Agr. Expt. Sta., Mimeographed Bulletin R. E. 334, July 1962. David, J.E., Frakes, M.C., Cook, R.L., "1958-60, Production Practices of Michigan Sugar Beet Growers," Quarterly Bulletin, Mich. Agr. Expt. Sta., Mich. State Univ., 44:3, Feb. 1962. Young, op. cit.

¹³Blosser, R.H., Cost of Producing Crops in Northwestern Ohio, Ohio Agr. Expt. Sta., Res. Bull. 923, Sept. 1962. _____, Crop Costs and Returns in West Central Ohio, Ohio Agr. Expt. Sta., Res. Bull. 909, June 1962.

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7. The seventh part of the report is a list of
appendices used in the study.

8. The eighth part of the report is a list of
acknowledgments to the people who helped in the study.

9. The ninth part of the report is a list of
the author's contact information.

yearly maintenance needs of half an hour per acre for fertilizing and other cultural practices such as harrowing or dragging. These labor requirements are not expected to change on these meadows since possible savings are counterbalanced by a more intensive care taken of the neglected areas.

The trend for grass silage goes in the same direction as for hay with a greater number of cuttings per year and higher yields, due to increased fertilization. Labor requirements per acre are expected to fall by only 15-17 percent, in spite of the more mechanized harvesting procedures and improved silo loading equipment. The overall labor needs per acre for grass silage are predicted to fall by 12-14 percent.

Vegetables

Due to large seasonal swings of the labor requirements of Michigan's vegetable enterprises, a fairly detailed breakdown is necessary in order to meet the objective of this thesis. The vegetable enterprises studied include; asparagus, beans, carrots, beets, cabbage, cauliflower, cantaloupe, sweet corn, celery, cucumbers, lettuce, mint, onions, peas, tomatoes, and green peppers. The labor requirement data were derived mostly from a series of publications entitled "Truck Crop Production Practices."¹⁴ For the missing enterprises in those publications, staff members of the Horticulture, Agricultural Engineering, Soil Science, and Farm Crops departments at Michigan State University were helpful in developing the

¹⁴The author is deeply indebted to Earle Gavett, Reuben Hecht, and Ralph Loomis for their valuable and unbureaucratic assistance in making this and other material available. Gavett, E.E., Truck Crop Production Practices, Berrien and Van Buren County, Mich., USDA, ERS, 1964, and others of this series.

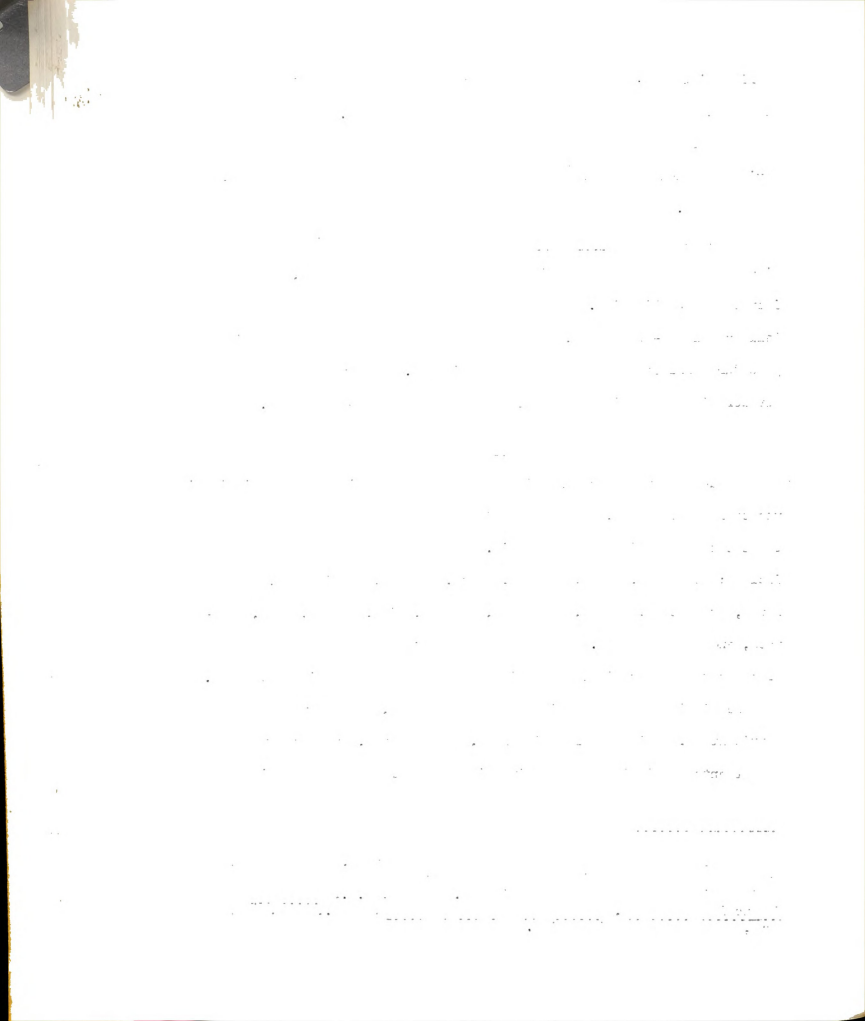


Table 3.3. Direct labor use per acre, month and year in vegetables, for Michigan, 1959 and 1970-75 under alternate assumptions with respect to technological advance

Enterprise and Nature of Estimate ¹	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						hours							
Asparagus													
'59	131.4	.1	.3	1.0	13.5	73.0	41.5	.8		.4	.7	.1	
'70-5L	120.2	.1	.2	.9	13.1	67.9	36.3	.6		.4	.6	.1	
'70-5h	89.9	.1	.2	.8	10.9	51.9	24.4	.6		.3	.6	.1	
Snap beans													
'59	76.0				1.0	2.4	3.6	12.6	26.4	25.0	5.0		
'70-5L	62.7				.8	2.0	2.9	10.8	21.2	20.0	5.0		
'70-5h	53.0				.7	1.7	2.0	9.8	16.8	18.0	4.0		
Cabbage and Cauliflower													
'59	95.0	.6	2.5	3.5	6.0	9.0	13.0	16.8	11.2	13.2	13.2	6.0	
'70-5L	77.1	.5	2.5	3.3	4.3	6.6	10.5	13.3	9.4	11.2	11.0	4.5	
'70-5h	67.6	.5	2.5	3.1	2.8	5.2	9.3	11.0	9.0	11.0	8.7	4.5	
Cantaloupe													
'59	190.8			1.3	19.3	36.9	27.1	2.6	40.6	48.0	15.0		
'70-5L	125.5			.8	11.0	25.8	16.2	1.4	26.3	34.0	10.0		
'70-5h	103.3			.4	10.0	18.7	12.2	.8	23.2	30.0	8.0		
Carrots and Beets													
'59	98.1			1.0	3.0	7.7	9.8	16.2	22.4	21.8	10.2	5.0	1.0
'70-5L	69.5			.5	1.6	3.5	6.5	12.7	16.3	15.8	8.1	4.0	.5
'70-5h	55.1			.5	2.0	1.7	4.4	9.8	14.3	12.8	6.1	3.0	.5
Celery													
'59	405.1			4.0	13.0	40.5	57.8	96.1	82.5	58.2	50.0	1.0	
'70-5L	330.0			4.0	11.0	32.2	47.2	80.8	64.4	48.2	40.0	.5	
'70-5h	251.8			4.0	9.0	23.0	34.0	58.7	52.4	38.2	30.0	.5	
Sweet corn													
'59	53.4			1.3	5.4	7.3	4.8	18.5	16.1				
'70-5L	42.9			.8	3.5	5.4	3.6	15.6	14.0				
'70-5h	38.9			.5	2.6	4.4	3.1	14.3	14.0				

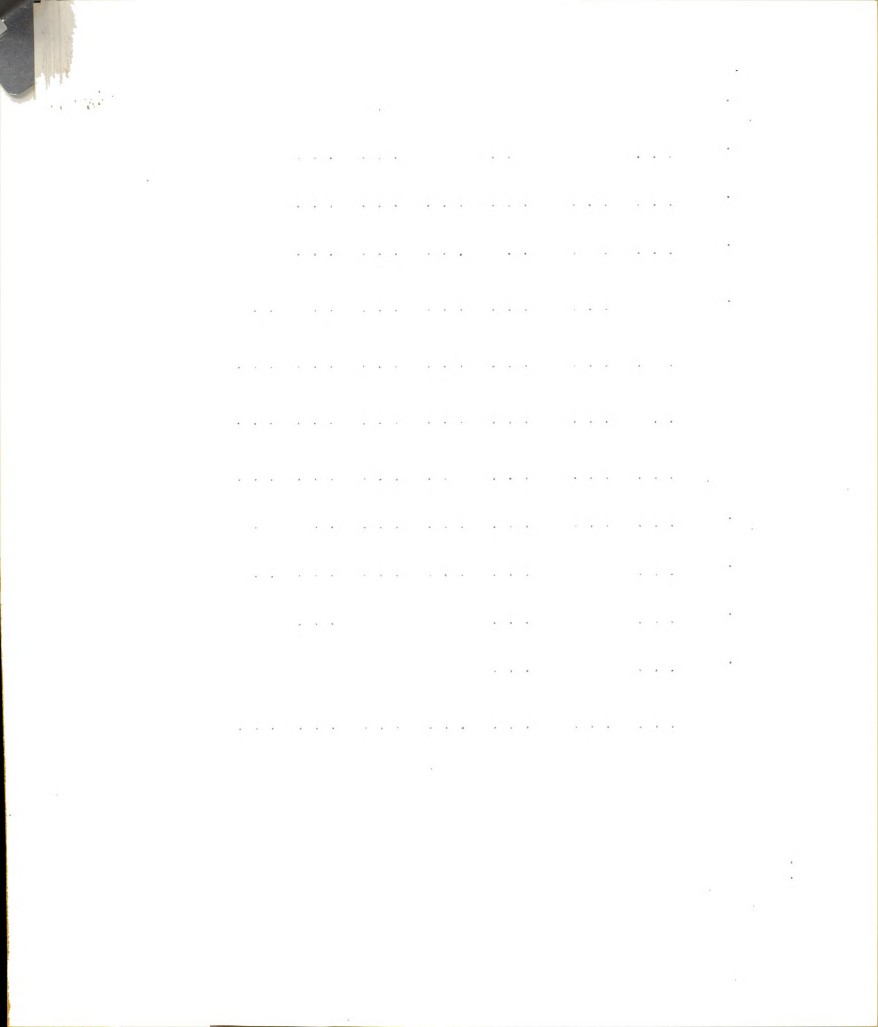
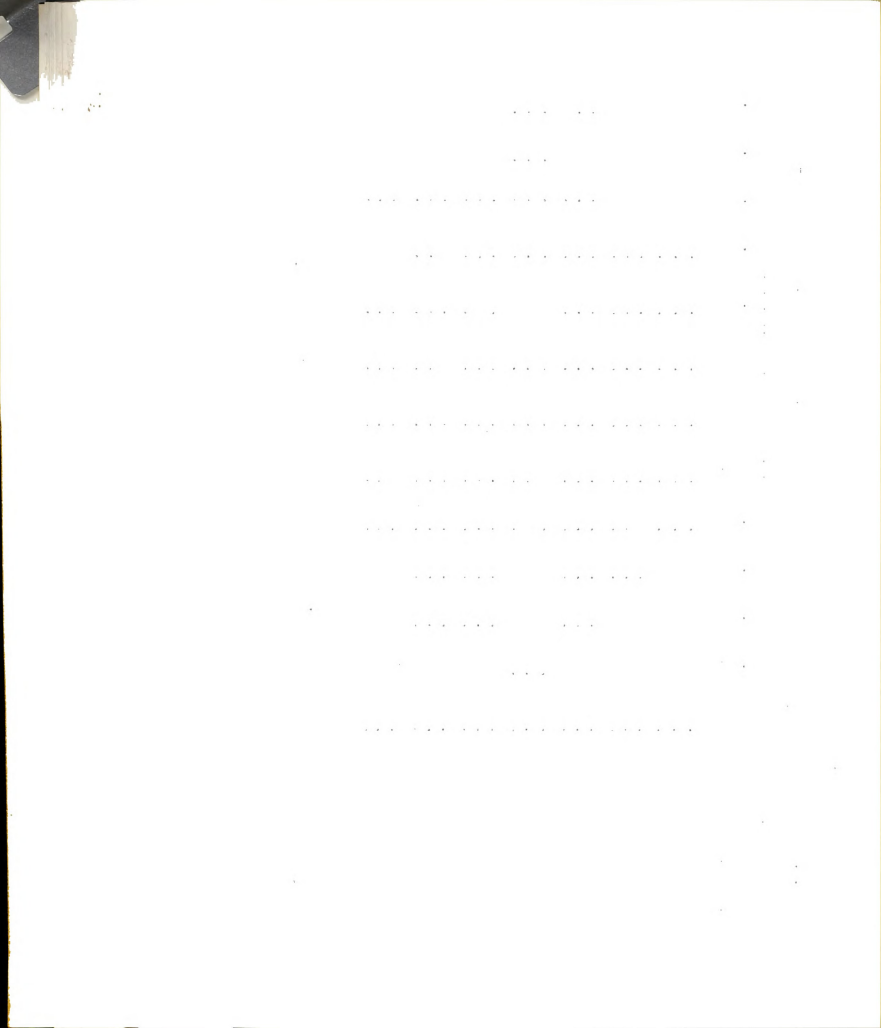


Table 3.3. Direct labor use per acre, month and year in vegetables, for Michigan, 1959 and 1970-75 under alternate assumptions with respect to technological advance (continued)

Enterprise and Nature of Estimate ¹		Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
			hours											
Cucumbers, Squash	'59	224.0				1.3	3.0	16.9	46.6	107.2	49.0			
	'70-5L	128.0				1.0	2.6	22.1	42.4	34.9	25.0			
	'70-5h	85.0				1.4	2.0	19.1	25.5	22.0	15.0			
Lettuce	'59	106.3			1.4	1.7	10.7	23.8	32.7	26.0	10.0			
	'70-5L	81.6			1.1	1.4	9.8	19.6	24.7	18.0	7.0			
	'70-5h	69.9			1.0	1.3	9.7	18.0	20.9	14.0	5.0			
Onion	'59	154.5		1.0	2.0	9.5	10.2	7.8	16.8	25.2	55.0	26.0		1.0
	'70-5L	122.5		1.0	1.5	7.0	8.2	7.3	15.3	20.2	44.0	17.0		1.0
	'70-5h	100.0		1.0	1.0	6.0	7.2	7.3	14.3	18.2	32.0	13.0		
Peas	'59	10.8	.2			1.0	1.8	3.4	3.0		.2	.5	.5	.2
	'70-5L	9.6	.2			.8	1.2	3.1	2.9		.2	.4	.4	.2
	'70-5h	8.6	.1			.7	1.1	3.0	2.8		.1	.3	.4	.1
Peppers	'59	114.9												
	'70-5L	88.2		3.5	9.7	7.0	9.5	12.5	9.1	31.1	25.5	7.0		
	'70-5h	74.9		3.0	8.4	5.6	8.5	9.0	7.4	22.0	18.3	6.0		
Tomatoes	'59	229.3		2.0	2.4	3.0	16.0	20.1	16.4	52.0	91.4	26.0		
	'70-5L	183.8		1.6	2.3	2.6	11.5	15.8	22.7	48.9	45.4	23.0		
	'70-5h	149.0		1.5	2.3	2.5	9.9	11.8	21.1	41.5	38.4	20.0		
Mint	'59	60.0				10.0	1.0	16.0	19.0	5.0		9.0		
	'70-5L	55.0				9.0	1.0	16.0	16.0	5.0		8.0		
	'70-5h	48.5				7.5	1.0	13.0	16.0	4.0		7.0		

¹'59 refers to 1959 estimates. '70-5L refers to 1970-75 projections, assuming moderate technological advance. '70-5h refers to 1970-75 projections, assuming rapid technological advance.



data which were cross-checked with publications and statistics.¹⁵ Table 3.3 on the previous pages gives the monthly distribution of the labor needs.

Likely technological changes between 1959 and 1970-75 and their influences upon the labor requirements for vegetables were estimated from the literature cited in footnotes 4 and 5 of this chapter and discussed with horticulturalists in research and extension at Michigan State University.

General Changes Expected in Vegetable Activities and Practices

Seed bed activities will show labor saving developments similar to those for field crops, especially with respect to herbicides, tandem operations, and minimum tillage where these are applicable. Insect and pest controls will be more commonly accepted and will require more applications but the field efficiency of the equipment will rise appreciably. Some spectacular results from the commercial application of plant hormones are expected.

The major part of labor used in producing vegetables is harvest labor; hence, the greatest efforts will be made to save time in those activities. The life of bulk boxes is twice that of field crates while they cost the same. Further, labor savings of 15-30 man-hours per 1,000 bushels can be realized in the field and an additional 10-25 hours in

¹⁵Miller, C.H., and Wilkins, L.B., "Mechanical Harvesting of Vegetables, A Review," Horticultural Research Series No. 2, N. C. State Coll., Sept. 1962. Farm Labor Reports, op. cit. U.S. Dept. of Labor, Bureau of Employment and Security, "Farm Labor 1964," Employment Security Exchange, No. 24, Sect. H and G. Wheeler, R.G., and Lord, E.F., "The Southwestern Michigan Fruit and Vegetable Farm Business, 1957," Quarterly Bulletin, Mich. Agr. Expt. Sta., Mich. State Univ., 40:4, May 1958 and 41:1, Aug. 1958. Gavett, E.E., Labor Used to Produce Vegetables, Estimates by States, 1958, USDA, ERS, Stat. Bull. 341, March 1964.

farm storage. This justifies the expense of mechanical lifters if the annual volume exceeds 10,000 bushels.¹⁶

Many of the technologies depend upon the development of new varieties suited for mechanical harvesting or which respond to plant hormones. Harvest operations of many vegetables would be much easier if a uniform maturity of the entire plot could be achieved.

Another technique may find widespread acceptance in vegetable enterprises requiring a great deal of ^{or} handhoeing. It involves covering of the ground with dark plastic film. This method conserves moisture, saves irrigation, combats weeds effectively and enhances the life of the micro-organisms in the soil that promote plant growth. All those factors help to increase yields to, in some tests, phenomenal levels. Conservative reports expect yields to increase by 70-199 percent.¹⁷

Fairly recently, news reached farmers that a chemical blocker may lower the costs of thinning vegetables such as lettuce and other row crops. The commercial manufacturing of a 2-row prototype is expected fairly soon.¹⁸

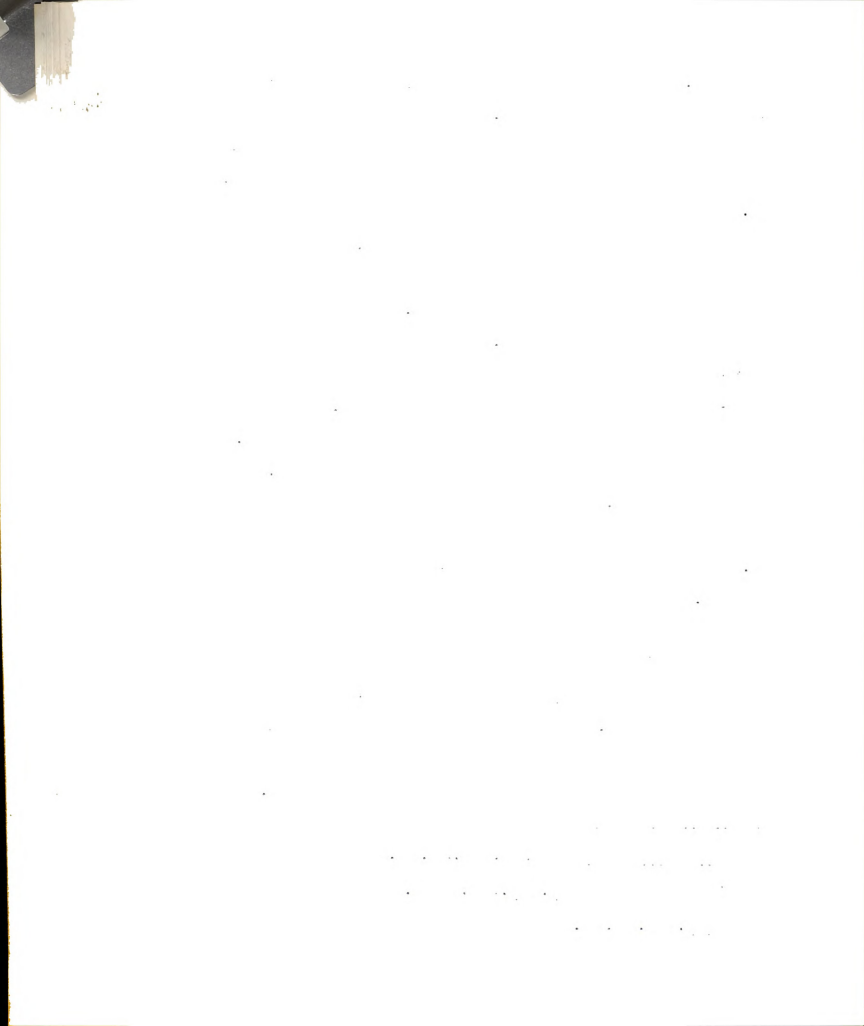
Discussions of Significant Changes in Labor Requirements of Individual Vegetable Enterprises

The life of an asparagus bed is about 15 years, four of which are virtually nonproductive. The tasks associated with the nonproductive beds are minor, such as fertilizing, spraying and cultivating, and a pro-rated share of this maintenance is allotted to the matured fields.

¹⁶Farm Labor Report, 1962, op. cit., p. 26.

¹⁷"Farm Labor 1964," op. cit., pp. 20-23.

¹⁸Ibid., pp. 11, 28.



Selective herbicides are used more and more to combat weeds, thus saving time used for cultivation. Over nine tenths of the total labor required to produce asparagus is spent in harvesting it. The harvest peak is in May at a time when other spring activities are pressing.¹⁹ Four to five thousand seasonal workers are usually employed during May to harvest asparagus.²⁰ In spite of low hourly wages of 75¢, producers are pursuing possibilities of eliminating some of the harvest labor. Thus, personnel carriers covering several rows are hooked onto a tractor driving in low gear permitting the harvesters to ride. This, therefore, facilitates and speeds up the snapping of the spears by a reported 20-25 percent.²¹ While field tests in Michigan in 1960 with semiselective harvesters proved unsatisfactory due to a 40-50 percent reduction in yield, experiments in New Jersey with a one row selective prototype are much more promising.²² The full introduction of those machines in Michigan asparagus fields will not be felt until after 1975. Hence, a reduction of only one third in the use for harvest labor is expected. The reduction of labor needed to produce asparagus will range from 15-32 percent in 1970-75 as compared to 1959.

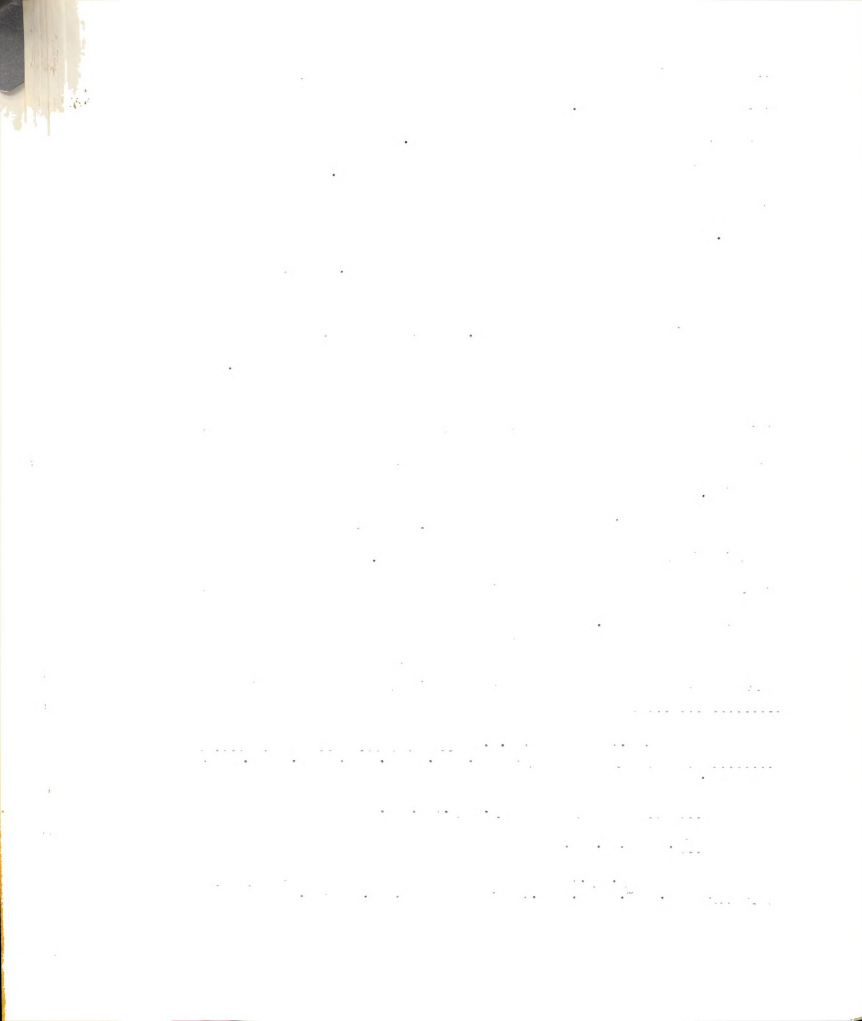
Preharvest operations for green snap beans were already fairly well mechanized in 1959 but there remained high labor demands during

¹⁹Swanson, J., and Black, J.A., 1960 Estimated Costs of Producing Asparagus in Lower Yakima Valley, Wash. Agr. Expt. Sta. Stat. Circ. 389, June 1961.

²⁰Farm Labor Report, 1963, op. cit., p. 13.

²¹Ibid. 1962, p. 23.

²²Knically, et. al., "Harvesting Asparagus Mechanically," Quarterly Bulletin, Mich. Agr. Expt. Sta., 45:4, May 1963, pp. 652-63.



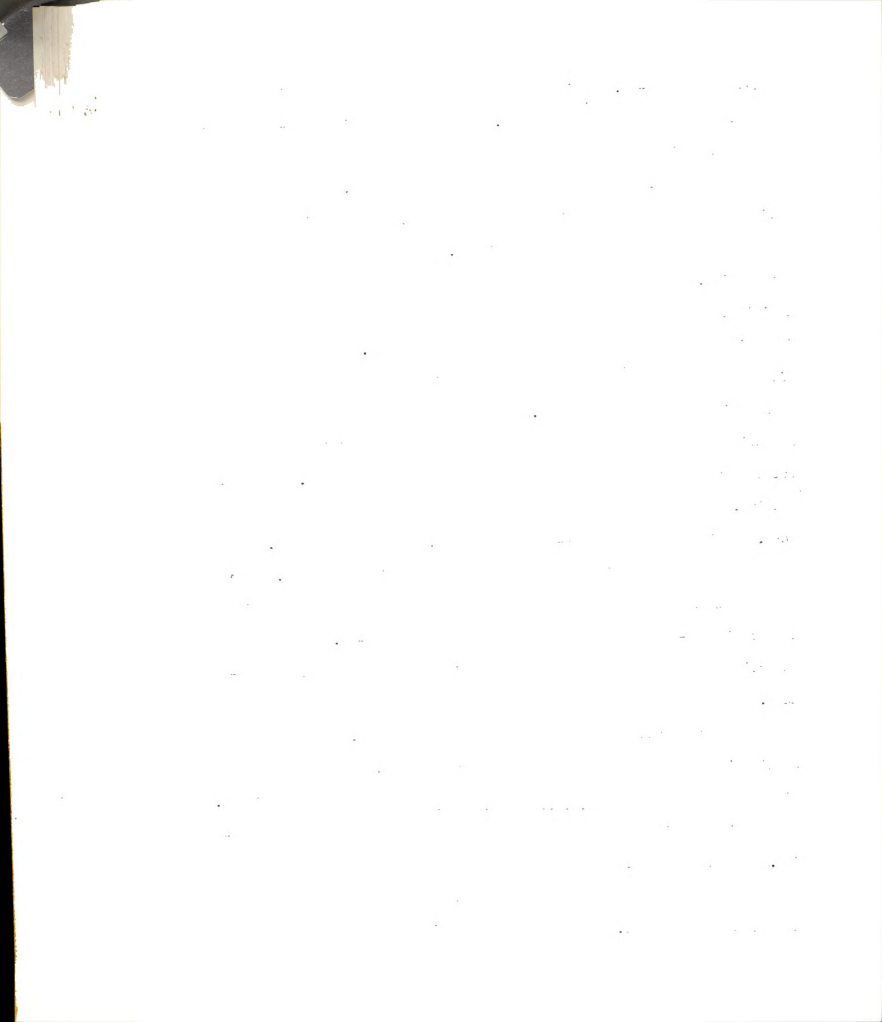
August and September. Over four-fifths of the acreage of beans goes to processors. The harvest of beans for processing is expected to be performed exclusively on a mechanical basis in the next years. While in 1956, 14,000 seasonal laborers were used for the snap bean harvest, less than a thousand workers were used in 1962 in spite of increased acreage. The introduction of the mechanical harvesters is attributed (1) to the coincidence of the cherry harvest and the first picking of the beans, and (2) difficulties in recruiting harvest labor. The efficiency of the harvester is increased when weeds are successfully kept under control and the beans are prevented from forming excessive top growth, e.g., by plant growth regulators. The present dependence of the harvester on dry soils is another drawback and may lead to complications in securing sufficient labor for handpicking in wet summers. By 1970-75, the total labor use per acre is projected to be 15-27 percent lower than the 1959 level. Manual labor use alone should fall by about 3 percent more.

The setting of plants of cabbage-like crops should be mechanized by a larger percentage of growers in the future thus reducing labor used by up to 40 percent. Mechanical tying of cauliflower has not yet been developed. Personnel carrier type harvest equipment is not considered to reduce the labor requirements much, but is rather a convenience. Fully mechanized harvesters are still in the developmental stage, but should reduce the harvest labor demand by 1970 by one-fifth to one-fourth of the 1959 requirements. Those machines test the firmness and size of the head and then cut or reject it. The total labor demand for cabbage and cauliflower is budgeted for 1970-75, 17-29 percent below the 1959 level.

Preplanting operations for cantaloupes that required 6.4 hours of labor in 1959 can be combined to reduce labor use for those activities by

45 percent by 1970-75. It is not foreseen that the time consuming hot bed operations can be shortened much. Mechanized planting by 2-row transplanters used in 1959 by only one fifth of a sample of southwest Michigan vegetable growers, will be adopted by all large growers. Further labor savings may be achieved by direct field planting, thus reducing by 60 percent the labor demand for this activity. The number of sprays will not decline, but the time spent per operation will decline due to more efficient sprayers and the omission of time consuming ground level dusting which can be done cheaply by commercial airplanes. A polyethylene film as described previously may find a profitable and time conserving application on cantaloupe fields. Two row cultivators and at least a reduction from 6 to 4 cultivations made possible by herbicides should cut the labor demands to about half the 1959 level by 1970-75. Picking, packing, and marketing of cantaloupes are performed over 20 times per acre, requiring during August-October of 1959, 103 hours per acre. The harvest of cantaloupes is being tried mechanically in California. It is expected that this harvester will be adopted by some growers in Michigan, thus saving 30-40 percent of the harvest labor by 1970-75. Overall the reductions of labor used for cantaloupes will be between 33 and 44 percent.

Improved cultural practices described previously, especially the application of weed killers by oiling and fumigation, will reduce by one fifth the labor needs for carrots and red beets in preharvest activities. The remaining thinning of the plants may be performed by chemical blocking. In recent years, 45 percent of the harvest of carrots and red beets was performed by mechanical harvesters of a similar type to that used in the sugar beet harvest. The continued expansion of mechanized



harvesting seems to be hampered by the severe difficulties experienced in harvesting the root crops when the soil is wet. Nevertheless, a reduction of 23-28 percent on labor use for harvesting those two crops is projected for 1970-75, due to the perfection and increased efficiency of the machine and its more widespread use. The total of direct and indirect labor used in the production of these two root crops is expected to fall 17-30 percent by 1970-75 as compared to 1959.

Celery is a typical labor intensive crop in Michigan. In the past, man-hour demands have declined rapidly. Future reductions in the use of labor for plant bed preparation, planting and cultivating, will have a smaller impact since the more frequent use of irrigation requires additional man-hours. Savings would be due to the use of tandem operations, minimum tillage, precision planting and spacing, larger equipment, and the use of herbicides. Most of the labor savings will occur during the harvest. Larger growers will use highly specialized machinery equipped with conveyor belts on which the cutters lay the celery. The sorting and packing is done on the head of the belts which spread over several rows on both sides. One fifth to two fifths less labor will be required for the harvest with such equipment. Direct and indirect labor requirements for celery are at best reduced from 1959 by 39 percent in the target period.

Sweet corn requires considerable effort to keep it free from weeds, ear worms, and borers. This explains the frequent sprays and dustings. Corn cultivation has a peak labor requirement in late May and June. The harvest creates a higher peak in July (with nearly 19 hours per acre) and in August. Up to 40 percent savings in the use of labor during pre-harvest activities are expected due to minimum tillage practices, more

effective chemical weed control and larger spray equipment. A mechanical 2-row harvester with a capacity of over 10 acres per eight hour day becomes profitable for areas in excess of 200 acres. This harvester is reported to cut costs 38 percent if used on 500 acres. Plant breeder efforts are expected to adapt varieties to machine harvesting by controlling the size of the plant. The position and the uniform maturity of the ears may make it possible to use the harvester even for the fresh market corn. These developments are not expected to have a widespread impact on Michigan corn growers for our target period. By then, the reduction for harvest labor is judged to lie between 13 and 16 percent from the 1959 level. For both direct and indirect labor, the demand will decline between 17 and 23 percent for the time periods considered.

Ninety percent of Michigan's cucumbers are processed into pickles. As Michigan is the leading national producer of pickles, growers and processors have much at stake when most of the 13-14,000 Mexican Nationals will be excluded from the harvest of this crop in 1965. In 1959, 14 hours per acre were spent by migratory laborers to hand hoe and train the vines in June and July. The harvest labor demands are highest in July and August with over 80 hours per acre in each month. Most of the harvest labor is used for picking, which does not allow postponement without critical losses of revenue.²³ For the planting operations, several labor saving practices are expected to be followed. Machine seeding of cucumber will replace to a large extent the time consuming and more expensive setting of plants or hand seeding. More widespread irrigation will increase labor requirements per acre. Most of the

²³Stuckman, N.W., "Michigan Pickling Cucumbers," Quarterly Bulletin, Mich. State Univ., Agr. Expt. Sta., Vol. 42, No. 1, Aug. 1959.

hoeing and cultivating activities can be reduced to machinework, if plastic film is used to cover the area next to the plants. Continuous harvesting and the viny growth of the cucumbers have retarded mechanical harvesting. Personnel carriers have made this work more attractive to those not willing to stoop and may double the picking capacity of a person if the carrier speed can be adjusted to the worker's ability to pick. The development moves in the direction of having two subsequent plantings in the same field. More plants would be set per acre of a variety in which the pickles mature simultaneously. A plant hormone spray may help to obtain a more uniform maturity and an easier separation of the pickles from the vines. A prototype of a pickle picker exists and has been tested successfully in Michigan. With these developments possible during this decade a decreased labor demand on the order of 60 percent appears feasible by 1970-75. This would help to depress the direct and overhead labor requirements to nearly half in the target period compared to 1959.

Cultivation and harvesting are the big jobs in the lettuce fields, requiring above 25 hours per acre during the months of June to August. There is a chance that a chemical blocking device will reduce labor demands for the thinning operations. The usual reductions of preharvest labor are, to a large extent, counterbalanced by increased irrigation. This will leave, at most, a net decline in preharvest labor use of 14 percent from 1959 to the 1970-75 period. However, great hopes exist for a drastic reduction of the harvest labor requirements. A 50 percent reduction of harvest labor is expected if the presently available semi-harvesters which speed up handcutting with conveyer belts and packing equipment are used more extensively and a machine tested in California

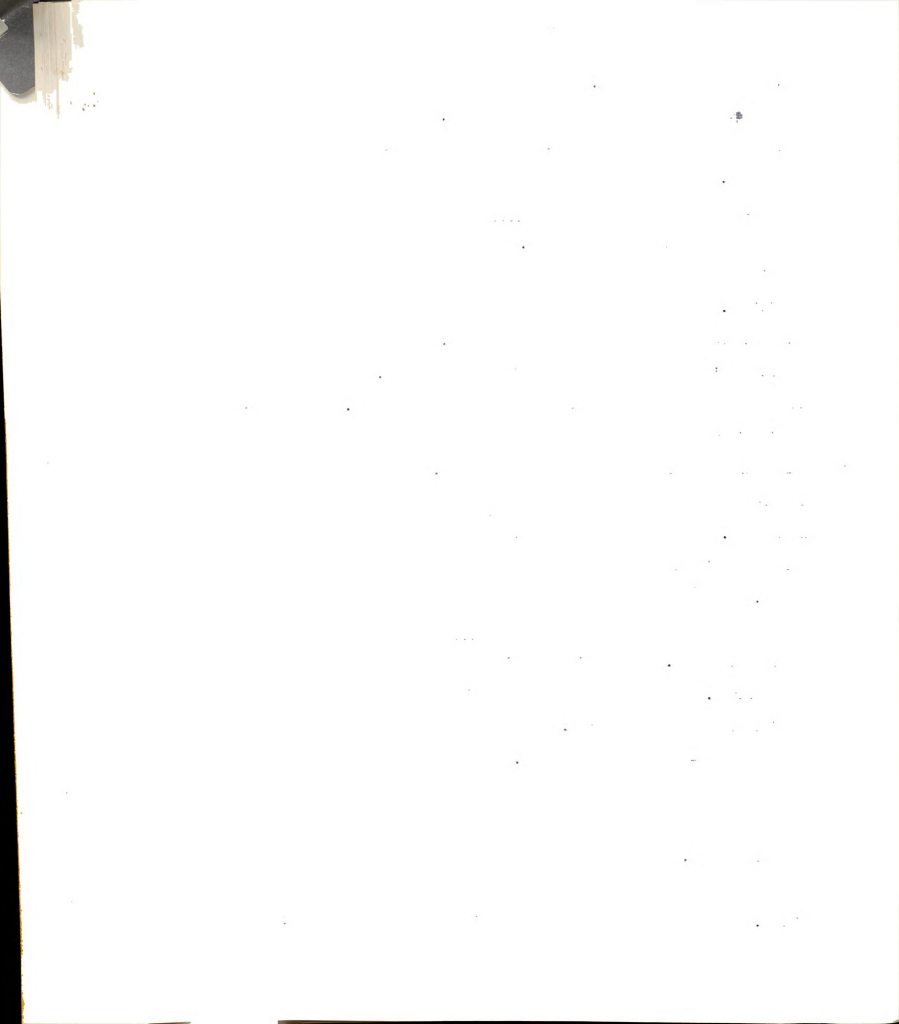


proves operational by 1970. The new equipment tests the firmness by a feeler mechanism and cuts only selected heads. The estimates for the total labor requirements by 1970-75 range between 58-79 percent of the 1959 level.

The labor requirements for onions peak in May for cultivation and in August and September for harvest. The preharvest hand labor has been and will be further reduced by the use of pre-emergence sprays and new herbicides. The "home made" and larger commercial harvesters are applicable on muck soil and for yellow onions only. They harvested over half of Michigan's 1963 crop of yellow onions on muck soil. On other soils, they caused too much bruising, especially of white onions. Further expansion in the use of bulk boxes will lighten the burden on labor in the fall when seasonal workers are in short supply. This may lead in 1970-75 to a 24 to 43 percent reduction of labor inputs for harvest jobs from the 1959 level. Under the circumstances, between 19 and 33 percent less direct and indirect labor is expected to be used per acre in the target period.

In recent years the production of peas for processing has been highly mechanized. Cultivation practices have been replaced by chemical weed control. Mobile pea viners have eliminated the costly transportation of vines to a stationary viner. The 1959 labor requirements are expected to decrease 10-20 percent by 1970-75.

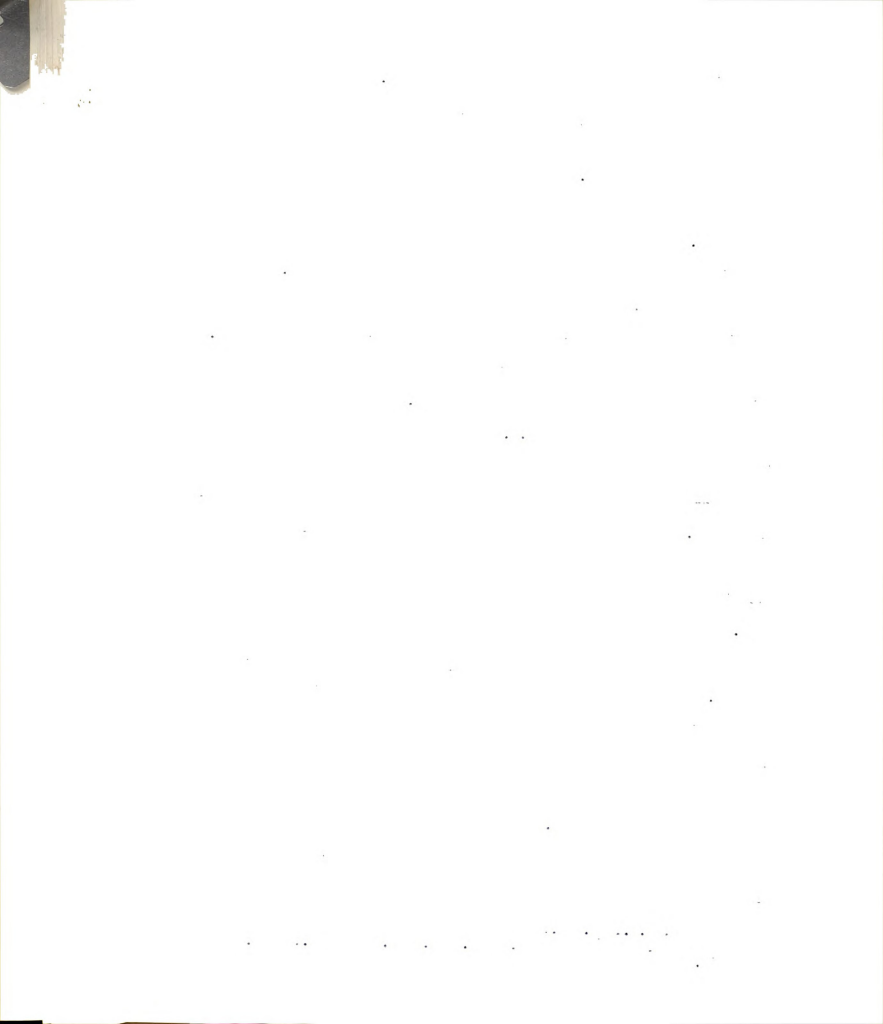
The labor demands for tomatoes increase rapidly from May on as the season progresses and lessen in late September after the principal harvest is over. Labor requirements were relatively high in the past due to the low efficiency of many operations carried out in small tomato fields. Larger size plantings will certainly reduce labor inputs,



although increased irrigation may retard this trend. A higher percentage of irrigated fields could be expected, especially if the plants are harvested once mechanically and a number of varieties with different maturity periods are planted. Direct seeding instead of field planting of tomatoes may develop into another significant reduction of the preharvest labor demand. There are strong indications that the commercially raised plants will be cheaper for the producer than farm raised plants. Under these circumstances, the reduction in labor requirements for preharvest activities from 1959 to 1970-75 may range between 23-33 percent per acre. Much more research effort will go into the reduction of the labor intensive harvest operations of tomato processing. If suitable strains can be developed by plant breeders--i.e., those which have a crack resistant skin and heavy fruit set at one time on a plant that stands well above the ground--tomatoes for the fresh market may be harvested also by mechanical devices. The use of bulk boxes, less frequent pickings, and mechanical harvesters as developed by agricultural engineers of Michigan State University may reduce the labor requirements as much as 40 percent this decade.²⁴

Harvest activities for green peppers are crowded into August-September. While most of the savings of labor during the growing phase can be attributed to chemical weed control, machine planting, or even seeding into the field and a mechanical harvester (still in the developmental stage) could bring amazing reductions in labor requirements if field sizes were large enough. The expected reduction in labor for preharvest tasks during this decade may reach 42 percent while at most 32

²⁴Stout, B.A., et. al., "1962 Mechanical Tomato Harvesting and Handling Studies," (mimeographed), Dept. Agr. Eng. and Hort., Mich. State Univ.



percent of the harvest labor will be required. Direct and indirect labor spent in green pepper production is expected to decline by 1970-75 between 21 and 33 percent from the 1959 level.

The local concentration of mint cultivation and the high per acre labor needs especially for the critical weed control activity justify its inclusion in the computations. No major changes are expected during this decade, except that chemical herbicides will lighten the burden of weeding,²⁵ thus reducing direct labor inputs by 12-20 percent by 1970-75.

Fruits

The fruit enterprises are grouped into the small fruits and the tree fruits. Generally, one can expect that simplifications in the cultivation of field crops can be expected to be followed in fruit production as long as they are applicable and feasible. Tandem operations, improved sprayers for herbicides, fungicides and insecticides, mechanized cultivating techniques, and harvesting will contribute to lightening the burden on hand labor and eliminate many tasks and laborers during the 1960's.

Table 3.4 on the following pages gives the monthly labor use for 1959 and 1970-75 under alternative assumptions with respect to technological advance.

Discussion of Significant Changes in Labor Requirements of Individual Fruit Enterprises

Small fruits

The enterprises considered here are strawberries, raspberries, and blueberries for which Michigan is a prominent U.S. producer. As it

²⁵Green, R.J., Mint Farming, ARS, USDA, Agr. Info. Bull. 212, Feb. 1963.

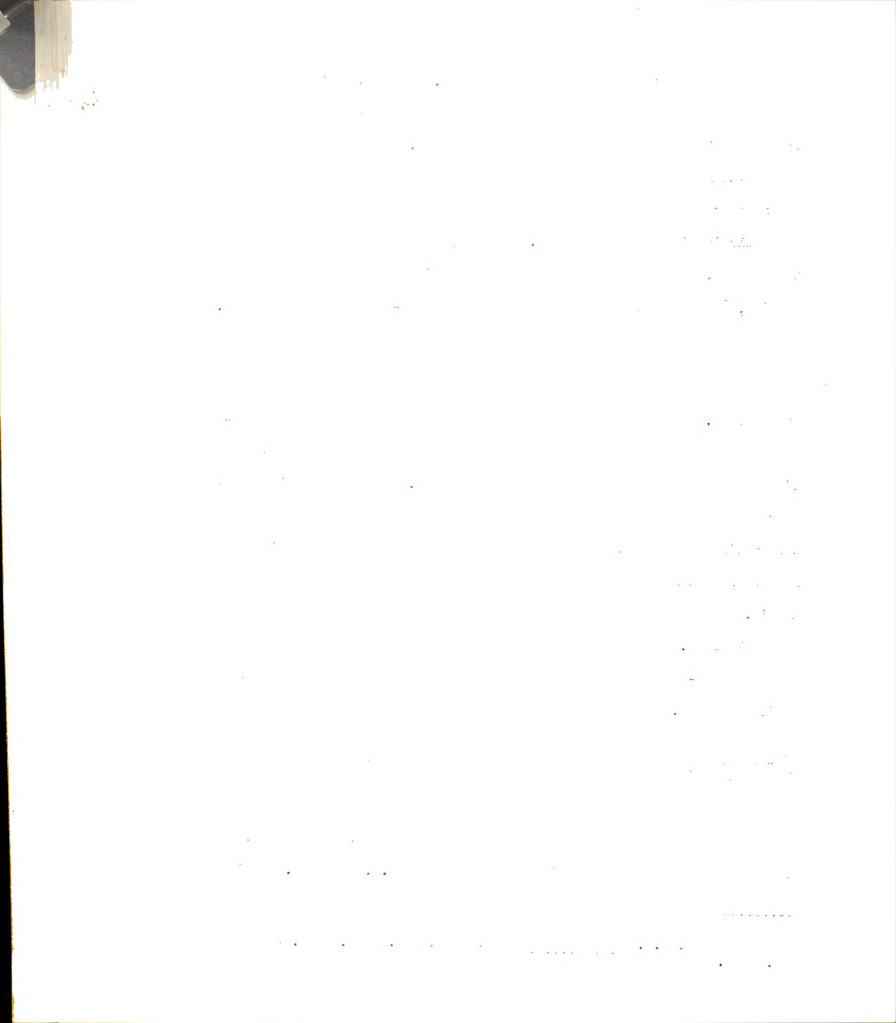


Table 3.4. Direct labor use per acre, month and year in fruits, for Michigan, 1959 and 1970-75 under alternate assumptions with respect to technological advance

Enterprise and Nature of Estimate	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						hours							
Apple - bearing '59	81.0	3.0	3.0	3.0	6.0	5.0	4.0	4.5	4.0	20.0	23.0	3.5	2.0
'70-5L	91.0	2.0	3.0	2.0	6.0	5.0	3.0	3.5	6.0	25.0	29.0	4.5	2.0
'70-5h	55.0	2.0	2.0	1.0	4.5	4.0	2.0	2.0	3.5	15.0	17.0	2.0	2.0
Apple - non- bearing													
'59	34.0	1.0	1.0	4.0	6.0	4.5	3.6	3.1	2.6	.6	2.6	4.0	1.0
'70-5L	22.5	.5	1.0	2.5	5.5	3.0	2.0	1.0	1.5	.5	1.5	2.5	1.0
'70-5h	20.5	.5	1.0	2.5	4.0	2.5	1.5	2.0	1.0	1.0	1.5	2.0	1.0
Cherry, tart, bearing													
'59	172.0	2.0	3.0	3.0	4.5	3.5	18.0	109.0	27.0				2.0
'70-5L	57.5	2.9	2.9	2.9	3.7	3.4	1.9	34.8	1.4		0.5	0.4	2.7
'70-5h	37.4	2.3	2.5	3.0	2.8	2.6	1.3	18.5	.8		0.5	0.5	2.6
Cherry, tart, non-bearing													
'59	40.0	2.0	2.0	6.0	8.4	4.9	4.4	3.9	2.4			3.0	3.0
'70-5L	25.0	1.0	2.0	5.0	5.4	2.4	1.9	1.9	0.4			3.0	2.0
'70-5h	22.0	1.0	2.0	4.5	4.9	2.4	1.9	1.9	0.4			2.0	1.0
Cherry, sweet bearing													
'59	211.0	2.0	3.0	3.0	2.5	3.8	3.3	85.7	105.7				2.0
'70-5L	193.4	3.2	3.0		1.0	4.0	2.5	77.5	98.7		0.4		2.1
'70-5h	114.0	2.6	3.0		.3	3.0	1.7	48.2	54.8		0.3	.1	
Cherry, sweet non-bearing													
'59	29.5	1.0	2.0	5.0	8.4	2.9	2.9	1.4	0.9			3.0	2.0
'70-5L	20.5	1.0	2.0	3.0	4.9	2.4	2.9	0.9	0.4			2.0	1.0
'70-5h	18.0	1.0	2.0	2.5	3.9	1.4	2.9	0.9	0.4			2.0	1.0
Grape - bearing													
'59	95.0	4.0	6.0	13.0	6.5	4.5	4.0	1.5	1.5	33.5	15.5		5.0
'70-5L	63.0	4.0	6.0	5.0	7.5	1.7	3.7	1.2	1.0	22.6	10.3		
'70-5h	44.9	4.0	6.0	4.0	3.5	1.7	3.2	1.2	1.0	13.3	7.0		
Grape - non- bearing													
'59	71.0	3.0	4.2	13.2	11.2	2.7	2.7	1.7	1.7	2.2	16.2	10.2	2.0
'70-5L	51.0	3.0	4.2	13.2	10.2	1.7	2.7	1.7	1.7	1.2	9.2	2.2	
'70-5h	42.5	1.0	4.2	12.2	10.2	0.7	2.2	0.7	1.2	1.2	7.7	1.2	
Peach - bearing													
'59	115.5	4.0	4.0	4.0	2.5	4.0	12.5	13.5	23.5	38.5		5.0	4.0
'70-5L	67.0	2.0	2.0	2.1	2.6	3.2	4.7	4.7	17.1	25.1		2.5	1.0
'70-5h	55.3	1.9	1.9	2.0	2.0	3.1	4.7	2.0	12.6	22.6		2.5	

Table 3.4. Direct labor use per acre, month and year in fruits, for Michigan, 1959 and 1970-75 under alternate assumptions with respect to technological advance (continued)

Enterprise and Nature of Estimate ¹		Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
							hours							
Peach - non- bearing	'59	46.0	2.0	3.0	5.0	9.9	1.9	3.4	2.9	1.9	1.0		8.0	7.0
	'70-5L	30.0	2.0	2.0	4.0	4.9	1.9	2.4	1.9	1.9	1.0		4.0	4.0
	'70-5h	24.5	1.0	2.0	3.0	4.4	1.9	1.9	1.4	1.4			3.0	4.5
Pear - bearing	'59	85.0	3.0	3.0	3.0	2.5	4.0	5.5	3.5	12.0	24.5	18.0	3.0	3.0
	'70-5L	88.9	2.0	3.0	3.0	2.5	4.0	3.6	3.0	15.1	28.3	21.4	3.0	3.0
	'70-5h	70.2	2.0	2.9	1.9	2.1	4.1	3.1	3.0	11.3	21.3	16.0	4.0	2.1
Pear - non- bearing	'59	30.0	2.0	2.0	4.0	5.9	2.4	1.9	2.4	1.4		2.0	4.0	2.0
	'70-5L	18.0	2.0	2.0	3.0	2.4	1.9	1.4	1.4	.9		1.0	2.0	
	'70-5h	15.6		2.0	2.1	2.4	1.9	.9	1.4	.9		1.0	2.0	1.0
Plum - bearing	'59	102.0	2.0	3.0	3.0	4.0	3.5	3.0	2.0	22.0	34.0	22.5	1.0	2.0
	'70-5L	75.0	2.0	3.0	3.0	3.7	2.7	1.5	2.0	14.7	23.2	16.0	1.0	2.2
	'70-5h	58.5	1.4	2.9	2.9	2.6	2.2	1.0	1.5	9.0	19.9	13.5	.5	2.1
Plum - non- bearing	'59	32.0	2.0	2.0	3.0	8.4	3.4	3.4	1.9	1.9		2.0	3.0	1.0
	'70-5L	22.0	2.0	2.0	2.0	5.9	2.4	1.9	1.4	1.4		1.0	2.0	
	'70-5h	18.5	2.0	2.0	1.0	4.4	1.9	1.4	.9	.9		2.0	2.0	
Strawberries	'59	729.0	.3	.5	3.3	16.1	24.9	24.9	366.3	240.7	15.7	15.5		
	'70-5L	641.2	.3	.5	2.9	13.1	88.6	18.6	334.3	215.7	10.7	10.4		
	'70-5h	573.0	.2	.4	2.5	11.0	60.5	15.5	296.3	188.6	6.6	4.3		
Raspberries	'59	55.0			3.0	18.0	24.0	11.0	146.0	29.0			1.0	
	'70-5L	128.0			2.0	11.0	9.0	9.0	86.0	14.5			1.0	
	'70-5h	231.0			2.0	8.0	7.0	8.0	30.5	8.5			1.0	
Blueberries	'59	379.0		2.0	12.0	21.0	9.0	9.0	65.0	206.0	60.0		1.0	
	'70-5L	97.00		2.0	10.5	15.5	3.0	5.0	10.0	40.0	10.0		1.0	
	'70-5h	48.5		2.0	10.0	13.5	1.0	1.0	4.0	12.0	4.0		1.0	

¹'59 refers to 1959 estimates. '70-5L refers to 1970-75 projections, assuming moderate technological advance. '70-5h refers to 1970-75 projections, assuming rapid technological advance.



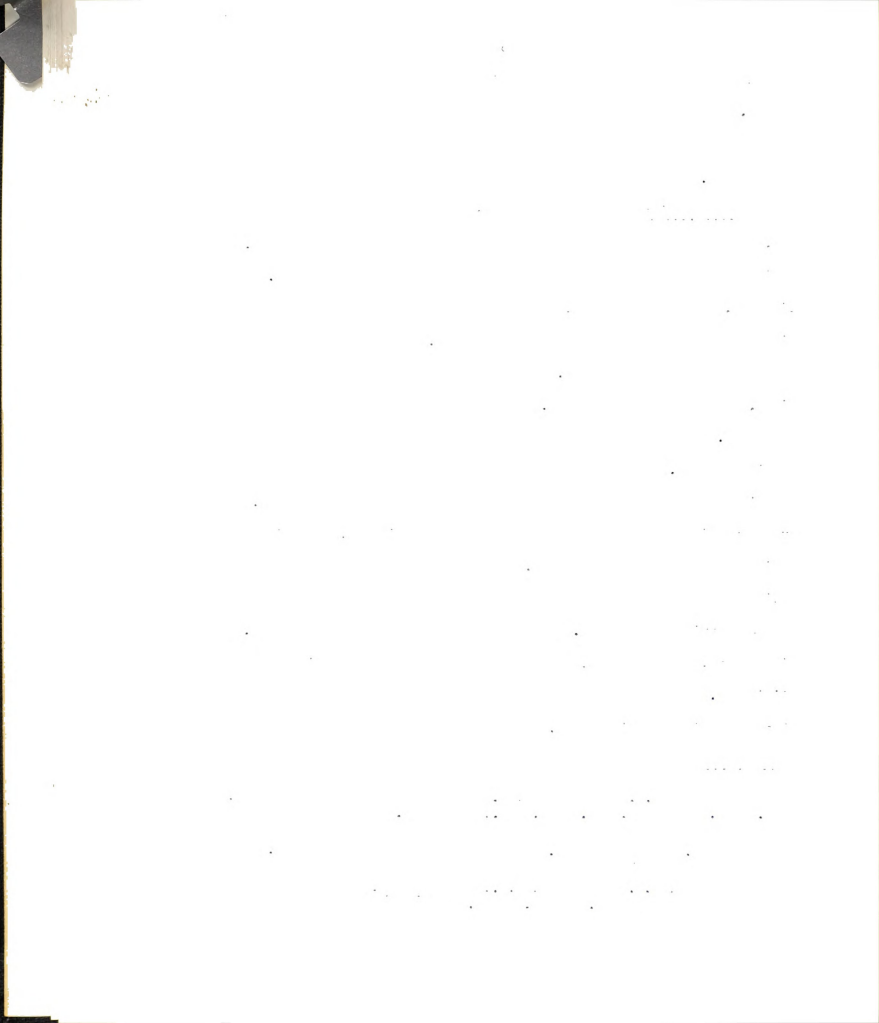
was difficult to obtain recently published material for these enterprises,²⁶ a great deal of information was obtained from the extension specialists in the Agricultural Economics and the Horticulture Departments.²⁷

Strawberries are one of the most labor intensive crops in Michigan, with an average labor requirement of 729 hours per acre in 1959. Their labor requirement peaks during the harvest in June and July. Cultivation, hoeing and weeding, the other activities using much labor, are distributed over the entire vegetative period. Strawberries are usually grown triannually in Michigan. Since in the first year no fruits are desired, the blossoms are removed. In the following two years fruits are harvested. The labor inputs during the first year are prorated over the bearing seasons. Roughly 85 percent of the labor use of the first year plantings are accounted for by planting and weed control activities. Over four fifths of the direct labor is used for picking, an activity unlikely to be mechanized by 1970.²⁸ Several changes in the preharvest activities are expected that could reduce the labor input by one third per acre during this decade. The key to high yields is weed control. With Sesone, a weed killer, much of the hand and machine hoeing can be eliminated. Chemical sprays may also eliminate the pinching of the blossoms during the first year. The use of plastic film instead of

²⁶Wright, K.T., and Johnson, S., "Small Fruit Costs in Michigan," *Circ. Bull.* 203, Mich. Agr. Expt. Sta., June 1946.

²⁷Prof. Kelsey and Prof. Bell were especially helpful here.

²⁸Nelson, J.B., and Peart, M.E., Strawberries, Ontario Farm Economics Studies, Ontario Dept. of Agr., 1958.



mulch would save time for weed control and bring higher and earlier yields. It is doubtful if the average strawberry producer can lower labor requirements more than one fourth by 1970-75.

Harvesting and pruning operations are the most time consuming tasks in the blueberry fields. While raspberries may be pruned mechanically in the future, blueberries will need hand pruning for years. Presently, nearly half of all growers use a handshaker for the blueberry harvest which requires about 60 hours per acre. Considerable reductions in the labor requirements of about 90 percent are foreseen with the help of the straddle row harvester. It is believed that 25-30 percent of the growers use them at the present time and that 90 percent of them will adopt this machine by 1970. To eliminate hand labor and rotary hoeing, herbicides and a sod culture between the rows are necessary. Approximately three fourths of the dusting is done now by contract planes, a practice most likely to expand further. Considering all these changes and the accomplishments of the active cooperative blueberry organization, total labor needed in blueberry production could be reduced by 1970-75 to 72-84 percent of the level of 1959.

Almost all of the raspberries are of the black variety. July is harvest time and therefore has the highest labor requirements. It is expected that the blueberry shaker may be adopted for mechanical harvest of raspberries by 1970-75 and will reduce the time needed for picking by 86 percent as compared to 1959. Pruning is another labor intensive activity that will be performed by hedge pruners. Planting now is done nearly exclusively by machine. Weed control could be effective and labor saving if the same procedures as employed in the blueberry fields are adopted. Irrigation will certainly bring an increased labor demand.

Due to the widespread adoption of the two major improvements in harvesting and pruning, the total labor requirements for this fruit are expected to lie, in 1970-75, between 40-70 percent below the 1959 level.

Tree Fruits

The following breakdown of the tree fruits is used: apples, tart and sweet cherries, peaches, pears, plums and grapes. Since labor demands for bearing and nonbearing orchards are different, acreages of each of the aforementioned fruits are subdivided into bearing and nonbearing trees. The orchards were considered nonbearing as long as the yield do not exceed 15 percent of the yield in the full bearing age, an age that varies from fruit to fruit.²⁹

Michigan is nationally prominent in the production of tree fruits.

Up to date material concerning labor inputs for such enterprises in Michigan would be rather skimpy had it not been for the efforts of Orlan Buller who generously offered his detailed labor coefficients for this work.³⁰

To establish an orchard, thorough soil preparation in the fall precedes the planting early the next spring. Cultivating, pruning, and fertilizing are other jobs done early or to a lesser degree late in the year. Spraying and miscellaneous work occur throughout the growing season. In addition to those jobs, a bearing orchard has the harvest, storing and selling activities during the summer, fall, and winter depending upon the kind of fruit considered. The harvest usually allows no delay and

²⁹Ricks, D.J., Larsen, R.P., and Wheeler, R.G., "Inputs and Relative Yields for Young Orchards," Fact Sheet 1055, Coop. Ext. Service, Mich. State Univ., Jan. 1961.

³⁰Buller, op. cit.



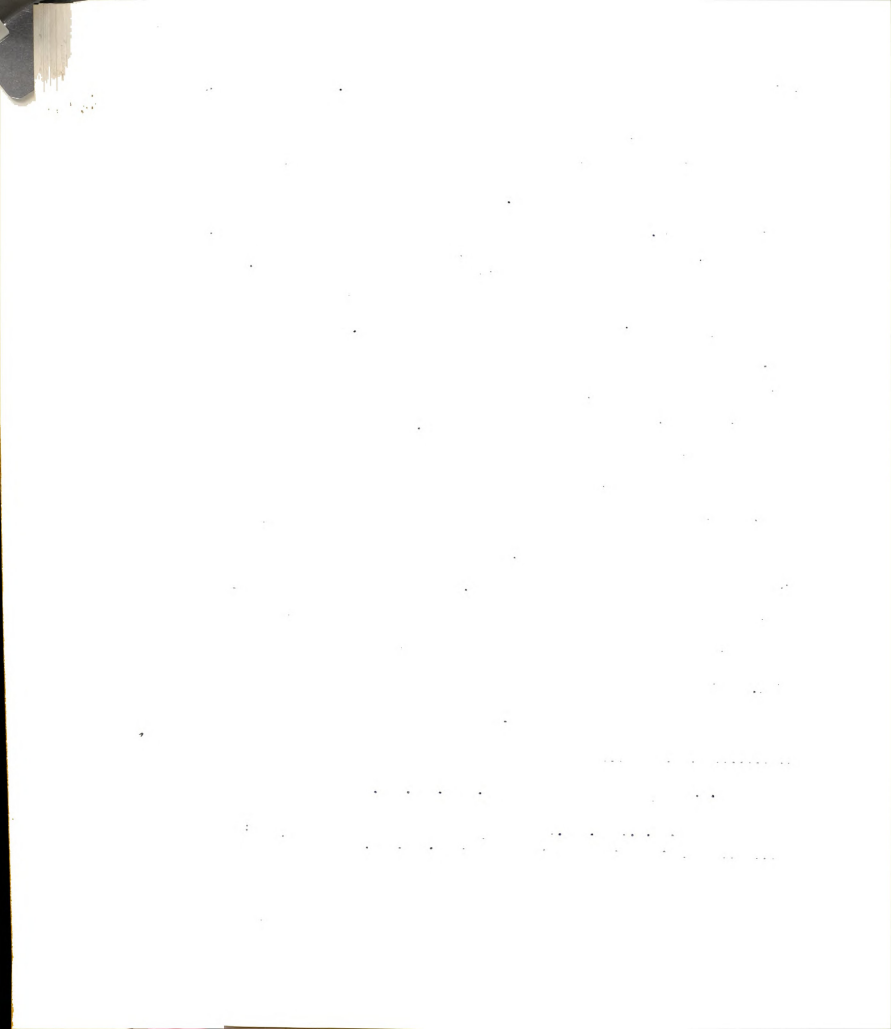
therefore produces pronounced peaks in labor requirements.

The Future Development of the Labor Activities

Specialization and diversification are two forces that have been especially noticeable on fruit farms. They do not necessarily work in the same direction. More efficient use of equipment and other production, marketing and management economies have pushed farmers to specialize. From 1950 to 1959 the number of fruit farms declined by 82 percent but acreage decreased only by a little more than 10 percent.³¹ On the other hand, diversification minimizes risk, spreads the work load provided activities do not coincide, and may also contribute to the more efficient utilization of existing facilities and machines. Fruit growers diversified by producing a greater variety of fruits and vegetables as in southwestern and eastern Michigan but simultaneously specialized by reducing or eliminating most other enterprises, as in the western and northwestern part of the Lower Peninsula. Climatic conditions set limits to diversification in the Traverse City area.³² A good example is the mechanical harvesting equipment which will offer prospects of additional labor savings and net income gains if it is used in more than one enterprise. This type of equipment is more profitable the more it is used and the higher the yields in the orchard. The lower limit for the economical

³¹U.S. Census of Agriculture, op. cit., p. 17.

³²Dennis, C.C., et. al., The Great Lakes Tart Cherry Industry: Production Costs, USDA, ERS-171, May 1964, pp. 13, 14.



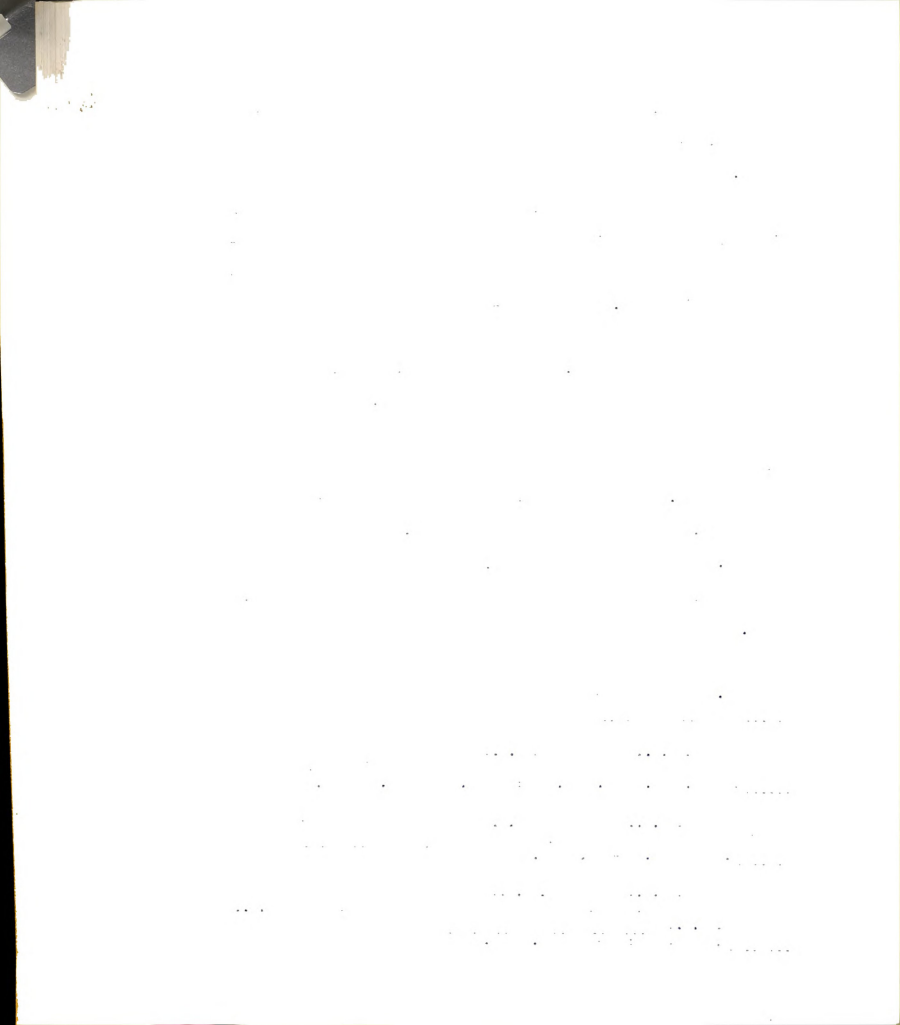
employment of these mechanical harvesters seems to be at 10,000 bushels of apples or pears, 14 acres of cherries (at four ton yields) or, alternatively, 20-50 acres of tree fruit depending upon yield and composition.³³

In the nonbearing orchards, it is expected that tandem operations during plant bed preparations and tree setting with the help of tractor-attached hole diggers will reduce the labor demands in excess of 50 percent during this decade. For the 1970-75 period, reductions in the remainder of the tasks in an orchard are expected to be between 10 to 25 percent as compared with 1959. In spite of bigger, faster, and more powerful sprayers for weed, fungus and insect control, labor requirements for spraying are not anticipated to diminish since more sprayings are expected in the future even though the field efficiency per spraying may rise appreciably. For all orchards, power pruning from a so-called "space basket," a hydraulically operated platform, can cut labor inputs 60 percent.³⁴ For the bearing orchards, the reductions in labor inputs loom large with bulk box handling supposedly saving 15-30 hours per 1,000 bushels. Further savings will follow from the widespread adoption of tree shakers for the harvest of those tree fruits suited for mechanical harvesting.³⁵ Some farmers are expected to increase their labor inputs

³³Ricks, D.J., and Wheeler, R.G., "Farm Management Aspects of Mechanical Harvesting and Handling of Tree Fruits in Michigan," Quarterly Bulletin, Mich. Agr. Expt. Sta., 43:3, Feb. 1961, pp. 606-17.

³⁴Hedden, D.L., and Hansen, C.M., "A Three Dimensional 'Space Basket' for Pruning Fruit Trees," American Society of Agricultural Engineers, Paper no. 62-153, 1962.

³⁵Gaston, H.P., and Levin, J.H., "Handling Tree Fruits in Bulk," reprint from June 16, 1956, issue of the Rural New Yorker, Levin, J.H., and Gaston, H.P., Equipment Used by Deciduous Fruit Growers on Handling Bulk Boxes, USDA, ARS: 42-20, Aug. 1958.



for picking since the yields are expected to increase significantly and these are directly related to the labor used for harvest. It should be pointed out that this relationship is not strictly proportional; rather, with increasing yields the time and hence cost for picking and growing increases at a slower rate for the acre.³⁶ The previously mentioned "space basket" may also be used for spot picking and thereby contribute to a reduction of the labor required in this job. For those fruits that are thinned, chemical or pneumatic thinning should prove a big labor saving.

Overhead time is not likely to change much since the intricacies of production and marketing need close attention. Twelve to seventeen hours were and will be spent per acre for equipment maintenance, management, supervision and for miscellaneous tasks.

The establishment of a new apple orchard will require about half as much time in 1970-75 as was used in 1959 although more than double as many trees per acre are expected to be in new plantings. The savings will be due to combined soil preparation methods and the use of planting hole diggers. Most of this work will be done in April. In order to bring an orchard of standard trees to bearing age, which is assumed to take six years, 40 percent less time will be needed in 1970-75 than in 1959. Dwarf or scored apple trees bear much earlier and hence their labor requirements are larger since plant bed preparations and planting are prorated into fewer years. It is doubtful that many dwarf trees will be planted in the future with the advent of the tree shaker although the limited information from the Kent county area suggests that during the past ten years an increasing number of such trees have been planted

³⁶Dennis, et. al., op. cit., pp. 13 f.

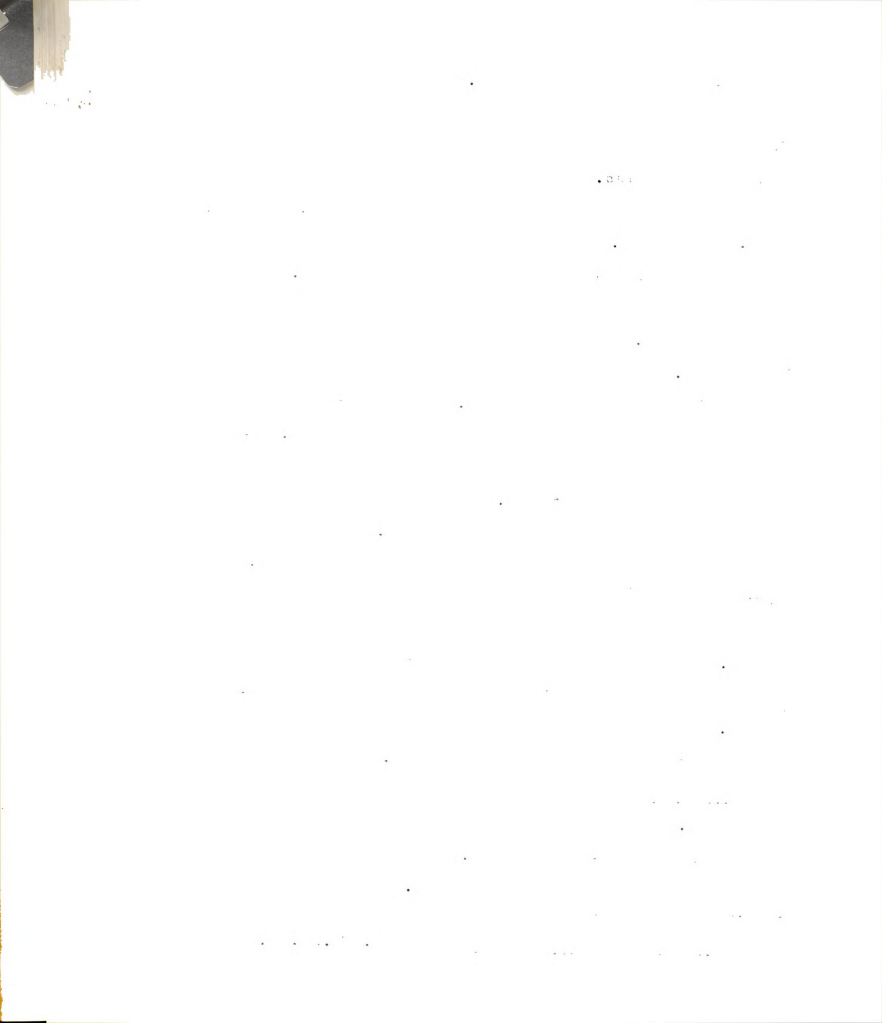


in order to reduce the hand picking time.³⁷

Bearing orchards require approximately 60 hours per acre for hand picking in August to October which constitutes 60 percent of the total labor in these orchards. Another peak with labor requirements of seven hours per acre occurs in April and May when the farmer sprays, fertilizes, prunes, and cultivates. The time spent for pre-harvest activities will be reduced between 18 and 35 percent during the current decade. A substantial part of the reduction will be due to mechanized pruning and thinning procedures. Chemical weed control will save some of the discing and hoeing. The success of harvesting by shakers depends upon a special training and pruning of the trees. It is estimated that currently less than 5 percent of the apples are harvested mechanically. Reports indicate that in 1963 half of the apples for processing purposes were already handled in pallet boxes. This handling technique is expected to be followed by nearly all growers in 1970. There are two major factors determining the harvest labor requirements for apples. The expectation of one third higher yields will increase labor demands while the use of tree shakers and bulk boxes will reduce labor inputs per acre. The net balance will be heavily influenced by the extent to which shakers can be employed in the harvest of apples for fresh consumption. A likely reduction of 15-20 percent from the 1959 levels is anticipated by the target period for harvest labor.

Tart cherry trees are considered to be bearing within three years from planting. Labor requirements for establishing the orchard will be 55 percent lower in 1970-75 than in 1959. The main reductions will occur in soil preparation, planting and pruning.

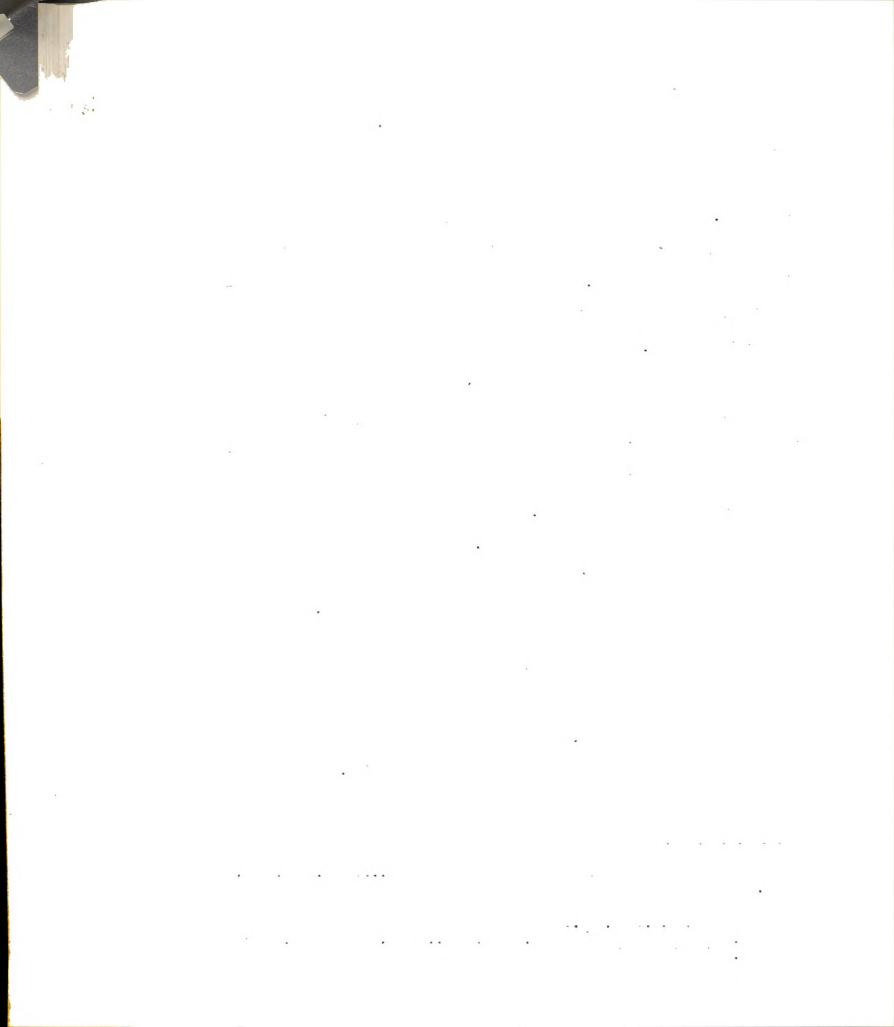
³⁷ Kent County Area Fruit Tree Survey 1963, op. cit., p. 10.



For 1970-75 the labor inputs into preharvest activities are expected to decline by 8-21 percent from the 1959 base. The tart cherry harvest has the best chances of being mechanized completely by 1970 even for the medium sized producer since almost all the production goes for processing. It should be emphasized that farmers with seven acres or more of tart cherries and a yield of six tons per acre will realize profits from machine harvests. If four tons per acre is taken as the average yield, the enterprise size has to double to 14 acres to be profitable for machine harvest. The larger the enterprise, the easier it is to cut the costs of harvesting by using machines.³⁸ However, several reasons are advanced that may retard the adoption of this technique: (1) There is the expensive initial outlay for the power shaker and catching frame, and the labor saving ice water tanks for transporting the fruits, which are necessary to prevent scalding. (2) For successful use of shakers, special training and pruning is required. (3) Some growers feel that the shakers damage the root system and bark of the trees, but that fear does not seem to be justified with the improved boom type shakers. Another disadvantage of the shaking method is that the shock absorbing aprons also catch bad fruits and fruits with stems which force processors to employ destemming devices or let the cherries run over inspection belts to remove the unwanted material. Only about 20 percent of the labor inputs of 1959 are foreseen to be necessary in the target period.³⁹ This would imply that the total hours of labor needed for tart cherry production

³⁸Ricks and Wheeler, "Farm Management Aspects...", op. cit., pp. 610 f.

³⁹Levin, J.H., et. al., "Mechanizing the Harvest of Red Tart Cherries," Quarterly Bulletin, Agr. Expt. Sta., Mich. State Univ., 42:4, May 1960.



could be reduced by 58-72 percent this decade, mainly saving labor in July.

The situation for sweet cherries will be similar to that for sour variety. There are fewer trees per acre. Nonbearing groves will need 30-39 percent less labor by 1970-75 than in 1959. It is forecast that expected labor inputs in 1970-75 for preharvest activities will decline by 23-45 percent from the 1959 level. Another peculiarity of both varieties of cherries is that experts recommend fall fertilization. This could relieve growers of some of the peak labor demands in the spring and transfer this activity to the late fall slack period.

Differences occur between the varieties in the timing of the harvest. The sweet cherry harvest follows closely and partly overlaps the harvest for tart cherries. It takes about 40 hours more to harvest sweet cherries. It should be noted that the yields are assumed to rise by more than 60 percent. Chemicals may have to be developed and applied to loosen the cherries from the stem for machine harvest. It is assumed that at least half and at best three-fourths of the harvest will be machine harvested by 1970-75, thereby diminishing the labor inputs for these activities by 9-56 percent. Extensive pallet box use is forecast for the target period.

All direct and indirect labor is expected to decline by 8-43 percent per acre.

Peaches begin bearing the third year after planting, which explains the high, annual, prorated labor requirements for nonbearing groves. The reductions of labor inputs are in the activities discussed previously in the section concerned with the future development of practices. They result in a 35-47 percent decline for nonbearing orchards by 1970-75.

The anticipated reductions of per acre labor inputs during pre-harvest operations of 56-63 percent are attributed mostly to savings in pruning and thinning time. About one-third of the acreage is already thinned by machines. The shaking of clingstone peaches is anticipated to be introduced throughout by 1970, while freestone peaches for the fresh market will still be hand picked, thus leading to an anticipated labor saving of 33-44 percent from 1959. All in all, the labor inputs may decline by 38-47 percent by the periods under consideration. Most of the reductions of labor use will come in the critical months of June to September.

The cultivation of pears is similar to that of apples. In 1970-75 nonbearing orchards will probably use 40-48 percent less time than in 1959. Pears need less spraying, but a little more harvesting time than apples.

In the target period, 21-27 percent less labor than in 1959 is expected to be employed during preharvest activities due to man-hour savings already described. Even if the catching aprons of the mechanical boom harvesters should have vastly improved impact absorbing qualities, it is very doubtful that more than half of the entire pear production will be harvested by machine since pears bruise very easily. This, coupled with greatly increased yields, will increase the harvest labor needed by 18 percent, if only 25 percent are harvested mechanically in 1970-75. Harvest labor will decrease by 13 percent if half of the trees are mechanically harvested. Under these circumstances total labor used to produce pears may change little and, at best, may decline 15 percent during the 60's.

The cultivation of plums is in many aspects similar to that of

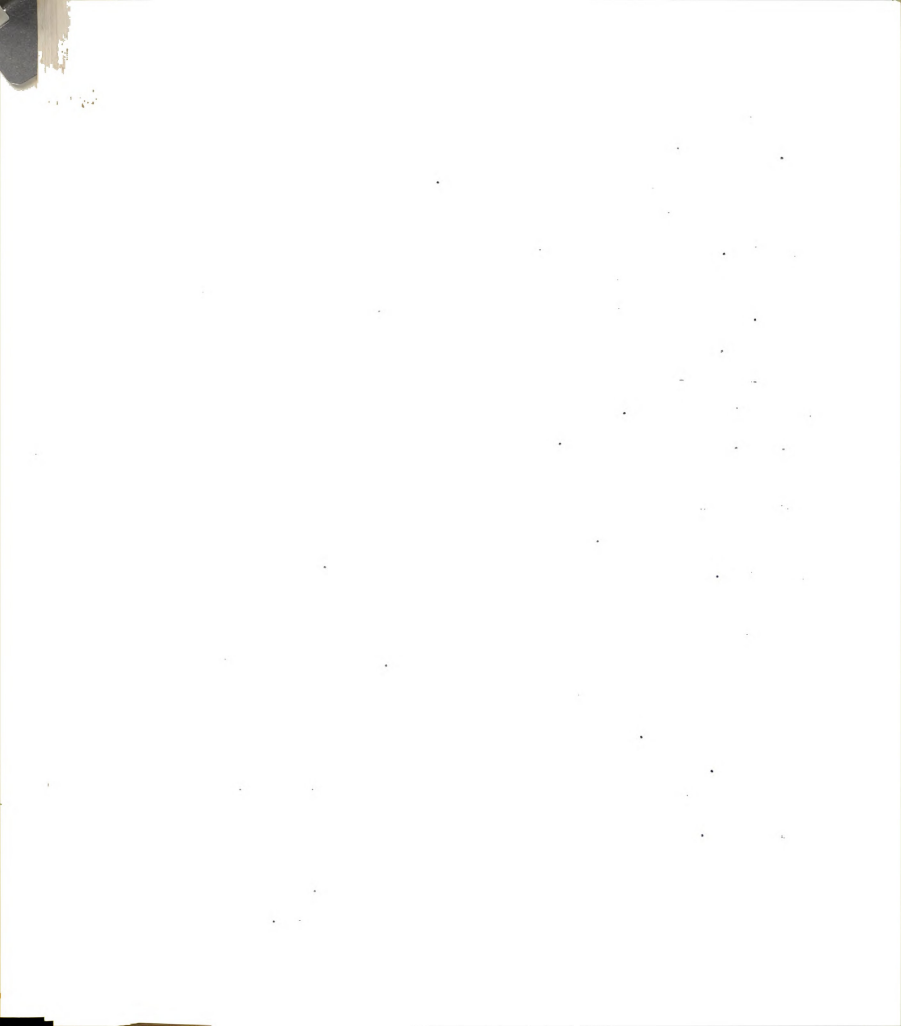
the tart cherries. Orchards are considered nonbearing for four years after planting. The bulk of the labor is attributed to the plant bed preparation and the planting itself. The anticipated lower labor inputs for nonbearing orchards in the target period will lie between 31 and 37 percent of the 1959 level. Most of the reductions are expected for the spring and summer months when other work is pressing, thus contributing to the diminuation of undesirable peaks.

Preharvest activities are expected to use between 12-27 percent less time in 1970-75 than they took in 1959. The reductions result from faster pruning with power equipment and less need for cultivation due to effective chemical weed control. Since the cultivating jobs are done mostly during the busy summer season, a lessening of the work load is foreseen. The mechanical harvest of the Blue Damson variety has been successful for some years. Horticulturalists and agricultural engineers believe that other varieties of plums can be harvested with equipment previously developed for the cherry harvest. Reductions of cost and labor will be more pronounced if the equipment is employed in both enterprises.⁴⁰ Doubts about the quality of the mechanically harvested plums seem unjustified. Hence, it is concluded that in the target period at least four fifths, and under more pressing circumstances, nine tenths of the plums will be shaker harvested. Machine harvest and pallet box handling will reduce the time for harvesting by one third to one half approximately for 1970-75 as compared to 1959. Direct and indirect labor inputs are predicted to be 24-38 percent lower in the target period than in 1959.

⁴⁰Gaston, H.P., et. al., "Mechanizing the Harvest of Plums," Quarterly Bulletin, Mich. Agr. Expt. Sta., 42:4; May 1960, pp. 779-83.

The peak labor demands of a vineyard occur primarily during the harvest in September and October and also during the early spring activities. A vineyard's life is in excess of 50 years which explains the great care taken in establishing a new vineyard. The requirements of 71 hours per acre in 1959 are nearly double those for the other fruit enterprises. Trellis construction, time consuming pruning and tying in addition to involved plant bed preparations account for most of the difference. Shortened and improved plant bed preparation, mechanization of planting, and simplified pruning effectuate the sizeable reduction by 1970-75 of 28-40 percent of the 1959 level in labor requirements for establishing a vineyard. The largest savings of labor are forecast for May, July, October and November.

Chemical weed control and power pruners help to explain the large savings of 36-48 percent during the preharvest season for the target period as compared to 1959. But the largest changes are predicted for the harvest. Two major developments are discussed and tried. (1) The use of chemicals for defoliation and partial abscission of the individual berries may be risky due to probable side effects on vine and grape although the labor savings could amount to one fifth. There are also experiments to defoliate the vine and allow shakers with catching frames to do the harvesting. This requires a special type of offset trellis arrangement. (2) California and New York are attempting to do the juicing right in the field with a machine that harvests and presses simultaneously. Preconditions for this development are; a variety that bears the grapes on long stems for easier removal by the machine cutting bar and a refrigerating unit to keep the juice from spoiling. Researchers from California expect the machine to be perfected by 1968-69.



Prototypes of this equipment are presently being tested on both coasts. One third to two fifths of the labor used in harvesting operations during the 1959 season are predicted to be saved by 1970 through the realization of those developments. For direct and indirect labor combined, a reduction of labor use of 30-47 percent of the 1959 level is anticipated.

Livestock

Livestock enterprises will be handled under the headings of cattle, sheep, hogs, and poultry. Further disaggregation of the four livestock branches is feasible in view of their different per unit labor demands. For all enterprises except hogs, the headcount is the basic unit of reference with respect to labor requirements. For hogs, the number of litters seems the appropriate unit for the purposes at hand. The 1959 level of labor use and its monthly distribution was derived from the literature indicated in the footnote below and later footnotes in this section.⁴¹ Consultations with experts in the field helped to check the future "high" and "low" estimates of the labor requirements for 1970-75 based on moderate and rapid technological advance which are indicated in Table 3.5 on the following pages.

General Expected Changes in Livestock Activities and Practices

In the last 25 years, technological advance in livestock production has not quite kept pace with that in the other major farm enterprises of Lake States agriculture. The 1962 regional index numbers of

⁴¹Hecht, R.W., Labor Used to Produce Livestock, 1959, USDA, ERS, Stat. Bull. 336, and the sources quoted under footnotes 5 to 6, page 63.

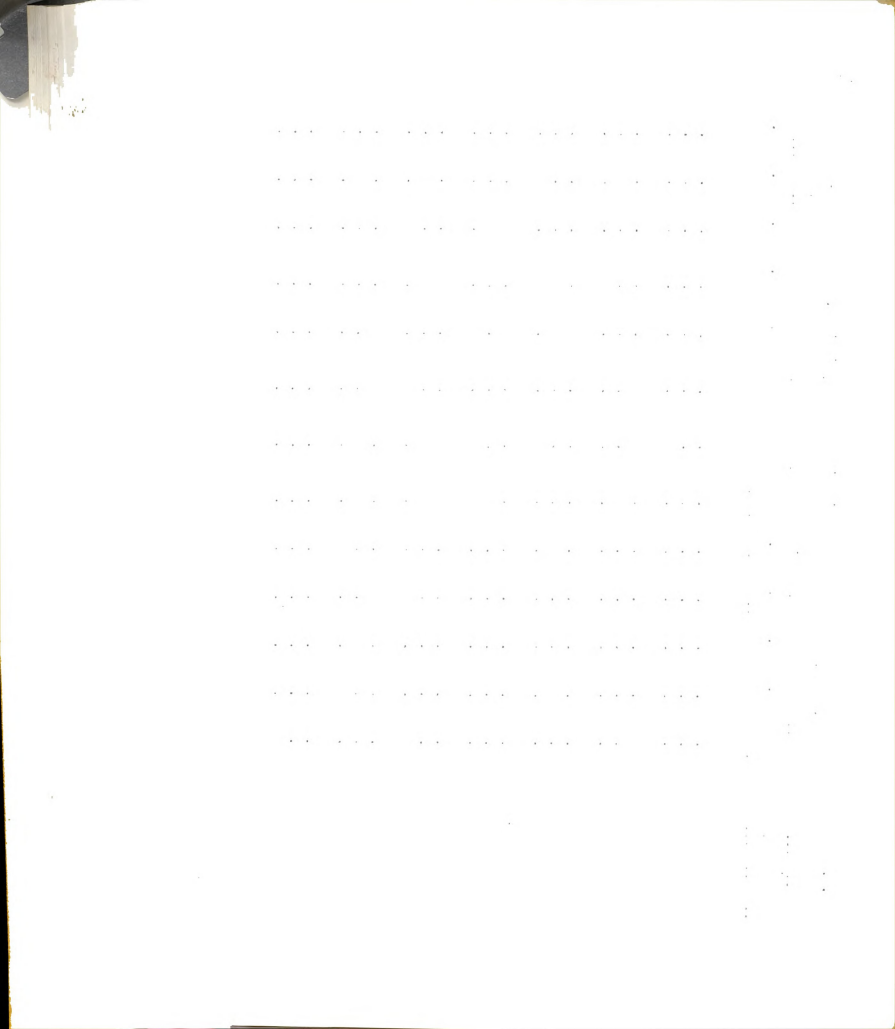


Table 3.5. Direct labor used per unit^a month and year in livestock for Michigan, 1959 and 1970-75 under alternate assumptions with respect to technological advance¹ (continued)

Enterprise and Nature of Estimate	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						hours							
Broilers		60.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
(per 100)		36.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
		30.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Turkeys		50.0	1.0	2.0	5.0	7.0	6.0	6.0	5.0	4.0	3.0	2.0	2.0
(per 100)		40.0	2.0	3.0	3.5	5.0	4.0	4.0	3.5	3.0	3.0	2.0	2.0
		35.0	2.0	3.0	3.0	4.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0

^aThe unit referred to is the head count unless stated otherwise.

¹'59 refers to 1959 estimates. '70-5L refers to 1970-75 projections, assuming moderate technological advance. '70-5h refers to 1970-75 projections, assuming rapid technological advance.

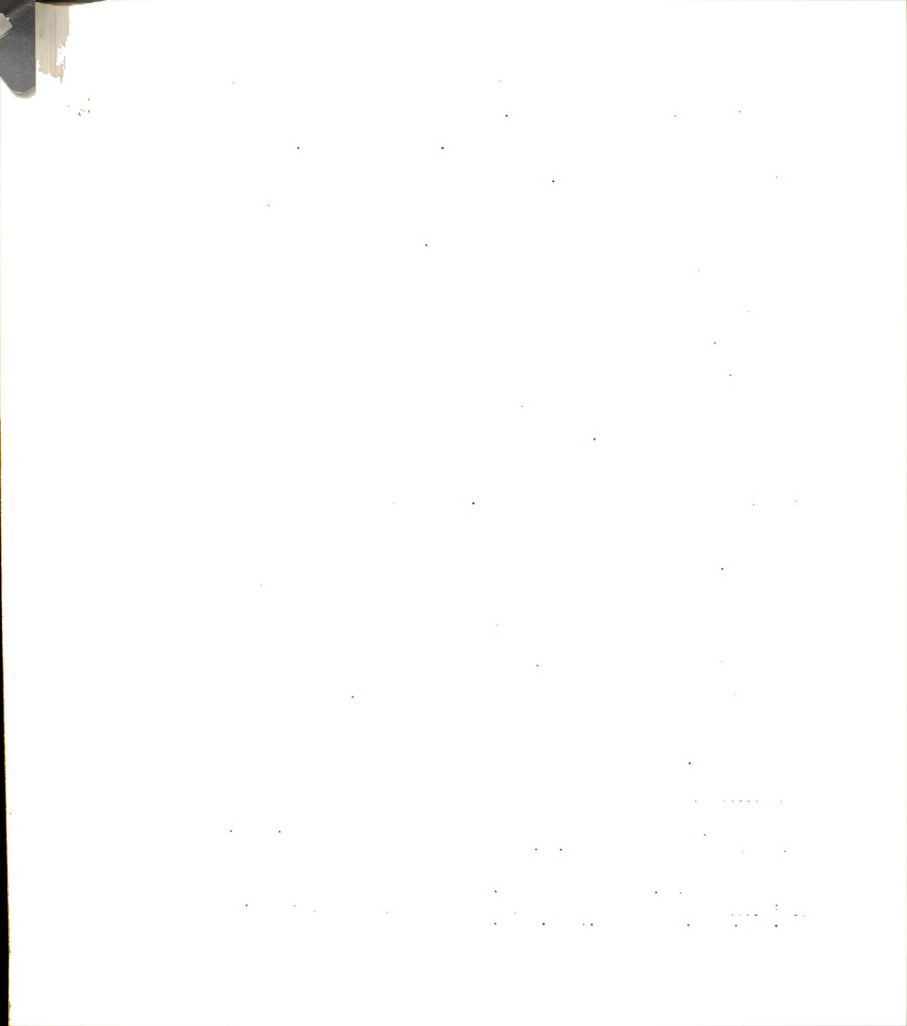


farm production per man-hour (base 1957-9) stood at 111 for meat animals, 128 for milk cows, and 150 for poultry. During the 25 years the combined index for all livestock products rose to 78 vs. 85 for all crops.⁴² This seems to indicate that farmers encountered in the forties and fifties some difficulties in enhancing the labor efficiency for most of the livestock enterprises relative to other farm sectors. Data from a 1958 survey in lower Michigan confirms the hesitancy of farmers to accept modern technologies readily; only 54 percent had erected pole type constructions in that year, 13 percent practiced loose dairy housing, 29 percent bulk milk tanks, 3 percent pipeline milking systems, 24 percent mechanized unloading facilities from grain bins, and 49 percent loading facilities from a vehicle into storage.⁴³ Since the sample is drawn from an above average farming region in Michigan, room for improved techniques is larger than indicated by the figures above. However, in recent years farmers have successfully pushed technological advance in the livestock enterprises.

The system of keeping livestock determines the labor requirements and is closely related to either the existing facilities or the facilities the farmer is able to acquire. Cheap pole type and more expensive longer lived barns with automatic feed mixing and feeding, ventilation, and simplified cleaning operations are designed to cut costs and save expensive labor. Headway in the construction of well designed livestock

⁴²USDA, ERS, Changes in Farm Production and Efficiency, Sta. Bull. 233, Supplement IV, May 1963, p. 4.

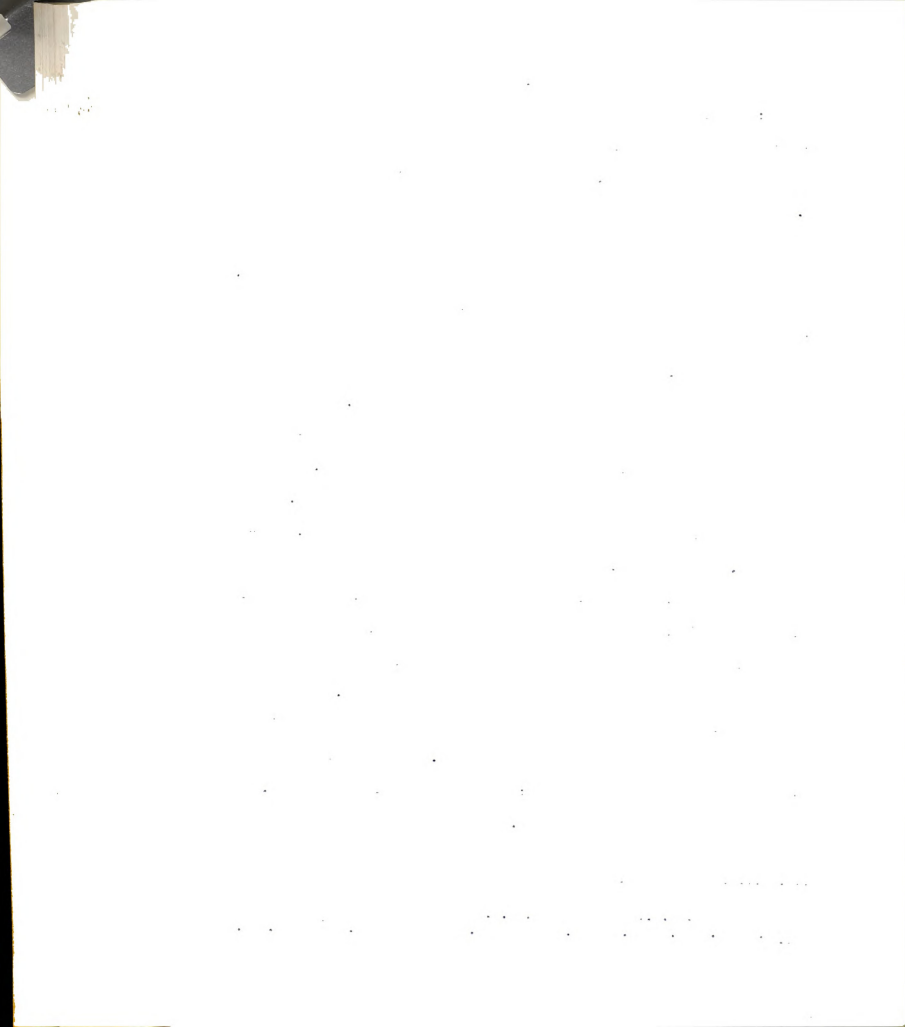
⁴³Nielson, J., and Crosswhite, W., The Michigan Township Experiment: Changes in Agricultural Production Efficiency and Earnings, Tech. Bull. 274, Mich. State Univ., Oct. 1959.



barns has been very slow in the past, probably for the following reasons: (1) lack of credit and inability of the farmer to finance such undertakings himself, (2) the general reorganization of enterprises within regions and farms, and (3) the specialization connected with it. The last two influences have been progressing in such a way that farmers preferred to await definite indications as to what kind and size of enterprise they should have before building barns for their livestock.

With the specialization of production, adjustments of enterprise sizes according to scale economies, and the lack of suitable help to care for livestock, farmers were forced to simplify and speed up the activities connected with raising and caring for livestock. There is a spectrum of feeding arrangements from the simple home built self-feeder to be filled once a week, to the fully automatic auger systems. The handling of feed has been investigated in time and motion studies. Transport distances have been shortened and the means simplified. Premixed feed, bulk delivery, tower silos with automatic loading and unloading facilities, conveyors, hay pelleting and wafering, storage bins, automatic weighing, milling and mixing devices on farms, and tractor drawn carts pulled directly to the feed bunk will all contribute considerably to the lightening of the burden of livestock care.⁴⁴ In other arrangements, the cattle get their own feed from horizontal silos with hardly any labor being used to feed the animals. Similarly, there are a variety of manure handling systems: fully automatic, small cranes, or tractor with pusher and manure loader.

⁴⁴ Maddex, R.L., and Comstock, J.M., An Auger System for Feeding Cattle, Coop. Ext. Serv., Mich. State Univ., FBC-746, Dec. 1962, pp. 7f.



Discussion of Significant Changes in Labor Requirements of Individual Livestock Enterprises

Cattle

The cattle enterprise is subdivided into: dairy cows, beef cows, heifers, and steers including bulls and calves.

Automated feeding equipment is important for the large and specialized livestock farms as they are appearing all over the state, especially under the assumed conditions of competition, labor costs, and scarcity of suitable help. In spite of the losses through waste, self feeding silos may be the most economical form if over 2,000 pounds per day are fed since they require little labor and equipment costs. Hand feeding with fork and cart seems to be profitable if only 500-800 pounds per day are hauled. For larger quantities, power equipment appears to be feasible.⁴⁵ The location of silos relative to feed bunks and the path in between is of great importance to the labor costs. Grains and supplements can be handled completely automatically with blender grinder units, metering systems, and conveyors,⁴⁶ if the scale of operation justifies it.

Since many of the dairy herds are on pasture during the summer season, the average labor requirements for all herds at this time are one third to one half of the labor needs during the barn feeding period.

Labor efficiency can be very much improved by an appropriate layout of the facilities. A centrally located milkhhouse that allows a circular traffic pattern, easy supervision of the animals, and cuts the

⁴⁵Lard, op. cit., p. 138. Shaudys, E.T., and Sitterly, J.H., Labor and Equipment for Feeding Silage, Ohio Agr. Expt. Sta., Res. Bull. 820, Nov. 1958.

⁴⁶Puckett, H.B., Automatic Feeding Equipment, USDA, Farmers Bull. No. 2198, March 1964.

distances between jobs reduces man-hour demand. There are many reports that emphasize the economies of scale in labor requirements per cow. The economies may reach one third by enlarging the herd from 20 to 35-45 cows for stanchion barns and up to one half for milking parlor operations.⁴⁷ These reports also stress the difference of over 50 percent in labor use per cow between (1) high levels of management involving high mechanization combined with efficient work methods, and (2) low mechanization combined with poor work methods. In Michigan, the optimum size dairy herd for 100-250 acre farms seems to lie between 30 and 50 cows. If capital for investments can be obtained, larger farms may profitably carry 120 cows. However, not many farms meet these conditions and farmers do not take the risk of investments of that magnitude in the face of increasing costs and very stable, if not declining milk prices. Hoglund predicts that by 1970 "the number of dairy herds of less than 10 cows will be reduced by 70 and herds of 10 to 19 cows by 80 percent." He expects a small increase in herds with 30-49 cows, though they will supply 58 percent of the milk and a tripling of herds with more than 50 cows.⁴⁸ Another important scale effect is the savings of milking time if the cows are high production animals. For stanchion barns only 25

⁴⁷Suter, R.C., op. cit., p. 34. Farm Management Manual, op. cit., p. 6. Fuller, E.F., and Jensen, H.R., Herd Size Effects on Labor for Loose Housing Chore Tasks, Univ. of Minn., Agr. Expt. Sta. Bull. 462, Wheeler, R.G., Will It Pay to Milk More than 20 or 30 Cows?, Mimeo 744, Dept. Agr. Econ., Mich. State Univ., Dec. 1958. Day, L.M., Aune, H.I., Pond, G.A., Effect of Herd Size on Dairy Chore Labor, Univ. of Minn., Agr. Expt. Sta., Bull. 449, June 1959. McKee, D., The Competitive Position of the Dairy Enterprise in Farming, Thumb Area of Michigan, Dept. Agr. Econ., Mich. State Univ., Mimeo 961, Feb. 1962.

⁴⁸Hoglund, C.R., Michigan Dairy Farming, Mich. State Univ., Spec. Bull. 440, 1962, p. 29.

percent more labor was required by double the milk production per cow, while for milking parlors the additional time amounted to less than 9 percent.⁴⁹ There is agreement among experts that many of the stanchion barns are outdated and sometimes difficult to remodel; therefore loose housing barns will increase in number especially in the group of farms with more than 40 cows. About one half of all dairy farmers in a survey indicated that they plan to change to the switch system of milking, thus making it possible to milk double the original capacity and house the cows in loose housing. Those questioned expect to expand their herd size by 10 cows on the average.⁵⁰ Hoglund also predicts that 35 percent of the dairy cows will be handled in loose housing and milking parlor systems.⁵¹ If herd size is expanded, labor savings are much bigger. One man could milk about 12-16 cows per hour in a stanchion barn with three milker units. Today, one milker in a herringbone parlor with six units can easily handle 50 cows per hour.⁵² Since only one third of the dairy farmers in southern Michigan had a bulk tank in 1959,⁵³

⁴⁹Hawkins, H.D., and Suter, R.C., Dairy Cattle Rates of Resource Use for Budgeting Enterprise Costs and Returns, Purdue Univ. Agr. Expt. Sta., Res. Bull. 735, Feb. 1962, p. 6.

⁵⁰Hoglund, Michigan Dairy Farming, op. cit., pp. 30 f.

⁵¹Hawkins and Suter, Res. Bull. 735, op. cit., p. 5.

⁵²Hawkins, H.D., and Suter, R.C., Dairy Cattle, Budgeted Costs and Returns for Various Systems of Management, Purdue Univ., Agr. Expt. Sta. Res. Bull. 743, July 1962, p. 5. Hoglund, C.R., Boyd, J.S., Snyder, W.W., "Herringbone and Other Milking Systems," Quarterly Bulletin, Mich. Agr. Expt. Sta. 41-3, Feb. 1959.

⁵³Hoglund, Michigan Dairy Farming, op. cit., p. 16.

the full adoption of bulk milk handling, particularly in connection with milking parlors and pipe lines, will help to cut the labor demands for this enterprise. The rapid decline of the number of dairy herds causes the 1959 proportion of bulk tank users to grow even though no additional farmers adopt bulk tanks. Further, a double five herringbone milking parlor is not the only solution for saving labor. Old stanchion barns are easily converted into a mechanized stanchion, switch milking and parlor systems with relatively smaller investments to give comparatively high returns in the form of saved labor.⁵⁴ It goes without saying that the mechanization of feeding of dairy cows will be not only further developed but imperative to the larger herd.

Seventy-five percent of the dairy farmers with less than 40 cows practice some system of grazing. Green chopping prevails in the herd size from 40-50 cows while operations with more than 50 cows tend to use storage feeding. Rotational grazing and, to a larger extent, green chop-pasture systems, require additional manpower as compared with the traditional free grazing system. Due to the lack of additional manpower, it is doubted that many farmers will switch to green chopping unless they drastically expand their herd size. But even if green chop is fed, there exists large differences depending on whether the wagon is unloaded by hand, by power, or self feeding is practiced. Many farmers in southern Michigan⁵⁵ not yet practising storage feeding anticipate doing so. The labor use in distributing feed on the drylot (silage and concentrate) by wagon, self-unloading wagon and mechanical feeder are respectively one third, one sixth, and one twentieth for 40 cows as compared to conventional basket feeding. Again, the advantages of higher mechanization

⁵⁴Fuller, E.I., and Jensen, H.R., Alternative Dairy Chore Systems in Loose Housing, Univ. of Minn., Agr. Expt. Sta., Bull. 457, Feb. 1962.

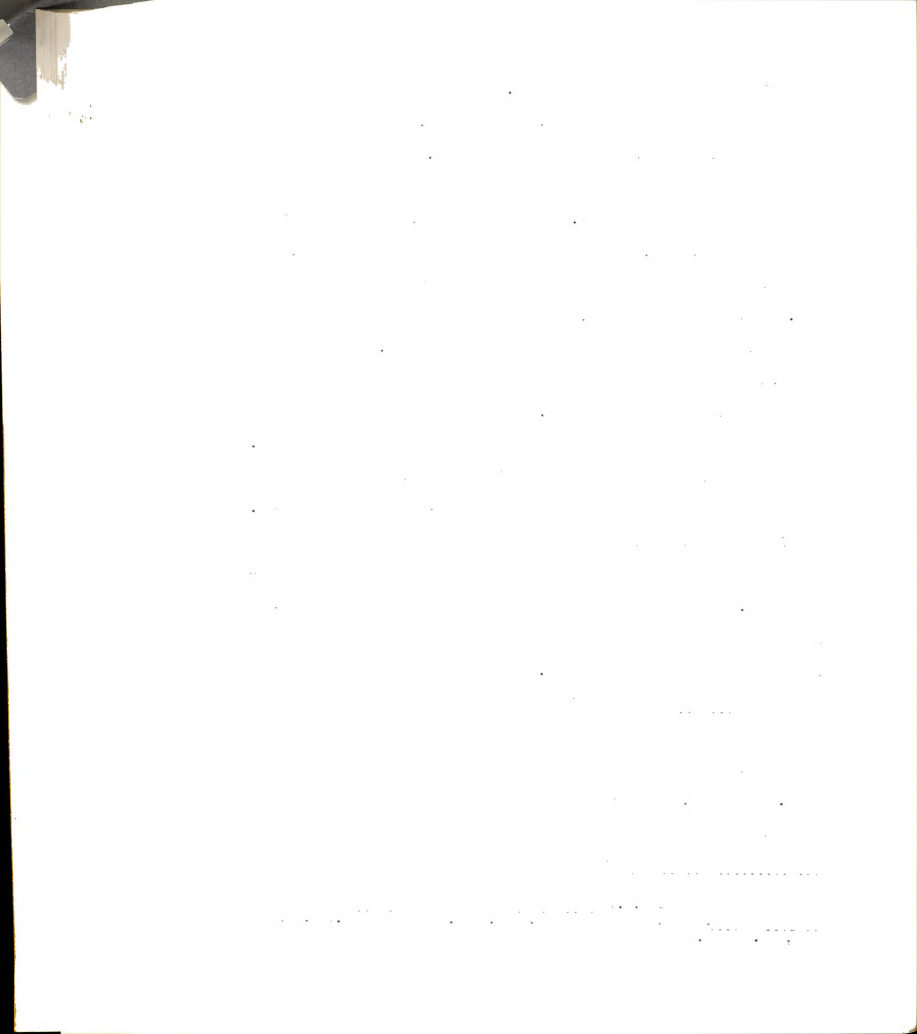
⁵⁵Hoglund, Michigan Dairy Farming, op. cit., p. 32.

in feeding are greater for larger herds.⁵⁶ There is some feeling that dairy farmers with larger herds may, in the future, revert to either a longer or complete barn, or drylot feeding period. This would imply that the labor requirements for this enterprise would be larger and fairly homogenous over the year. On the other hand, improved handling systems for feed, milk, and manure will tend to reduce labor needs, especially if combined with improvements in the layout of the barns and pens. Manure handling for loose housing systems is simply and economically done with the manure scraper and fork of the tractor. Lagoons and semiautomatic or other automatic gutter cleaner systems for disposing of waste materials are labor saving. Therefore it will pay farmers with large herds who do not change to the loose housing system to adopt them.

Taking all the described changes into account, the 1959 labor requirements for dairy cows are expected to fall 23-37 percent by 1970-75. The difference between the summer and winter seasons will be one third at most since more herds are anticipated to be held in a year round drylot system. With the high overhead requirements of 26 hours per cow, the labor inputs for dairy cows are foreseen to fall 18-30 percent of the 1959 level by the target period.

The beef cow enterprise is expected to increase considerably during this decade and much of the expansion will depend on the labor savings that are possible per animal and upon those that result from greater herds. Presently, since most of the beef herds in Michigan are on summer pasture, the labor spent during the months of June to September on beef

⁵⁴Van Arsdall, R.N., Economic Aspects of Mechanization of Feeding on Dairy Farms, USDA, ARS, Farm Econ. Res. Div., Urbana, Ill., A. E. 3457, pp. 12 ff.



cows is half an hour per month. Requirements during the winter months when most of the calving takes place are over five times as high.

While most of the herds of less than 25 cows are unprofitable, herd sizes of 50-75 cows seem to utilize the existing resources on an average Michigan farm most efficiently. Even larger herds economize in the use of labor, saving 50 percent per cow.⁵⁷ This can be explained by several factors: automatic feeding equipment, drylot feeding, and extended pasture. With larger breeding herds the breeding season is controlled and shortened to produce rather homogenous batches of young stock thus cutting the time spent in observing cows during calving.⁵⁸ With the increase in size of beef cow herds, average labor requirements are expected to fall 33-45 percent during the 1960's with most of the reductions coming during the winter when mechanized feeding reduces the need for labor. Inclusive of overhead tasks, the labor inputs of the beef cow enterprise will fall by 1970-75, 21-28 percent from the 1959 level.

Heifers and calves require much attention during the calving and breeding period; this commonly concentrates labor use during the winter months. In Michigan, only one sixth of the time required in the winter is necessary during the summer when most of the animals are on pasture.

For these enterprises scale economies and simplified feeding, bedding, and manure handling will bring labor savings by 1970-75 that may lie between 25-36 percent of the 1959 standard. Including overhead

⁵⁷ Janssen, M.R., Beef Cow Herd Costs and Returns, Purdue Univ. Agr. Expt. Sta., Res. Bull. 725, Aug. 1961. Shaudys, E.T., and Sitterly, J.H., Costs and Returns of the Beef Breeding Enterprise in Western Ohio, Ohio Agr. Expt. Sta., Res. Circ. 73, Aug. 1959.

⁵⁸ Armstrong, D.L., and Shaudys, E.T., Profitability of Practices Affecting the Calf Crop of Beef Herds, Ohio Agr. Expt. Sta., Res. Circ. 103, May 1961.

11. 6. 1911

Dear Sir,
I have the honor to acknowledge the receipt of your letter of the 11th inst. in relation to the matter of the
and in reply to inform you that the same has been forwarded to the proper authorities for their consideration.
I am, Sir, very respectfully,
Yours obedient servant,
[Signature]

Very truly yours,
[Signature]
[Name]
[Title]

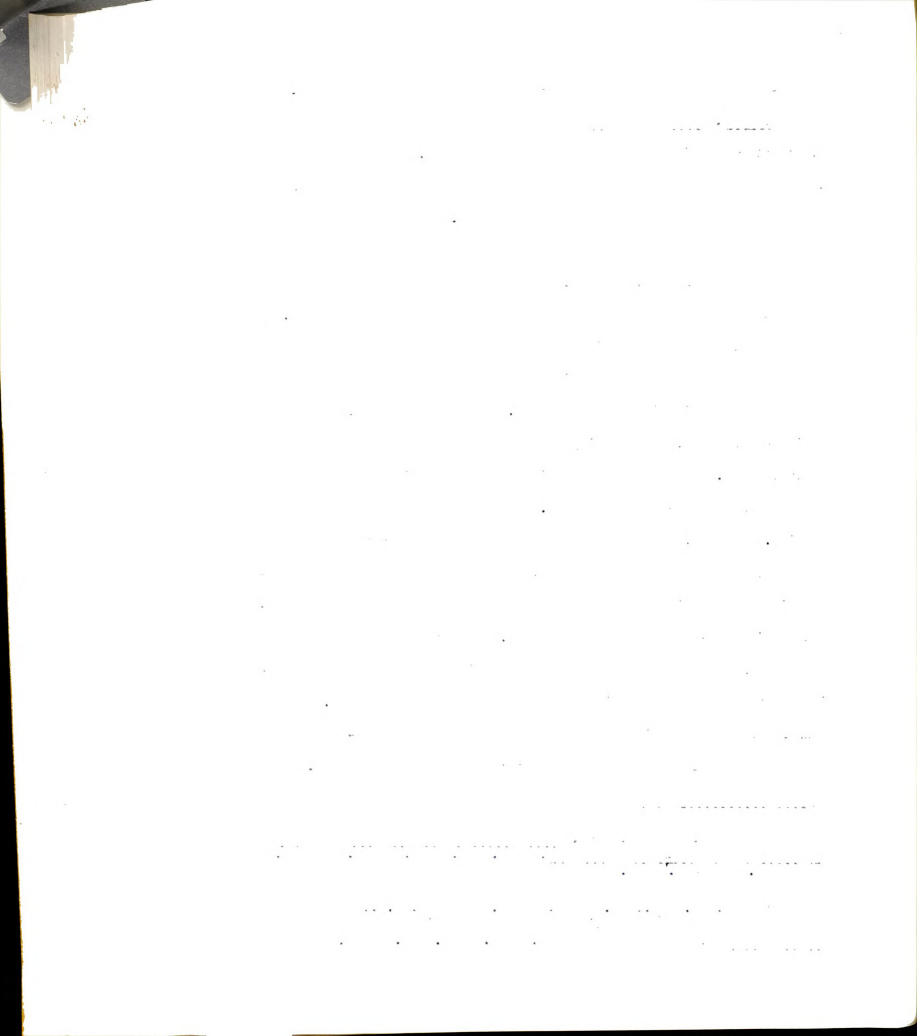
labor the savings will amount to 16-23 percent for the same period.

Steers, bulls and calves for meat production were grouped into the steer enterprise in order to simplify computations. The number of each component served as a weight for its respective labor use to arrive at the labor requirement for the steer enterprise. Labor needs are nominal from July to September since most of the feeder cattle from the previous fall have been marketed; however, they are over 20 times as large during the rest of the year when feeding takes place in the drylot or barn.

There has been a continued trend towards larger beef feeding operations since prices and profits have been good and significant economies to scale exist in costs and labor. For smaller herds, fed predominately by hand, labor savings result from increasing the herd size up to 80 head. This is mainly attributed to the division of the labor time by a greater number of animals.⁵⁹ Larger herds require mechanical feeding. Already, two thirds of the Michigan beef comes from producers who supply more than 200 head annually while one sixth comes from farmers with a production of less than 100 head and another sixth from producers with 100-200 head supply per year.⁶⁰ It is concluded that by 1970 approximately four fifths of the beef will be produced by specialized operators with production in excess of 200 head per annum. This will reduce labor requirements further as requirements per animal are about half as much for a herd of 250 as they are for herds of 50.

⁵⁹Johnson, Nodland, Pond, Labor Requirements for Feeding Cattle as Affected by Number of Cattle Fed, Dept. Agr. Econ., Univ. of Minn., Report No. 241, Oct. 1958.

⁶⁰Lard, op. cit., pp. 130 f, 135ff. Hoglund, C.R., "Investments and Annual Costs for Alternative Beef Cattle Feeding Systems," Research Report 7, Michigan State Univ., Agr. Expt. Sta., 1964.



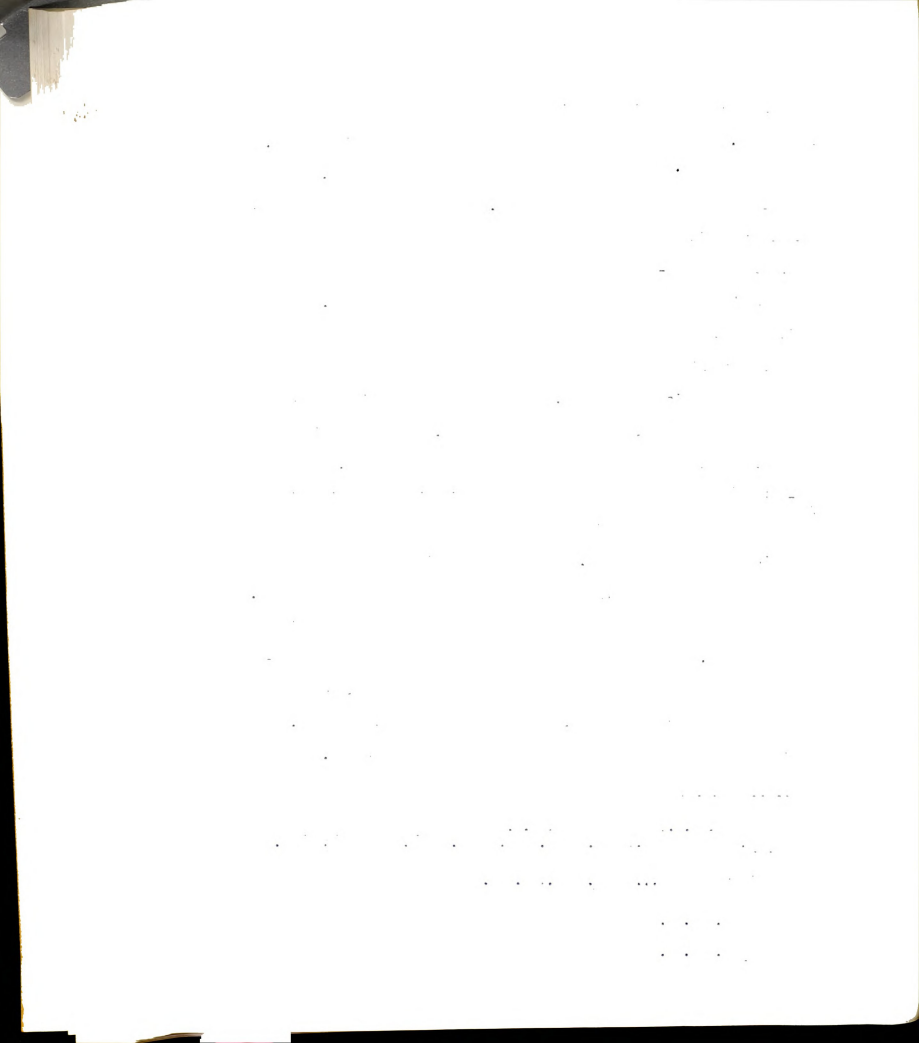
Different feeding and management methods will introduce a considerable amount of variability into the labor demands as an Indiana study shows. Milk fed baby beef sold after six months require only 2.5 hours of labor while long fed steers on roughage sold after 16.5 months needed the most labor (12 hours) recorded.⁶¹ Hoglund reports from a recent study of Michigan beef farmers that a noticeable "change to feeding of more corn as high-moisture grain and greater dependence on the corn silage crop" went along with the increase in size of operation.⁶² This has its repercussions on the labor requirements since the handling of those feed materials is profitably mechanized for larger herd sizes and for larger quantities fed per day. Reductions of labor time of 20-35 percent can be achieved, according to this study, by just changing from feeding the cattle on bunks in the lot to fence line feeding. It is self-evident that the highest degree of mechanization in feeding with augers can reduce the labor inputs by one third to one half as compared to feeding at bunks in the lot.⁶³ Drastic reductions of the labor needed per animal are evident when expanding from 100 to 250 head herds. Further enlargements of the herd size decrease labor inputs per animal only moderately. The representative sample of beef farmers also indicated that only about one third were using fully mechanized, one third semiautomatic feeding procedures, while the rest still fed by hand. The latter group was concentrated in the range of small herd sizes.⁶⁴

⁶¹Suter, R.C., and Washburn, S.H., Feeder Cattle Systems of Management, Purdue Univ., Agr. Expt. Sta., Res. Bull. 744, Aug. 1962.

⁶²"Investments...", op. cit., p. 61.

⁶³Ibid., p. 3.

⁶⁴Ibid., p. 2.



There is obviously plenty of room for improving the feeding techniques by 1970-75 thus helping to reduce the labor demands in beef production by 30-46 percent from 1959. If overhead labor of 5-6 hours is also considered in that comparison, 23-35 percent less labor input will be necessary per head of beef cattle. Another big advantage of the beef feeding enterprise that should be emphasized is the adaptability of different feeding programs to the labor available in different months.⁶⁵

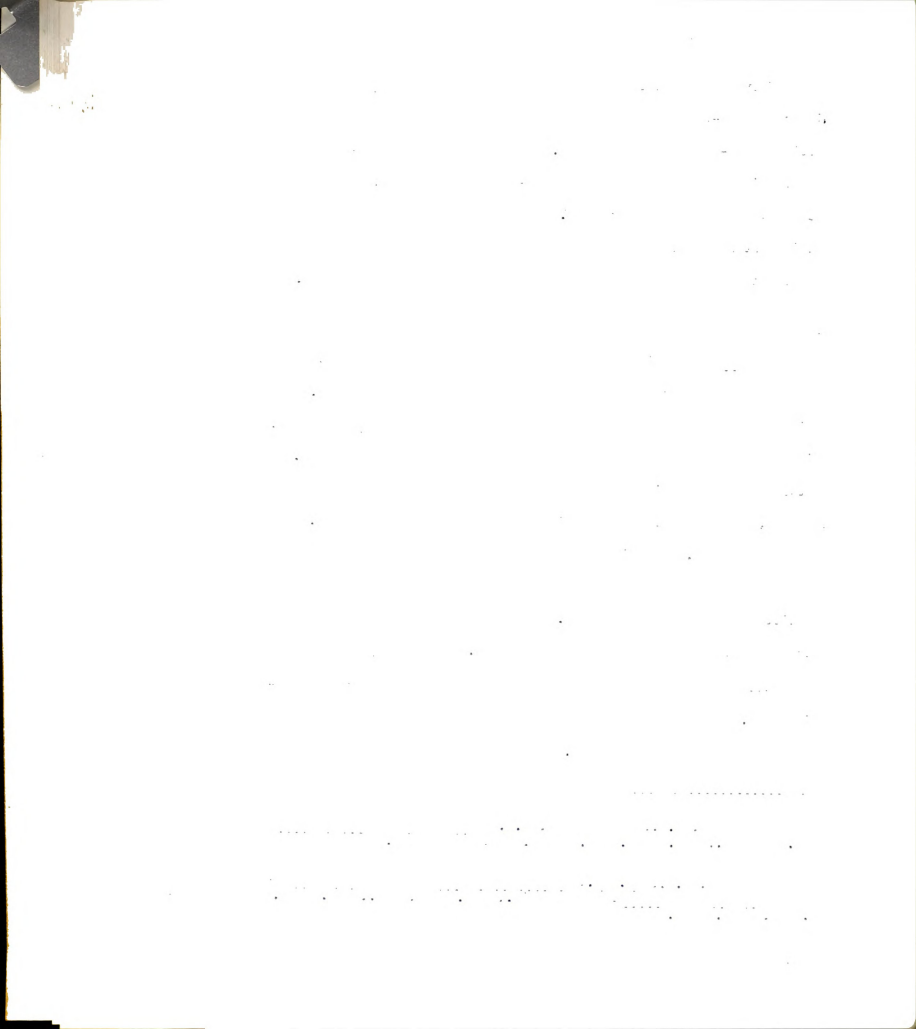
Hogs and Sheep

The hog enterprise seems to be best and most simply represented by the numbers of litters farrowed during the course of the year. Since spring and fall farrowings are almost equally distributed in Michigan, this does not cause any complication in establishing the labor use. Due to the dominant two litter system the labor needs are high from December to April, peak in March and are high during August and September.

Here again, economies to scale are so large that an increase of the number of sows from 8 to 24 cut the labor requirements for raising per litter farrowed by 50 percent. Further expansion of the operation does not contribute as much to labor savings.⁶⁶ The system of farrowing is expected to change and thereby generate different monthly labor requirements. The two litter system will have the respective farrowing dates one month earlier than now. The four litter system will become

⁶⁵ Johnson, R.G., and Nodland, T.R., Labor Used in Cattle Feeding, Univ. of Minn., Agr. Expt. Sta., Bull. 451, March 1960.

⁶⁶ Bauman, R.A., et. al., Economics of Size and Economic Efficiency in the Hog Enterprise, Purdue Univ., Agr. Expt. Sta., Res. Bull. No. 699, Sept. 1961.



more widely used by 1970. With four farrowing dates occurring in January, March, July, and September the peaks in labor requirements are dampened since only half of the sows farrow at a time.

About one fifth of the labor is spent on breeding and the maintenance of the herd, another one fifth on feed processing, one third on sows and pigs to weaning, and the rest for fattening and marketing.⁶⁷ Improvements in the buildings, the huts, or their layout, and the traffic pattern of the animals between the shelters can yield high labor savings.⁶⁸ Disease control is another important factor in reducing labor requirements.

Feeding equipment and feed processing can both be highly mechanized or the latter can be done in commercial mills. Usually larger operations grind their corn themselves and mix it with concentrates which they have delivered in bulk. Storage bins, elevators, and augers all help to automate the chores. Mechanized manure systems eliminate hand labor for these tasks.

It is therefore anticipated that 25-38 percent of the labor inputs of 1959 can be eliminated by 1970-75. Accounting also for overhead labor, a reduction of 25-29 percent is expected between the same periods.

The sheep enterprise is taken as a unit considering the replacement necessary for the maintenance of the flock. Only a very small percentage of the costs of a flock of sheep come from labor. Most of the

⁶⁷Bailey, R.A., and Sitterly, J.H., Man Labor on the Commercial Hog Enterprise, Ohio Agr. Expt. Sta., Res. Bull. 792, Sept. 1957.

⁶⁸Beer, C., Some Economic Factors to be Considered in Swine Production. Unpublished M.S. Thesis, Mich. State Coll., 1955, pp. 63-72.
Reeser, R.M., and Baker, R.H., Feeding Lambs, Ohio Agr. Expt. Sta., Res. Bull. 884, June 1961.

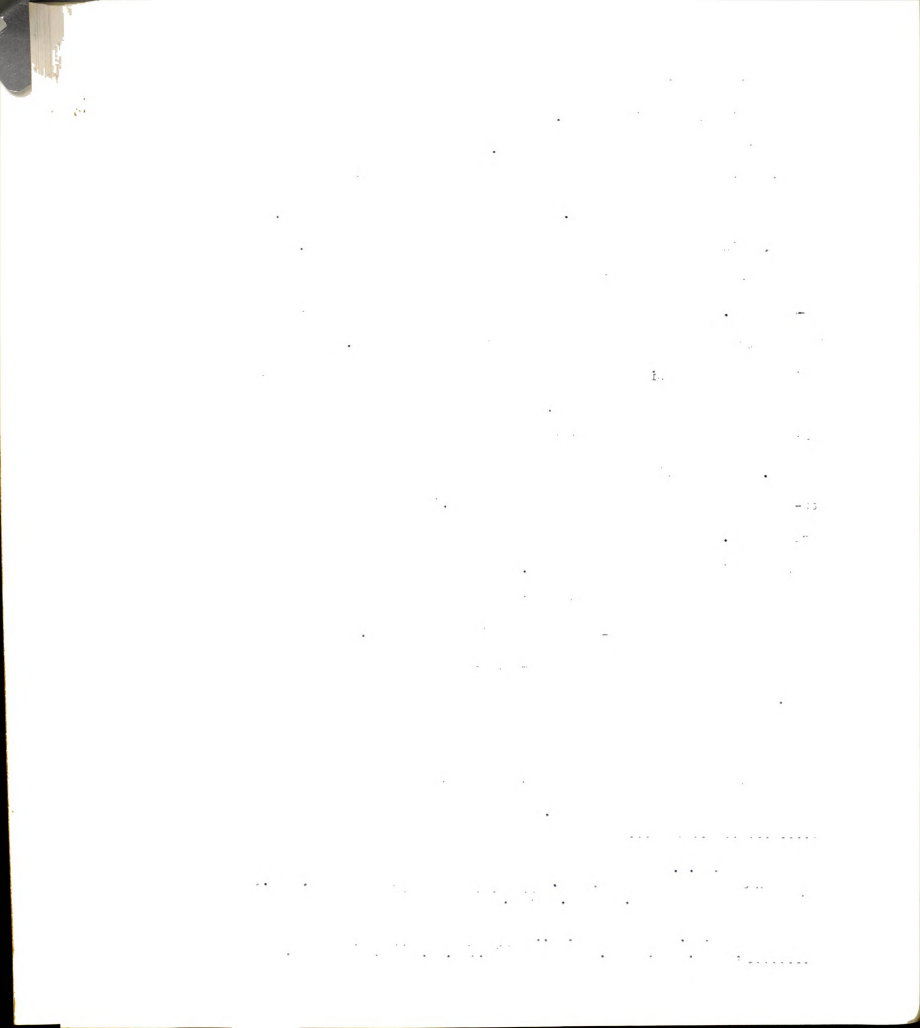
labor requirements in the sheep enterprise occur during the winter feeding and during the lambing season. Lambing can be arranged so that the lamb feeding occurs during a slack season. Sheep are very adaptable to many situations and can make use of certain feed and facilities that have zero opportunity costs otherwise. They also require low investments.⁶⁹ However, prices for wool and mutton have not been too high either. The sheep enterprise seems to fit in with and encourages a large amount of off-farm work. There may be some tendency for late lambing (April-May) in the future in order to produce lambs for the fall market. Big labor savings result from a high percentage of multiple births which may be enhanced by the practice of flushing. Pellet feeding is another way of saving labor besides the possibility of going into mechanized drylot feeding. Prophylactic worm control helps reduce labor needs since fewer man-hours are necessary for the more time consuming treatment of the infested sheep. A controlled breeding season can also contribute to a shorter lambing season and save labor.⁷⁰ There will be some concentration of stock sheep on fewer farms which may cause the direct labor requirements to decline by 12-23 percent during this decade. Total labor inputs are expected to reduce by 1970-75, 7-14 percent from the 1959 level.

Poultry

Poultry is comprised by layers, broilers, and turkeys which are considered as separate enterprises. Spectacular gains in the labor

⁶⁹Pope, A.L., "Practices that Effect Economics in Feeding and Management of Ewes and Lambs," 16 Ohio Sheep Day 1963, Ohio Expt. Sta., Animal Science Series No. 130, p. 25-29.

⁷⁰Earle, W., and Rogalla, J., Costs and Returns from the Sheep Enterprise, Dept. Agr. Econ., Cornell Univ., A. E. 1066, July 1957.



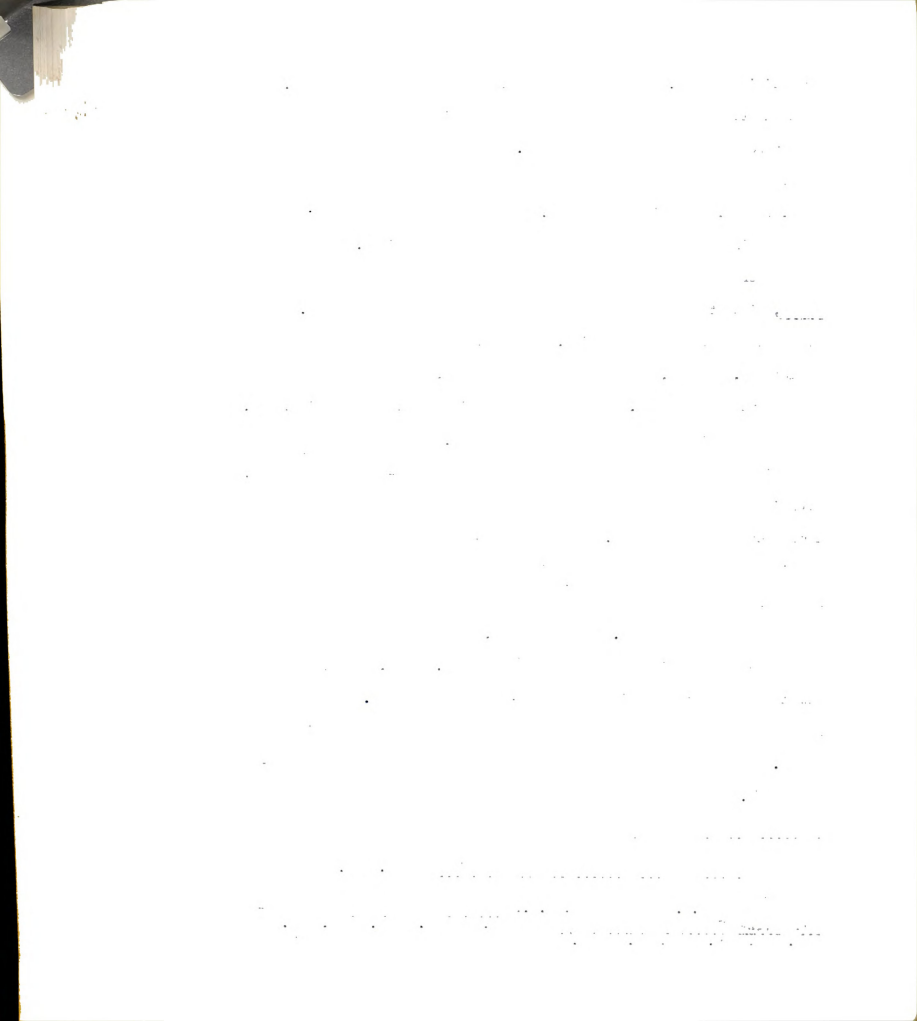
productivity have been made in recent decades in poultry production.⁷¹ The trend towards specialization and concentration has not bypassed this branch of the agricultural sector. There are instances in which farmers have discontinued all other enterprises to build a specialized layer, turkey, or broiler operation. Very often a promoter of some kind stands behind locally concentrated large scale enterprises.

There are no major fluctuations in the labor requirements of the layers, since they are predominately kept indoors the year around. About half of the labor goes to feeding, watering, and egg gathering, one third to cleaning, packing, and sometimes grading eggs, and the rest to occasional work such as cleaning, preparing and handling feed, disinfecting, etc.⁷²

The housing for hens varies considerably, from remodeled barns to prefabricated buildings with the latest automatic self-feeding equipment. Labor inputs can vary as much as 90 percent under different types of arrangements and management. Labor savings are possible by enlarging the size of the operation and substituting some capital for labor so that a flock of over 1150 hens uses less than two thirds of the labor that a 400 hen flock needs. In the future, the raising of pullets may also be left increasingly to commercial breeders. Then, six week old pullets will be acquired instead of day-old pullet chicks. Range or complete confinement holdings are both practiced during the growing period. The housing arrangement can determine decisively the labor requirements. If barns have wide doors the handling of feed and removing

⁷¹Changes in Farm Production and Efficiency, loc. cit.

⁷²Ross, R.C., and Capener, W.N., Economic Performance of Commercial Laying Flocks in Illinois Farms, Univ. of Ill., Agr. Expt. Sta., Bull. 647, Nov. 1959, pp. 14 ff.



of manure can be done with tractor equipment. Many of the operations still have old fashioned trough or drum type feeders. The feeding arrangements and preparations can be eased by elevators, chutes, overhead bins, mills and mixers, and self unloading wagons. The nest arrangements can vary from the individual type to the community and rollaway types.

Modern laying houses, automatic waterers, feeders, and pit cleaners should help to cut the labor requirements for the remaining larger operations. There are also the battery type arrangements where the hen lives in a wire cage, has an automatic waterer, metered feed rations on a conveyor belt, and droppings and eggs are mechanically removed.

Under the given circumstances the reductions of labor needs are expected to range between 24-47 percent during this decade. When overhead time is also considered, the reductions will range between 15-38 percent by 1970-75.

Broiler production has probably become the most specialized branch of the poultry industry while layers and turkeys are, to a larger extent, still sidelines of an agricultural firm. The even distribution of the labor requirements is explained by the commercially oriented producers who extend their operations throughout the year. They produce 4-6 broods per year since the production period has been reduced from 100 days to about 70 days over the past three decades.

There are definite scale economies with respect to the labor inputs since larger specialized farms use much less per bird. Disease prevention and some environmental controls have helped to lower labor use per broiler. Since 1935 the feed-meat conversion ratios have doubled and the production of the finished product was speeded up. Hence the

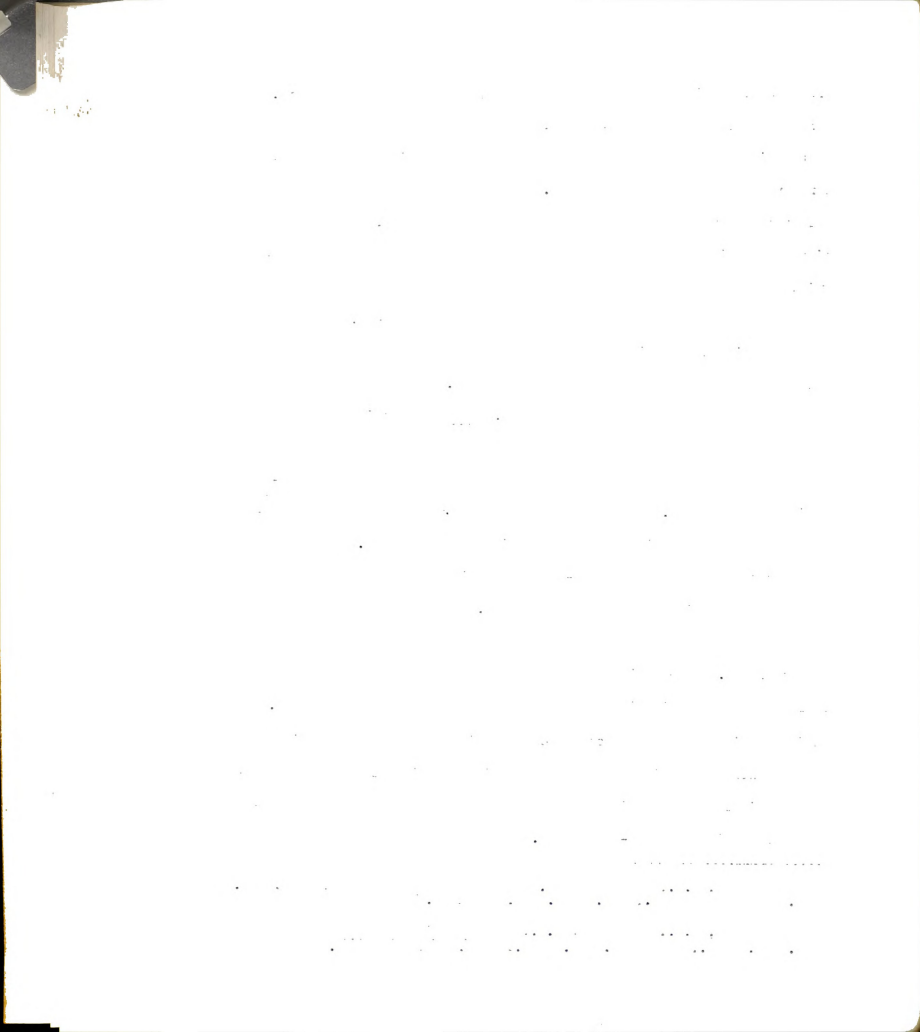


end product requires less feed and labor per broiler at the same time.⁷³ Many of the tasks such as debeaking, and immunizations are increasingly custom hired by the larger commercial firms, thus relieving the operators from these time consuming jobs. Further improvements in the layout of the barns and in the arrangements of feed storage, feed preparation and feeding (as discussed in the section on layers) will also contribute here to direct labor savings from the 1959 level that are foreseen to range between 40 and 50 percent per bird by 1970-75. If overhead labor is also considered the corresponding reduction amounts to between 25 and 34 percent for the target period.

In contrast to broilers and layers, turkey production is highly seasonal due to the primary egg production from February to July and due to the consumer preferences to buy the bulk of turkeys between Thanksgiving and Christmas. This seasonality of production explains the varying labor needs that will hardly change in the years ahead. Labor is only a small cost item (about 10-12 percent) in the production of turkeys if they are kept in confinement or on range. Underemployed family members of the operator with an opportunity cost of close to zero often care for the birds. Here again the labor requirements per 100 birds decrease nearly 100 percent with increases in herd size from 800 to 4400 birds.⁷⁴ It is anticipated that the acceptance of similar labor savings as in the other poultry enterprises will make their impact this decade in the reduction of direct labor requirements by 20-30 percent and of direct and indirect labor inputs by 13-19 percent.

⁷³Heady, E.O., and Hayami, Y., Poultry Supply Functions, Dept. Agr. Econ., Iowa State Univ., Res. Bull. 505, May 1962.

⁷⁴Ellis, T.H., and Hovey, R.M., The Economics of Turkey Production, Dept. Agr. Econ., North Dak. Agr. Coll., Bull. 414, June 1959.



CHAPTER IV

THE ANALYSIS OF THE LABOR USE FOR MICHIGAN AGRICULTURE

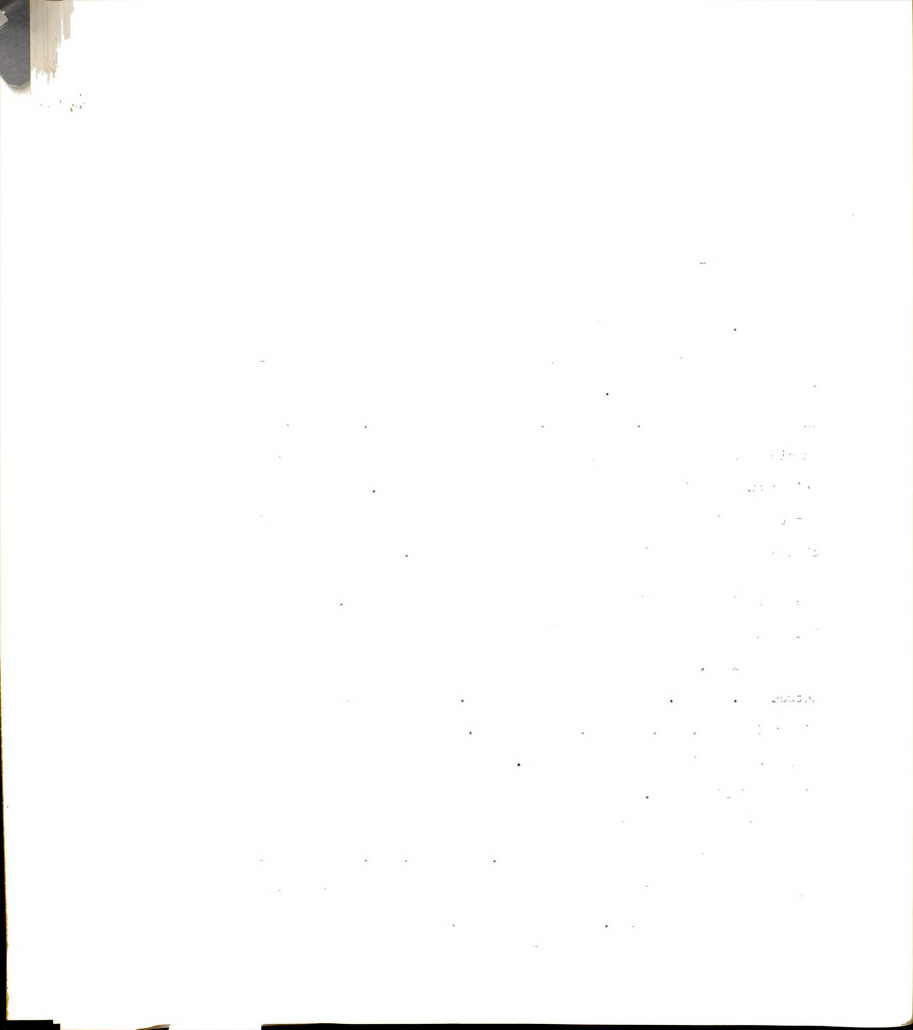
The man-hour use per unit for 1959 and the target period has been established in Chapter III and the regional enterprise sizes in Chapter II. This chapter will draw upon the findings of those chapters and sum up the man-hour requirements by regions and for the state during the course of the year. The computed workload is aggregated from the labor use in crops, vegetables, fruits and livestock. The discussion will analyze peaks and troughs and will point out the enterprises and activities causing the abnormal requirements. Later in the chapter the impending changes in the labor use due to expected economic changes and advances in technology are investigated.

The Analysis of the Labor Use for the State and its Regions, 1959

The State

In 1959, labor use for the state from December to March ranged between 12.5 to 14.5 million hours per month. It was about 50 percent higher in April, May, October, and November. From June to September the workload was twice that of the winter. The peak was recorded for July with 31 million hours.

Livestock enterprises accounted for at least six sevenths of the labor used during December through March. In April, May, and October, all the other enterprises combined needed as much labor as the livestock enterprises required. In June and July, crops demanded more



man-hours than the livestock enterprises. From June to September the approximate shares of the total amount of labor used came to one third each from livestock, crop, and the combined fruit and vegetable enterprises. In November, two thirds of the total labor inputs went to the livestock enterprises, the other third went to the other enterprises with crops explaining five sixths of the needs. Figure II on the following pages shows the shares of the four enterprise groups in the total monthly workload of the state for 1959 and the two levels of predictions for 1970-75.

Table 4.1 on page 120 reports the estimated total labor use by month and region for 1959 and the projections for 1970-75. The appendix Table A shows similar figures disaggregated into enterprise groups.

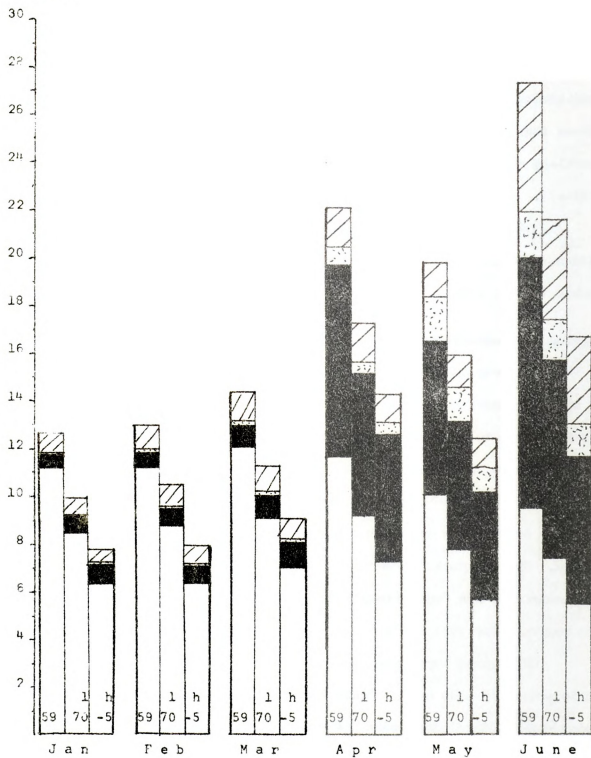
Region I (Southwestern Michigan)

The overall man-hour requirements for region I for 1959 followed a very distinctive pattern during the year. While the labor requirements from January to March, November and December stayed between 3 and 4.5 million hours for each month they expanded to about 6 million hours for April, May, June and October. They peaked very sharply in July (over 10 million hours) with August and September requiring about 8.5 million hours. The graphical illustration III on pages 121-122 represents the shares of the four enterprise groups in the total monthly workload in region I for 1959 and the two predictions for 1970-75.

Of largest importance over the entire year were the livestock enterprises in this area. Their labor requirements, however, were much more evenly distributed over the year than those of any other enterprise group. They hovered at about the 2.5 million hour mark for all months except May to August, when they fell to 2.25 or 2.0 million hours



Millions
of hours



Millions
of hours

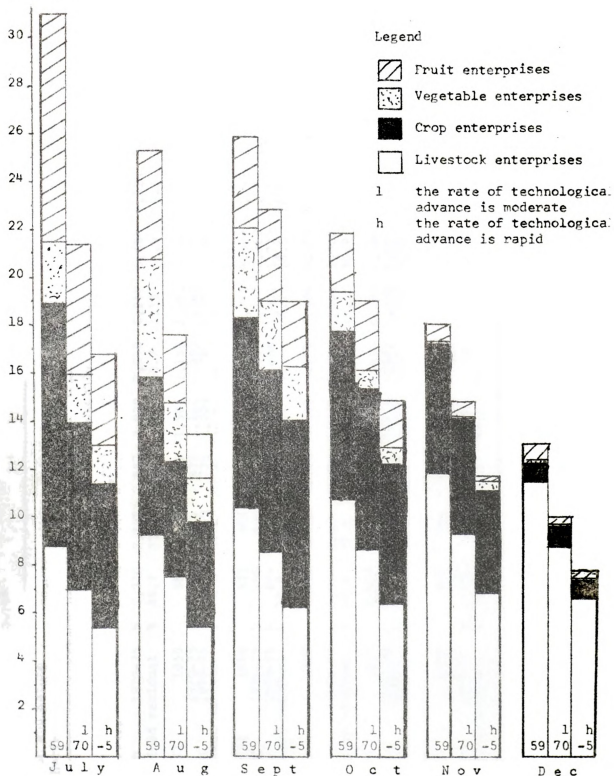


Figure II. Estimated labor use for enterprise groups in the state for 1959 and 1970-75 under alternative assumptions with respect to technological advance.

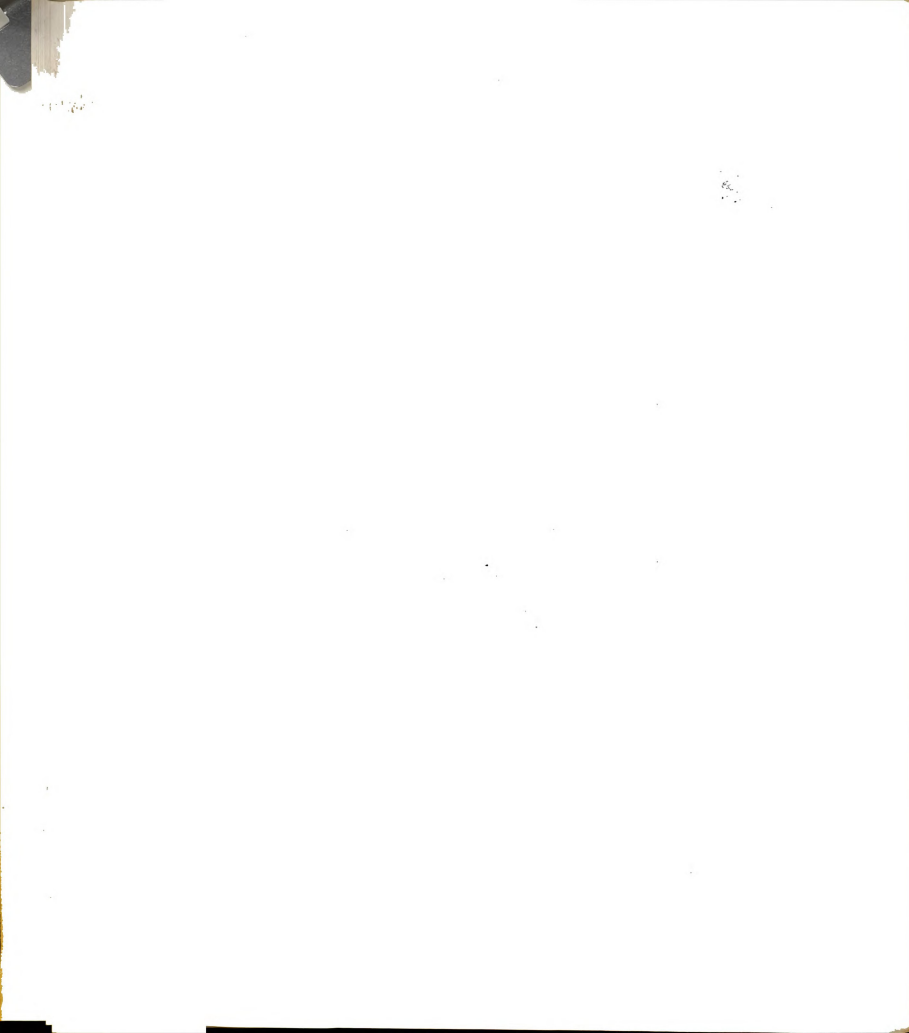
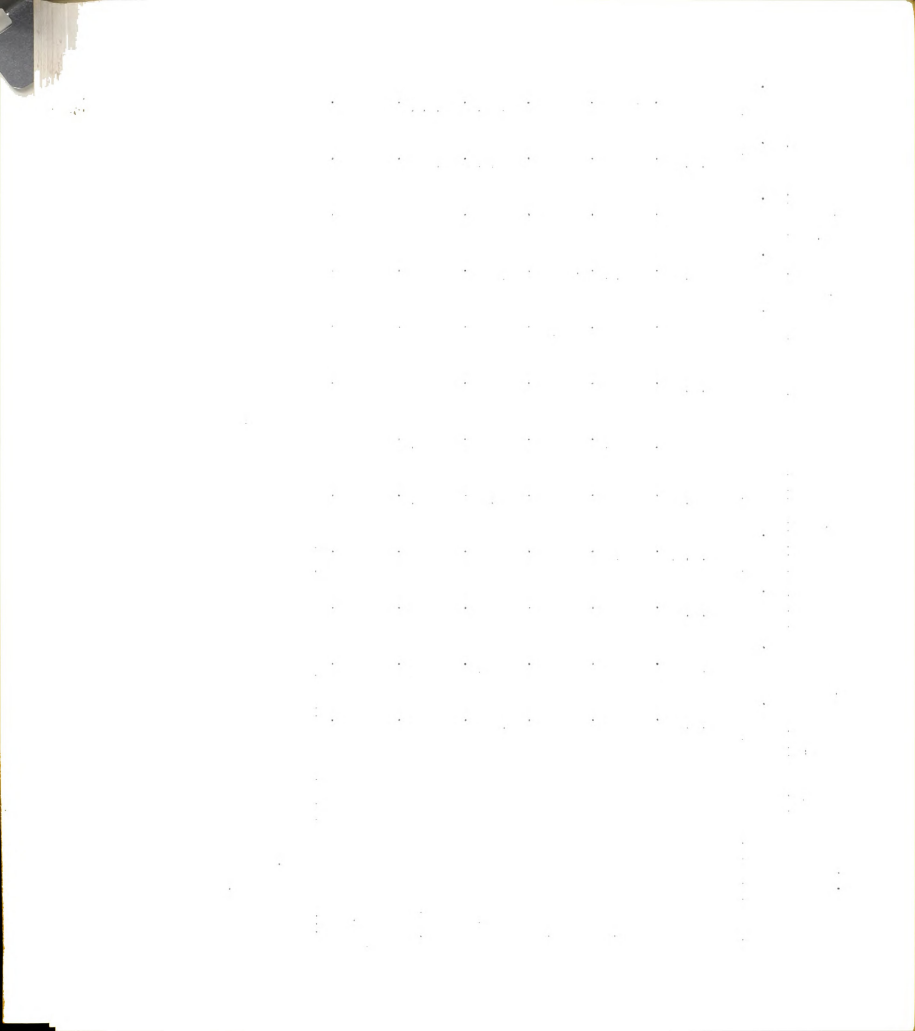


Table 4.1. Labor use and unexplained residual between available labor and normal labor use, 1959 and projected labor use under alternate assumptions regarding technological advance, by month and region, 1970-75^a

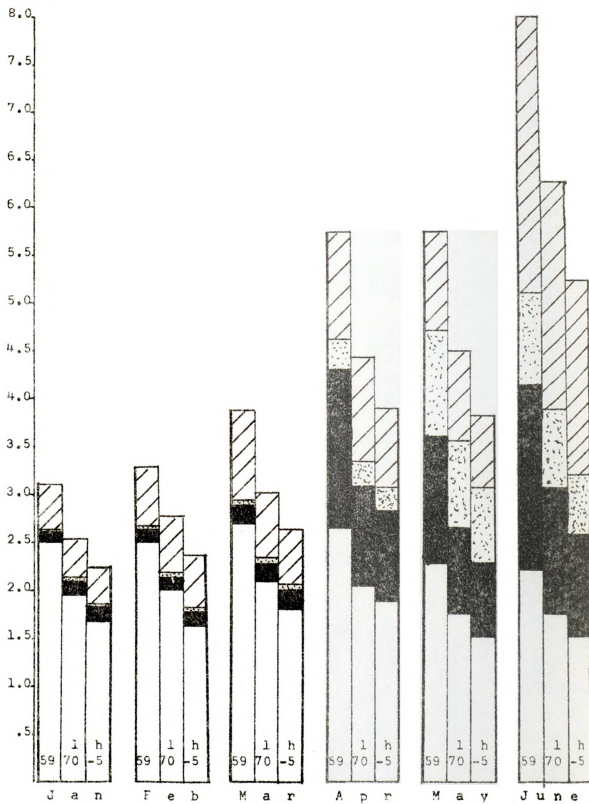
Region and Nature of Estimate ¹		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
		Thousands of hours & percent											
Region I	1959	3,113	3,292	3,880	5,760	5,745	7,980	9,716	7,672	8,092	5,626	4,255	3,207
Southwestern	1970-75	L 2,530	2,793	3,049	4,485	4,539	6,265	6,581	5,065	6,991	5,304	3,494	2,475
Michigan	1970-75	h 2,230	2,390	2,667	3,922	3,849	5,257	5,094	4,025	5,757	4,163	2,973	2,173
Unexplained residual	%	35.7	32.0	20.3	20.3	28.7	1.19	.9	48.9	24.0	40.0	29.1	37.9
Region II	1959	950	966	1,048	1,505	1,180	1,931	2,160	1,721	1,614	1,209	1,182	972
Western	1970-75	L 750	773	833	1,161	902	1,540	1,590	1,196	1,350	1,058	955	767
Michigan	1970-75	h 678	669	736	1,029	782	1,309	1,294	996	1,217	888	818	676
Unexplained residual	%	29.0	27.8	21.6	30.7	48.3	18.3	38.8	59.1	38.8	53.8	33.8	32.7
Region III	1959	922	964	1,061	1,541	1,174	2,240	4,083	2,245	1,442	1,143	985	935
Northern	1970-75	L 786	820	868	1,194	940	1,684	2,360	1,526	1,297	1,061	830	779
Michigan	1970-75	h 674	699	762	1,045	808	1,431	1,732	1,158	1,147	852	704	678
Unexplained residual	%	37.7	34.8	28.3	31.7	48.0	5.2	53.0	76.8	41.2	55.8	46.4	40.2
Region IV	1959	2,802	2,831	3,041	4,813	4,374	5,904	5,557	5,323	5,888	5,585	4,351	2,868
Thumb, Saginaw	1970-75	L 2,182	2,227	2,420	3,877	3,611	5,057	4,462	3,677	5,010	4,942	3,640	2,251
Valley	1970-75	h 1,908	1,926	2,139	3,437	3,020	3,625	3,607	3,227	4,487	4,294	3,089	1,989
Unexplained residual	%	38.5	37.9	33.3	30.7	37.3	19.1	30.9	41.6	24.7	24.1	24.4	39.8
Region V	1959	4,327	4,414	4,844	7,844	6,921	8,129	7,554	7,485	8,383	6,939	6,562	4,437
Southern	1970-75	L 3,472	3,631	3,917	6,119	5,488	6,488	6,082	5,453	7,385	6,323	5,601	3,577
Michigan	1970-75	h 3,076	3,093	3,489	5,508	4,759	5,387	5,310	4,747	6,647	5,365	4,838	3,168
Unexplained residual	%	30.4	29.0	22.4	20.2	30.0	21.6	29.4	33.0	22.5	35.4	19.0	32.2
Region VI	1959	648	650	691	830	885	1,227	1,058	927	898	820	728	679
Upper	1970-75	L 460	463	503	570	569	931	792	640	684	537	515	465
Peninsula	1970-75	h 401	403	440	503	508	888	680	559	634	450	440	410
Unexplained residual	%	33.6	33.3	29.1	47.0	44.3	26.6	37.3	36.6	48.6	48.8	45.4	34.7

^aBecause of rounding these totals may not conform precisely with the detailed data of Appendix Tables A.1.

¹L refers to a moderate rate of technological advance. h refers to a rapid rate of technological advance.



Millions
of hours



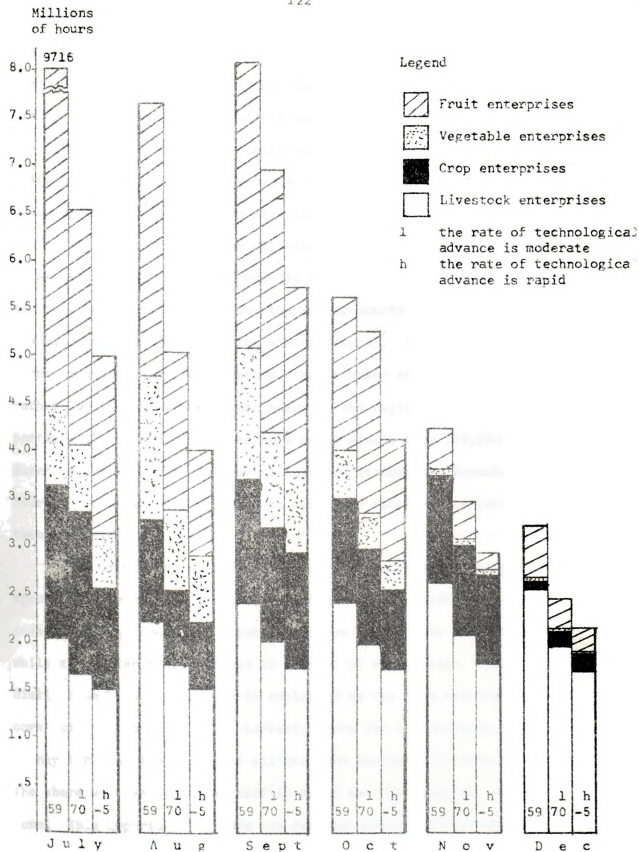
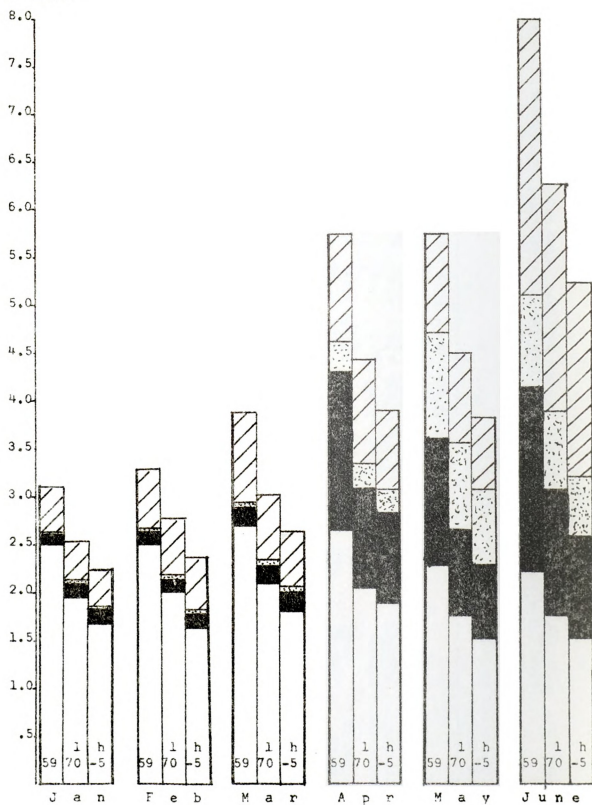


Figure III. Estimated labor use for enterprise groups in Region I (Southwestern Michigan) for 1959 and 1970-75 under alternative assumptions with respect to technological advance.

Millions
of hours



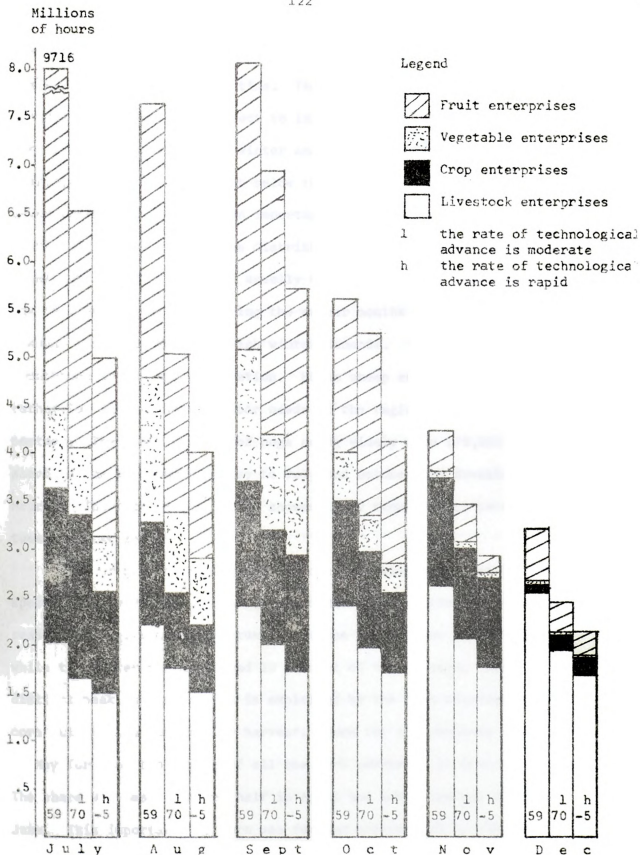
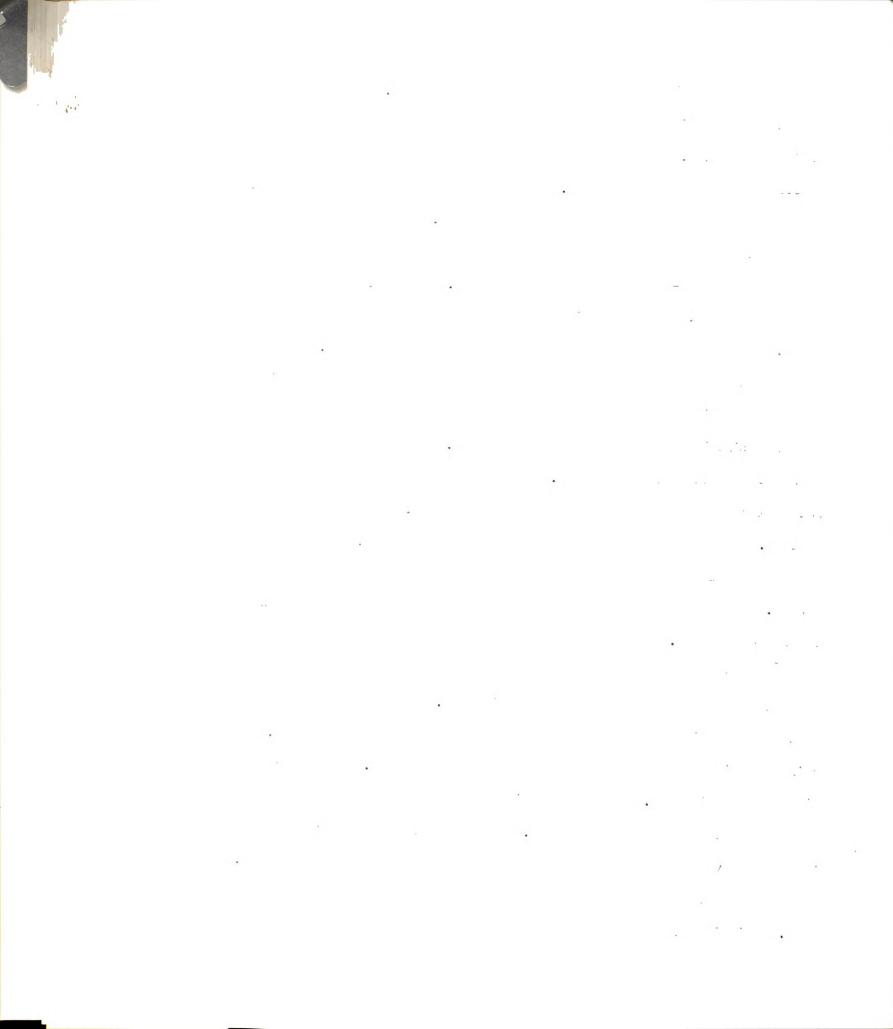


Figure III. Estimated labor use for enterprise groups in Region I (Southwestern Michigan) for 1959 and 1970-75 under alternative assumptions with respect to technological advance.

11. 11. 11

allowing more labor to be devoted to other enterprises. Nearly all the livestock enterprises contributed to the lower overall labor needs during the summer months, since either the animals were on pasture or their number declined during that time. The dairy enterprise was the most important enterprise with respect to labor demands. Each month required over 1 million hours during winter and fall while summer and spring requirements were 10-25 percent below this level. Poultry, especially layer operations, was next in importance with 300,000-400,000 hours per month, but with a fairly even distribution throughout the year. The other cattle enterprises had usually 6-20 times higher labor use during the fall and winter than during the summer months with spring showing a gradual reduction from the high winter demands. This was especially pronounced in the steer operation. While sheep enterprises ranked rather low in the overall labor needs of the region, hogs were more important. The labor demands of hogs swung widely from 175,000 hours in March to the low months of May to July and October and November (58,000 hours). The rest of the months showed labor requirements part way between the extremes.

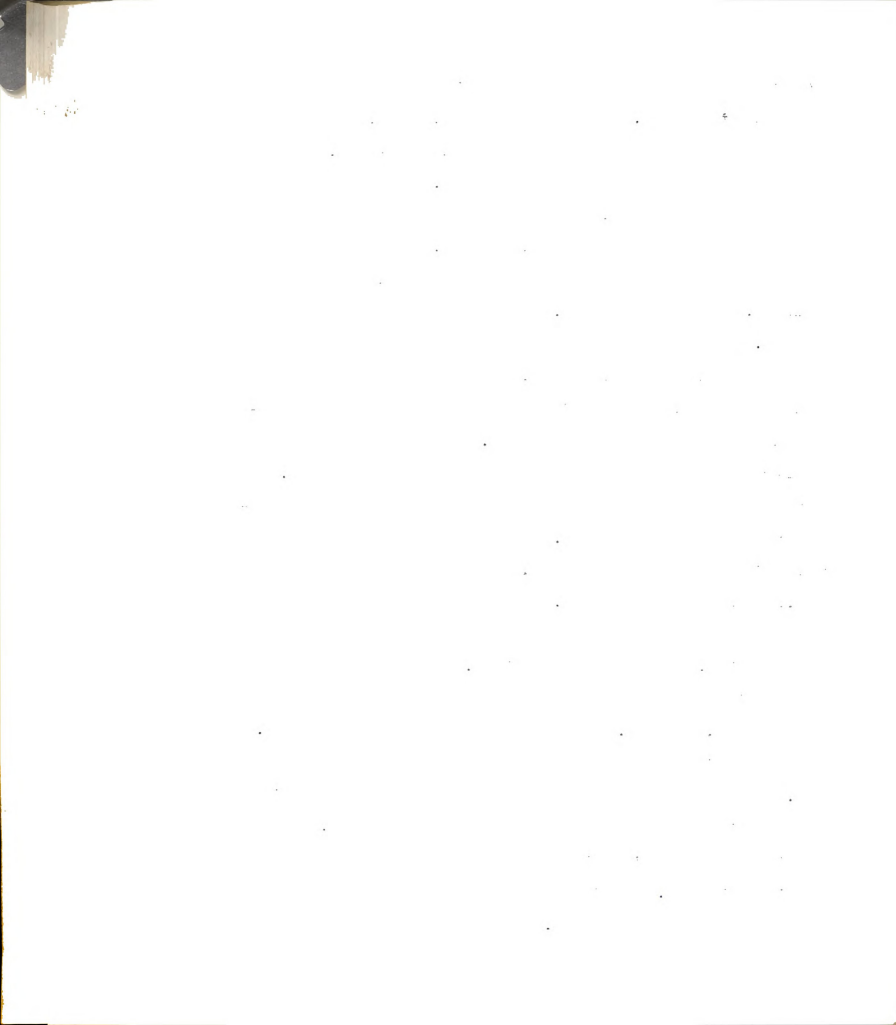
The crop enterprise group was next to least important with respect to labor demands in southwestern Michigan. During the growing season the requirements fluctuated between one and two million hours, while the winter months showed 10 percent of those needs. There was one distinct peak in June. This is explained by the high requirements for corn cultivation and the hay harvest. Corn for all purposes accounted in May for over two thirds of all the work performed in crop enterprises. The share was less than one half in April and more than one third in June. This importance of corn was further underscored in the fall when



over one half of the crop labor went to cornfields in October and nearly four fifths in November. Hay and seeds (alfalfa, clover, grass) contributed to the big peak in June with about 800,000 man-hours. Hay also showed strong labor demands in July to September. Wheat harvest demanded a lot of labor in July (400,000 hours) as well as during planting in September and October (altogether 500,000 hours). The same activities for oats caused labor to be used heavily in August (310,000 hours) and April (235,000 hours) respectively. Pastures had their peak labor demand in April.

The vegetable enterprise group, although mostly confined to the Benton Harbor area, registered higher labor inputs in August and September than all the crop enterprises combined. During all the summer months tomatoes required labor inputs in excess of 100,000 hours per month. From August until October more than one third of the labor used for vegetables went to the tomato harvest. Of great importance were the cucumber fields with labor requirements of 650,000 hours in August and nearly 3000,000 hours in adjacent months. The relatively high labor needs for vegetables in May and June can be attributed to the asparagus harvest with two thirds, and one fourth respectively. Onions registered high labor requirements from August to October with the peak occurring in September (220,000 hours). Celery had high demands in July and August.

The fruit enterprises caused the largest disturbance in the workload. They showed extraordinarily high demands for labor during their harvest period, which embraces the months of July to September. Nearly one fifth of the region's entire man power went to the harvest of tart cherries during July. In this region sour cherries also had fairly high labor needs during June and August. The small berries demanded much



labor during harvest operations occurring from June to September. Labor use peaked in strawberries in June (1.7 million hours) and July, in raspberries in July, and in blueberries in August. Each of the latter two contributed about 1 million hours to the total labor requirements. The sweet cherry harvest required less than one tenth of the July tart cherry labor. The pear harvest activities in September were of the same magnitude. In September and October the harvest of apples registered man-hour demands reaching for the million hour mark. The harvest of peaches contributed to the labor demands .5 and .75 million hours in August and September respectively. Grapes had high labor requirements during September and October (nearly 800 and 400 thousand hours respectively), thus helping to explain the long fruit harvest season in this area. All the fruit enterprises played a relatively important role in this part of Michigan. Their labor needs dropped barely below 50,000 hours for any month. During the spring, planting, spraying, and fertilizing pushed their labor demands to the 100,000 hour level for March through May.

Region II (Western Michigan)

The overall man-hour demand of region II in 1959 was characterized by three four month periods of different magnitudes. The winter charted requirements of 1 million hours, while the summer months moved between 1.5 and 2.27 million hours with a July peak. The spring and fall registered labor demands of between 1 and 1.5 million hours. The graphical illustration IV on the following page represents the shares of the four enterprise groups in the total monthly work load in this region for 1959.

Livestock enterprises contributed most to the demand for labor in each month with the exception of July when vegetables called for a



Legend

- Fruit enterprises
 Vegetable enterprises
 Crop enterprises
 Livestock enterprises

Millions
of hours

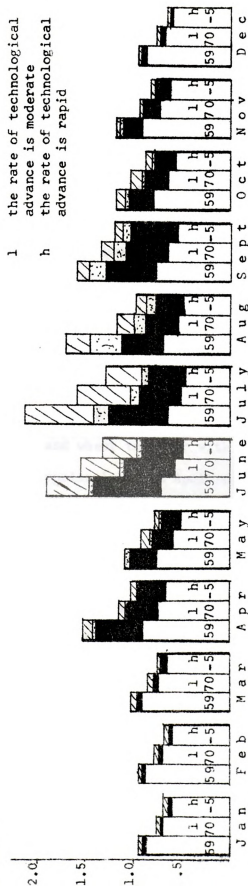
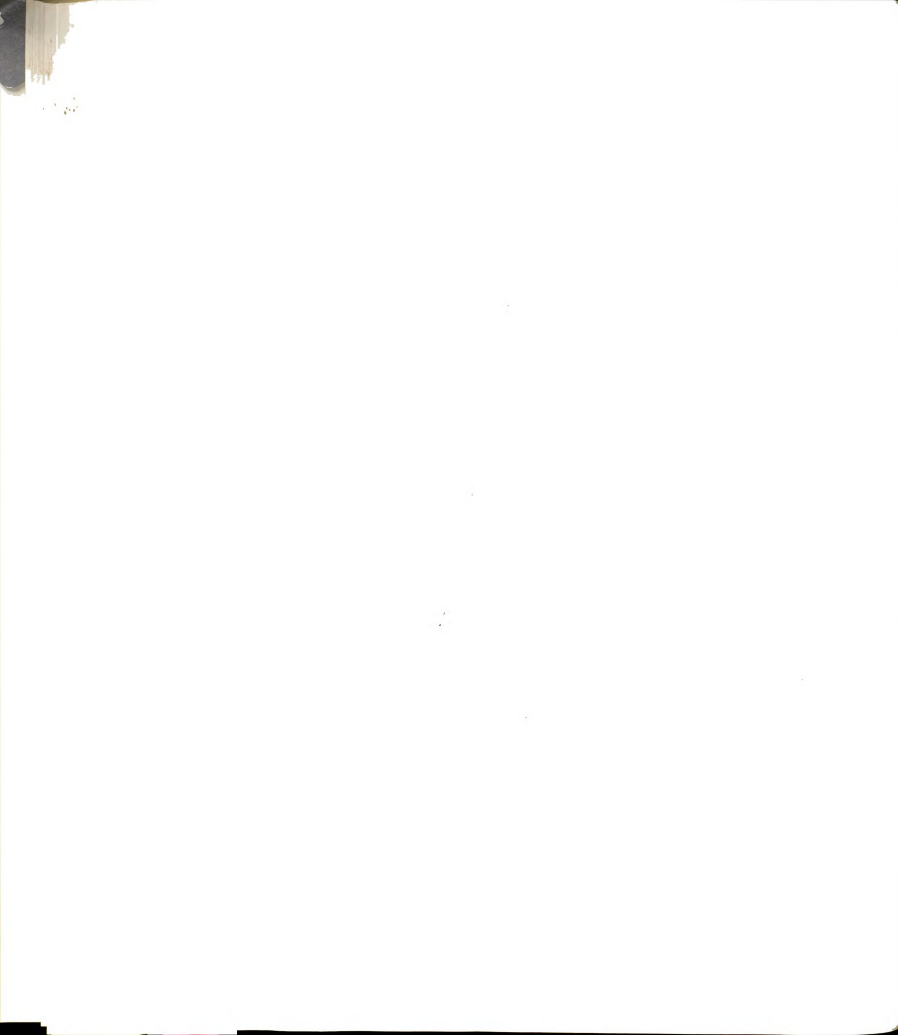


Figure IV. Estimated labor use for enterprise groups in Region II (Western Michigan) for 1959 and 1970-75 under alternative assumptions with respect to technological advance.



higher labor input. The seasonal distribution of livestock labor use was fairly stable, moving only between 938,000 hours for March as a peak to 667,000 hours in July, thus allowing some of its labor to be used in other than livestock activities during the summer time. The milk cow enterprise was more important with respect to the use of labor throughout the year than all the other enterprises combined. The next two enterprises with sizeable labor needs were the heifer and steer enterprises. They had combined peak requirements in the winter months of approximately 185,000 hours and a trough in July and August of 21,000 hours.

The crop enterprises ranked second in overall importance, oscillating between 38,000 hours in January and 724,000 hours in June. A substantial amount of labor use occurred in April to June and October and November, in activities connected with corn cultivation and harvest. For the same activities, oats and wheat together with rye needed significant shares of the crop enterprise labor in April and from July to September. Dry beans used a large amount of labor in September, while hay explains the high June needs. The many acres of pasture required a large share of the overall labor demands for April.

Fruits required .85 million hours and .45 million hours in July and August respectively, most of which was accounted for by the cherry and strawberry harvest. In other months, less than .15 million hours of labor were used in all activities in the fruit enterprises.

Labor inputs in vegetable enterprises showed a high in August. Activities for this and adjacent months were primarily the cucumber harvest, and secondly, the snapbean harvest.

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Millions
of hours

Legend

-  Fruit enterprises
-  Vegetable enterprises
-  Crop enterprises
-  Livestock enterprises

- l the rate of technological advance is moderate
- h the rate of technological advance is rapid

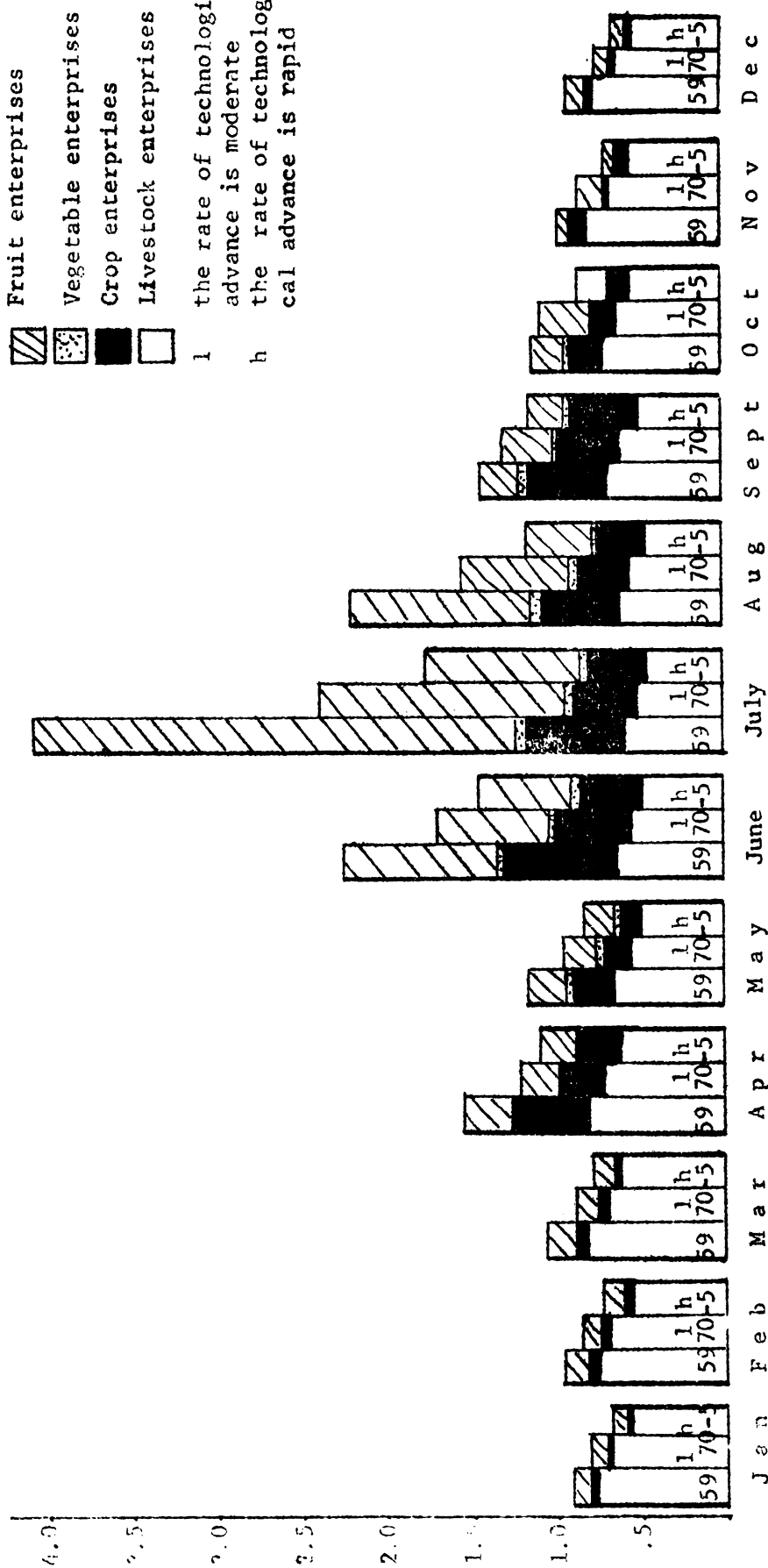


Figure V. Estimated labor use for enterprise groups in Region III (Northern Michigan) for 1959 and 1970-75 under alternative assumptions with respect to technological advance.

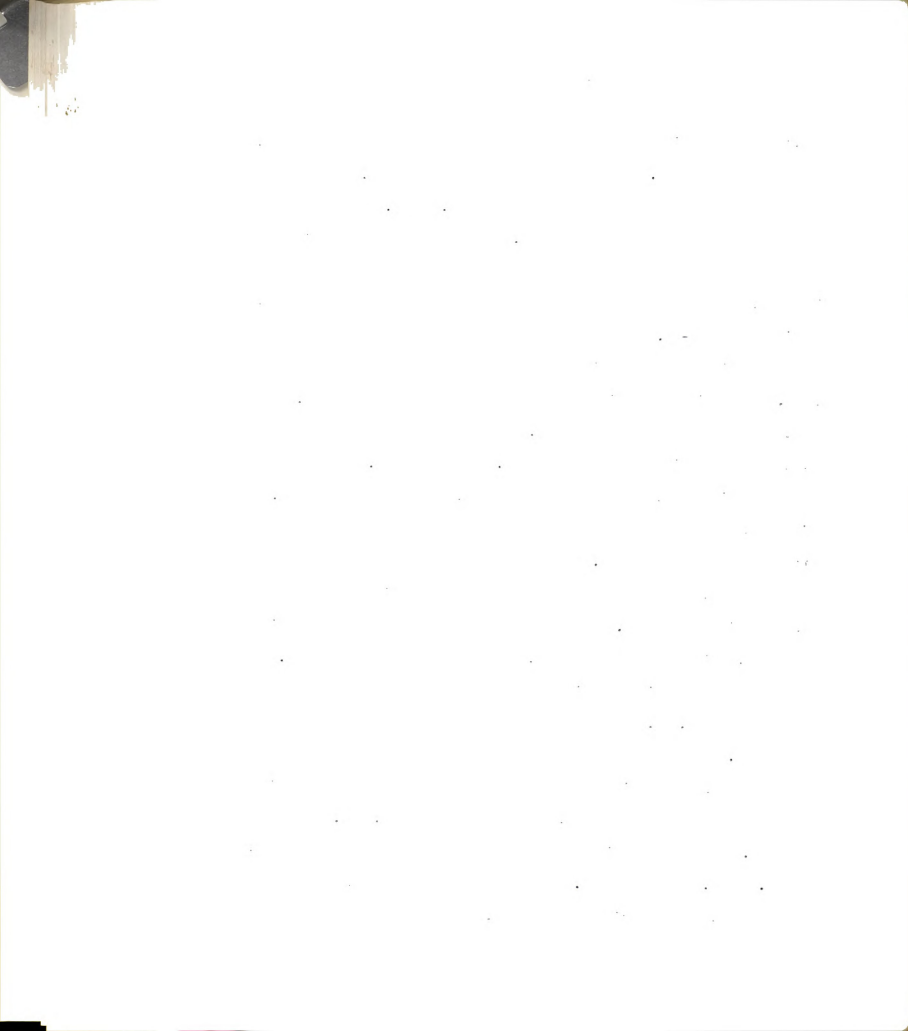


Region III (Northern Michigan, Lower Peninsula)

Region III showed a distinct peak of the overall labor requirements of four million hours in July while in June as well as in August, approximately 2 and 2.5 million hours were needed in 1959. The remainder of the months registered labor demands between .9 to 1.6 million hours per month for all enterprises combined. The graphical illustration V on the preceding page represents the shares of the four enterprise groups in the total monthly work load in this region for 1959 and the two predictions for 1970-75.

The livestock enterprises had the highest overall labor requirements, but a fairly even distribution over the course of the year. They fluctuated between a low in July of .58 million hours to the higher level during the winter season of about .8 million hours. Over half of the labor spent in livestock enterprises was accounted for by dairy cows. Heifers accounted for about 13 percent during the winter and for three percent in the summer months. The remaining cattle enterprises required another 13 percent of the livestock labor during the winter and only one percent during the summer. Of the poultry enterprises, layer operations had labor requirements of between 42,000 and 48,000 hours per month. Hog and sheep enterprises combined were not very important in this area, demanding at most, 30,000 hours in March and only 8,000 hours in July and October.

The fruit enterprises gradually increased in their labor requirements from a low in November (67,000 hours) to May (246,000), and jumped then to 2.8 million hours in July with June and August labor demands between 1. and 1.5 million hours. Three fourths of the summer peak was caused by harvest activities for cherries, mainly of the tart cherry



variety. Strawberries required between 300,000 and 463,000 hours for June and July, thus explaining most of the labor used for fruit enterprises during this time. The only enterprise that had labor demands in excess of 150,000 hours was apples in September and October.

Crops had overall labor demands of about one half million hours per month in April and from June to September. In the rest of the months the labor use lay below .3 million hours. Crops required, at most, one third of the total labor input for the region. The months with high labor requirements coincided with the hay and small grain harvest, and the summer grain planting. The corn silage harvest needed over one tenth of all crop labor in September, while pastures required as much in April. Potatoes also helped to explain the concentration of labor needs in the crop enterprises during planting time in April and May and during the harvest in September-October with 70,000-80,000 hours per month.

Vegetables of all kinds did not play an important role in this region, which was expressed by the fact that the combined labor input reached only 87,000 hours in August.

Region IV (Thumb, Saginaw Valley)

Region IV had monthly labor requirements of about 3 million hours from December to March in 1959. April, May, and November required in the neighborhood of 4.5 million hours, while in June to October the labor inputs amounted to 5.5 million hours and more. The graphical illustrations VI on the following pages represent the shares of the four enterprise groups in the total monthly work load in region IV for 1959 and the two predictions for 1970-75.

Again the lion's share fell to the livestock enterprises,

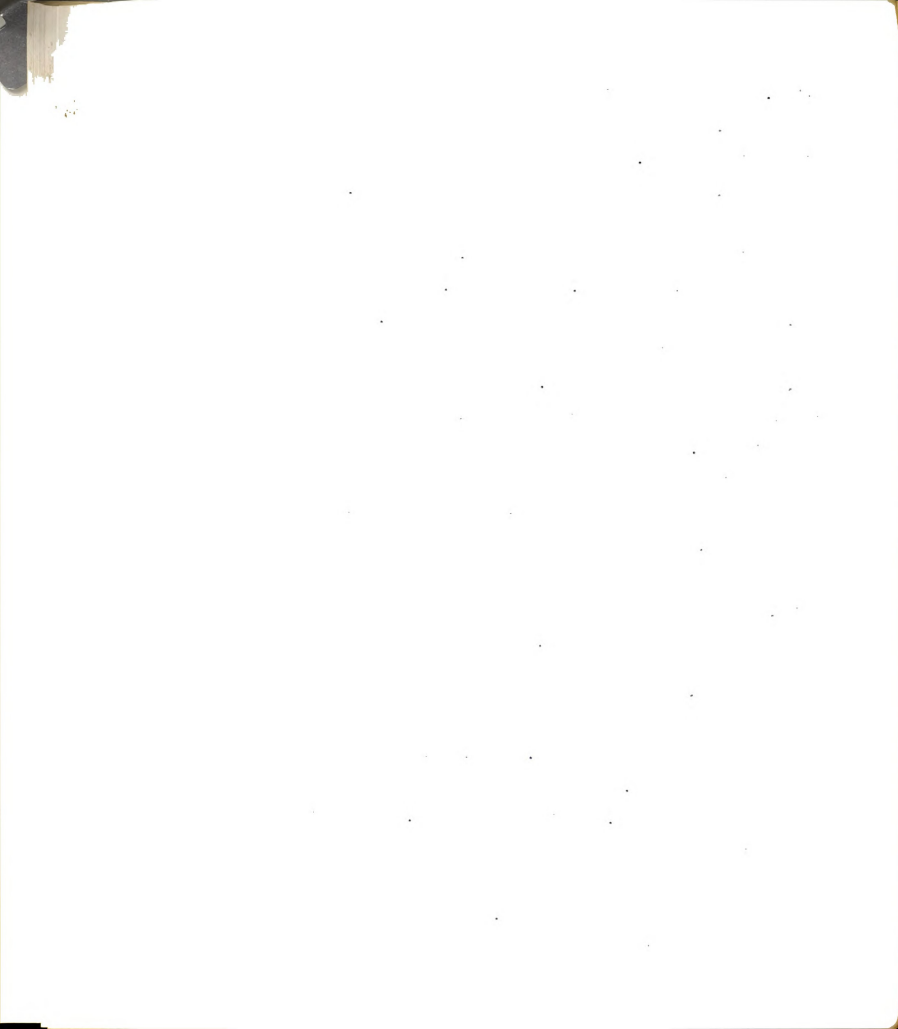
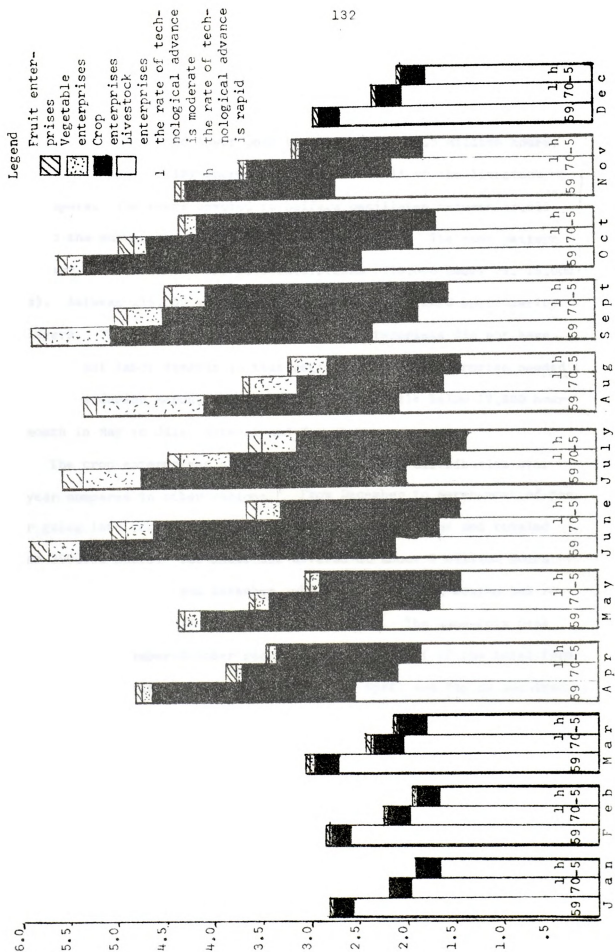


Figure VI. Estimated labor use for enterprise groups in Region IV (Saginaw Valley, Thumb) for 1959 and 1970-75 under alternative assumptions with respect to technological advance.



except for June-July and September-October when the demands of the crop enterprises exceeded them. The livestock enterprises showed the traditional pattern of higher labor inputs (above 2.5 million hours) during the winter half year and lower ones (between 2. and 2.5 million hours) during the summer. Dairy chores accounted for half of the livestock labor inputs. The hours devoted to heifers oscillated between 53,000 hours in the summer and 320,000 hours in the winter. The same pattern on a lower level held for the beef enterprises (220,000 hours vs. 15,000 hours). Between 176,000 and 201,000 hours per month were spent caring for layers. The other poultry and the sheep enterprises did not have very important labor demands in this region. The hog enterprise needed 50,000 hours during March, the peak month, and little below 17,000 hours per month in May to July, October and November.

The crop enterprises showed an erratic labor distribution over the year compared to other regions.¹ From December to March most of the labor going into crop activities was of the overhead type and totaled around 200,000 hours. The labor use hovered at about 2 million hours in April, May, August, and November, while the remaining months had requirements of between 2.7 and 3.3 million hours. The June-July peak and that for September-October required about one half of the total farm labor for this region. Most of the labor for April and May is required by spring seed bed preparation and planting of grains (three sixths), beans, potatoes, and sugar beets (two sixths) and the cultivation activities on meadows (one sixth). Nearly 35 percent of the labor used in

¹Brooke, M.D., Marginal Productivities of Inputs on Cash Crop Farms in the Thumb and Saginaw Valley Area of Michigan, 1957. Unpublished Master Thesis, Mich. State Univ. 1958.



crop activities during June was for making hay and grass silage. Sugar beet and potato cultivation required another 25 percent of the June labor inputs for crops, while beans took 20 percent and corn 14 percent. In July, the small grain harvest called for more than one fourth of the total crop labor, as did hay and seeds. Row crops account in that month for one third of the crop labor. Three fourths of the August labor was used in the oats harvest, the bean harvest, and in haying. The September-October peak originated from the corn silage and corn harvest (one third), plowing and planting of winter grains (one seventh) and bean harvest (one sixth). Over one third of the crop labor was tied up in the potato and sugar beet harvest. The outstanding November activities were: corn harvest (one third), sugar beet harvest (one fifth), and bean field plowing.

The August trough in the labor demands for crops was offset by a peak of over 1 million hours for vegetable enterprises. Three fourths of this time was attributed to the cucumber harvest, one tenth by tomato and celery activities, and another tenth by snapbeans and sweet corn. Cantaloupes, onions, carrots, and lettuce were the other important users of labor in August.

Fruit enterprises did not have very significant labor demands in that region. One half of the relatively high demands in June and July was due to the strawberry harvest. Apples with a peak labor demand of 93,000 hours in October and cherries with a high of 33,000 hours in July were the only other fruit enterprises of consequence.

Region V (Southern Michigan)

Area V is the most extensive farming region in Michigan and has therefore, a very high labor demand during the growing season, that in

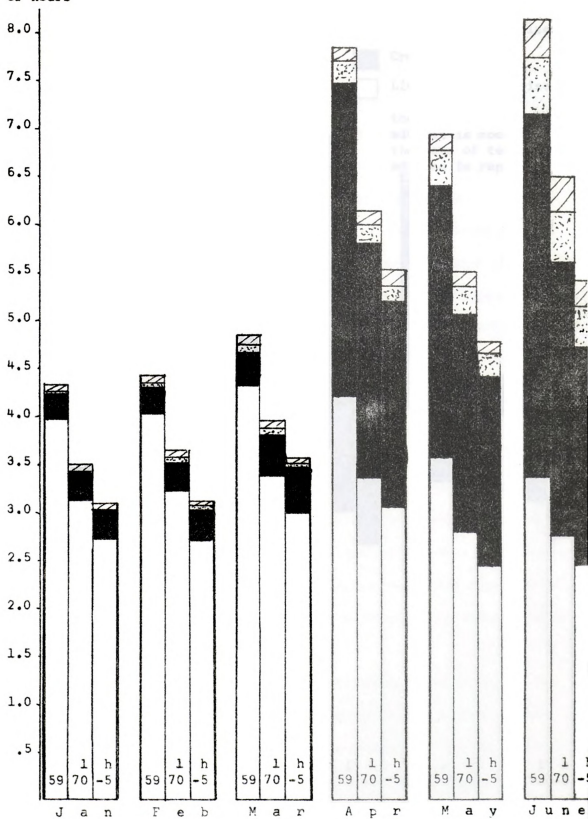
1959 was exceeded only by the June-July peak of the intensive fruit area I. During the dormant season (December-March inclusive) total labor requirements per month moved between 4.3-4.9 million hours. With the exception of September, they stayed between 6.7-7.9 million hours per month; in September they reached a peak of 8.38 million hours. The graphical illustration VII on the following pages represents the work load in region V for 1959 and the two predictions for 1970-75.

Livestock was again the foremost user of labor in every month except June, when crops showed a peak. The livestock enterprises followed their usual pattern of higher labor inputs during November-April and lower requirements during the remainder of the year. The peak of 4.3 million hours occurred in March and a low of 3.1 million hours occurred in July. Forty to forty-five percent of the total livestock labor was used in the dairy enterprise. This and most other livestock enterprises with the exception of poultry and hogs showed between one fourth to one third lower labor demands for the summer months than for the winter season. During the winter, one fifth of the livestock labor went into the other cattle enterprises; this share reduced to less than 5 percent during the pasture season. The heifer and feeder cattle required around 800,000 hours each month from November to April. The poultry enterprises had a fairly stable requirement throughout the year of from 298,000 to 331,000 hours per month; most of the labor input was accounted for by layer operations. Hogs contributed to the peak labor requirements for livestock in March with 244,000 hours. The labor inputs for this enterprise fell to two thirds of this level during most of the winter months and in August and September. All the other months required monthly only one third of the labor used in March.

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Page 13 of 13

Millions
of hours



Millions
of hours

Legend

-  Fruit enterprises
-  Vegetable enterprises
-  Crop enterprises
-  Livestock enterprises

- 1 the rate of technological advance is moderate
- h the rate of technological advance is rapid

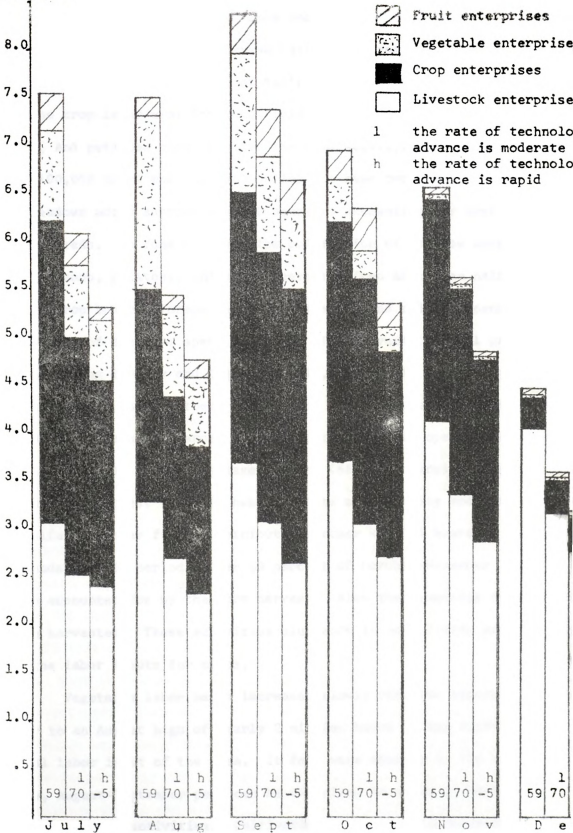
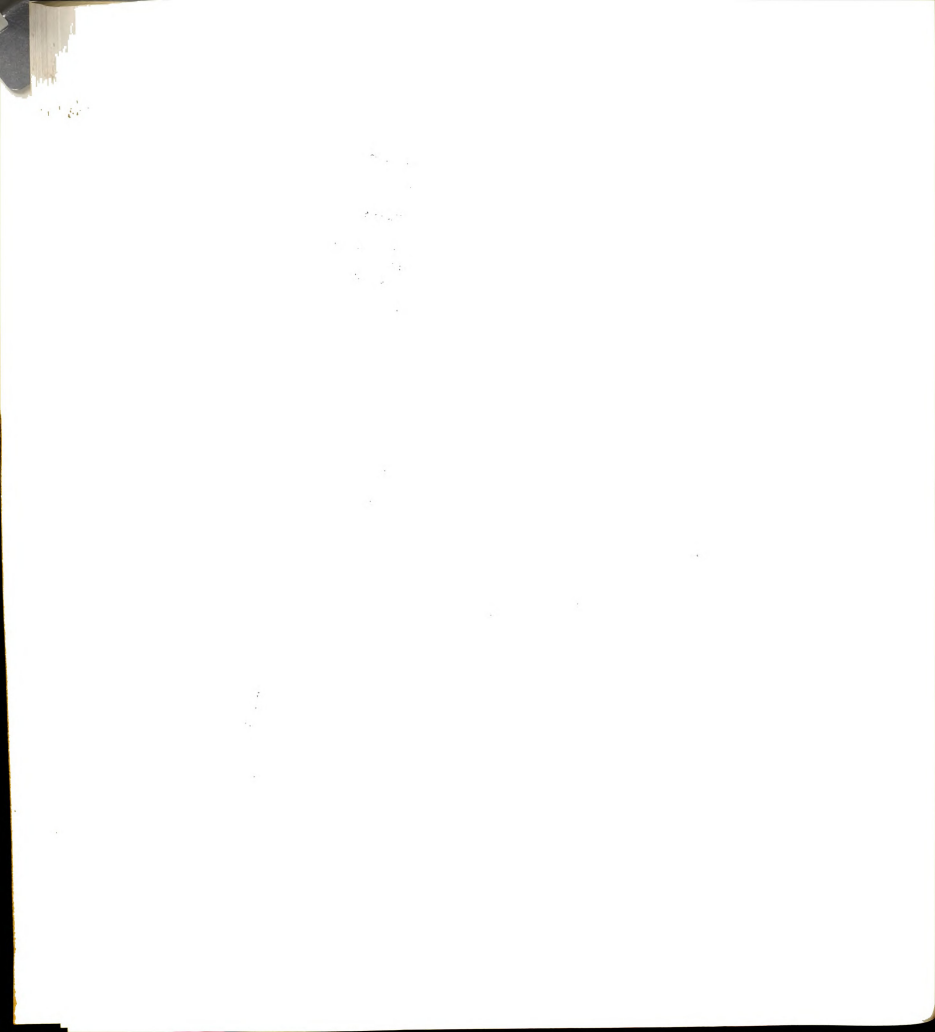
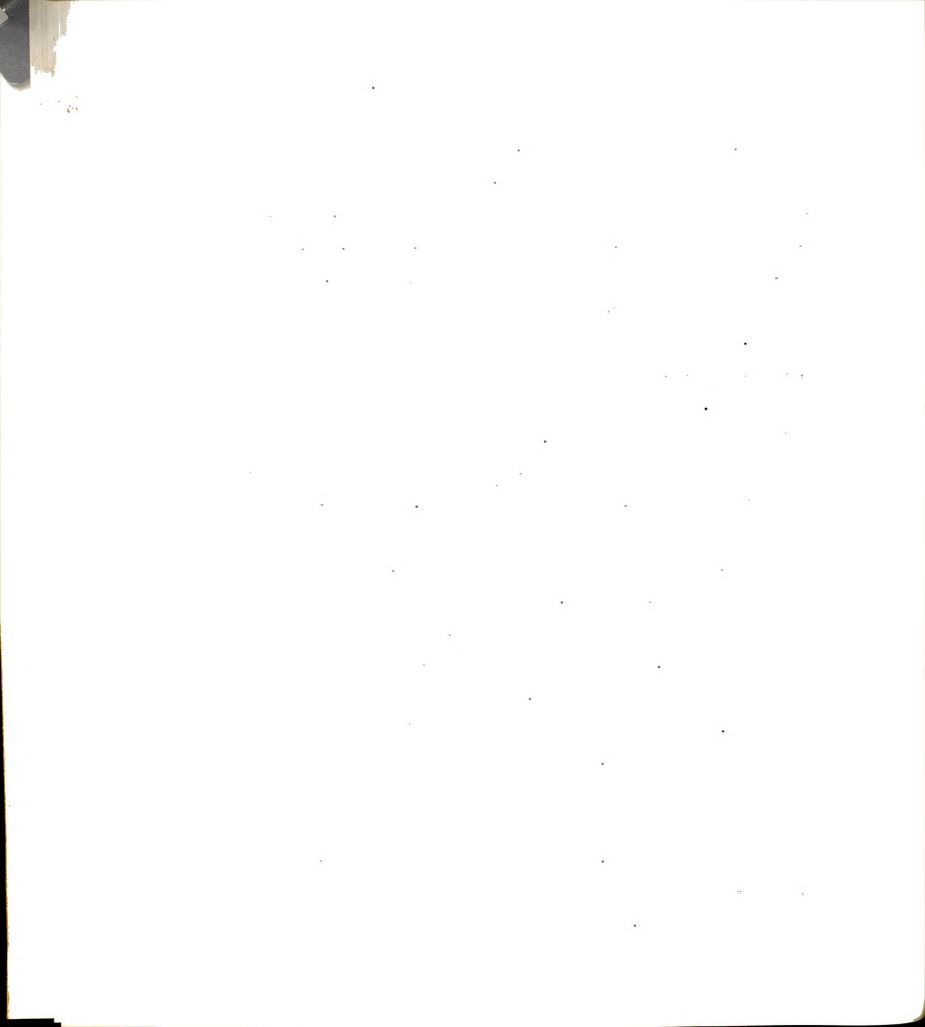


Figure VII. Estimated labor use for enterprise groups in Region V (Southern Michigan) for 1959 and 1970-75 under alternative assumptions with respect to technological advance



In 1959 the crop labor use ranged between 22 and 3.8 million hours during the growing season and from December to March showed only nominal requirements, mainly for overhead tasks. The peak occurred in June when vegetable labor demands were at their high. In April and May 45 percent of the crop labor went for corn field preparation and planting. Beans, oats, and potatoes required, for the same activities, 728,000, 625,000 and 100,000 hours respectively during the same two month period. Work on meadows added another 412,000 hours to accounting for most of the labor needs. In June and July the cultivation of the row crops such as corn, beans, potatoes, and sugar beets required about one half of the total crop labor. Forage harvest (hay and grass silage) accounted for one third of the time spent on crops. The harvest of small grains and seed falling in July and August explain, along with hay making and activities in beans and potatoes, most of the labor inputs. September-October labor needs were influenced by small grain planting operations (over 1 million hours), the corn silage harvest (650,000 hours), and potato and sugar beet harvest (425,000 hours). Late cuts for hay and harvests from alfalfa or clover fields contributed another 465,000 hours to the labor demands of this period. Over 50 percent of October-November labor inputs were accounted for by the corn harvest. Also the remaining sugar beets were harvested. These activities plus work in bean fields explain most of the labor inputs for crops.

Vegetable labor needs increased slowly from the beginning of the year to an August high of nearly 2 million hours or one fourth of the total labor input of the area. It fell more sharply in the fall. The July, August-September peak can be explained to about 50 percent by pickle harvest activities. Cultivation and harvest activities in the



mint fields explained more than one tenth of the June-July labor going to vegetables. Onions explained one fifth of the labor input in October and more than one tenth in September. Onions also required substantial labor inputs in July and August.

The fruit enterprises combined contributed, at most, one eighteenth of the overall labor demands during September, the month of their peak requirements in 1959. During the summer months, 365,000 to 400,000 hours of labor were used in vegetable fields, with the exception of August when only 190,000 hours were used. Sixty percent of the labor used in fruits in June and July was accounted for by the strawberry harvest. In August and September a significant man-hour share in fruits went to peach activities. Labor inputs during the apple harvest explain three fourths of the fruit labor demand during September and October.

Region VI (Upper Peninsula)

In 1959, the Upper Peninsula had, compared to the other regions, a very small man-hour load. It did not quite double from the winter months (600-700,000 hours per month) to 1 million to 1.25 million hours for June to August. The labor demand lies between those extremes for the rest of the year. The graphical illustration VIII on the previous page represents the shares of the four enterprise groups in the total monthly work load in this region for 1959 and the two predictions for 1970-75.

With the exception of the period from April to October, the livestock enterprises account for nearly all of the labor used in farming. Two thirds and four fifths of the work time spent during the summer and winter respectively went to the dairy enterprise. Another one tenth was contributed during the winter by the other cattle enterprises. In May and October, livestock labor requirements were half of winter



Legend

-  Fruit enterprises
-  Vegetable enterprises
-  Crop enterprises
-  Livestock enterprises

- l the rate of technological advance is moderate
- h the rate of technological advance is rapid

Millions of hours

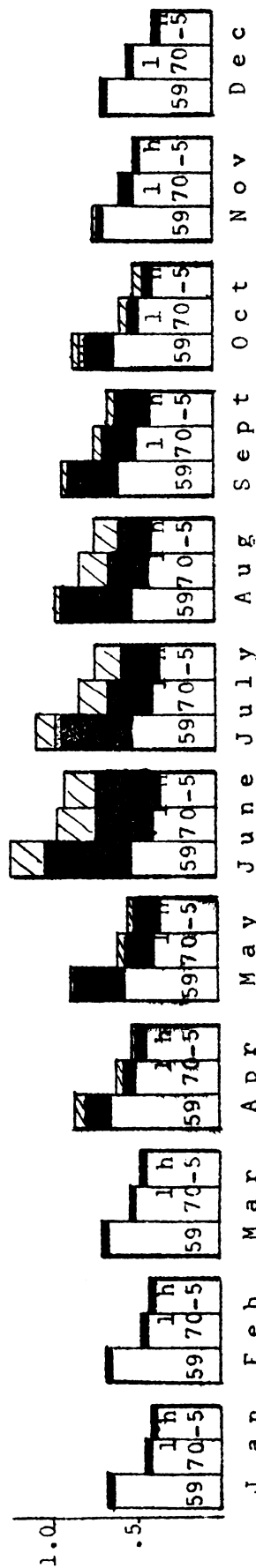
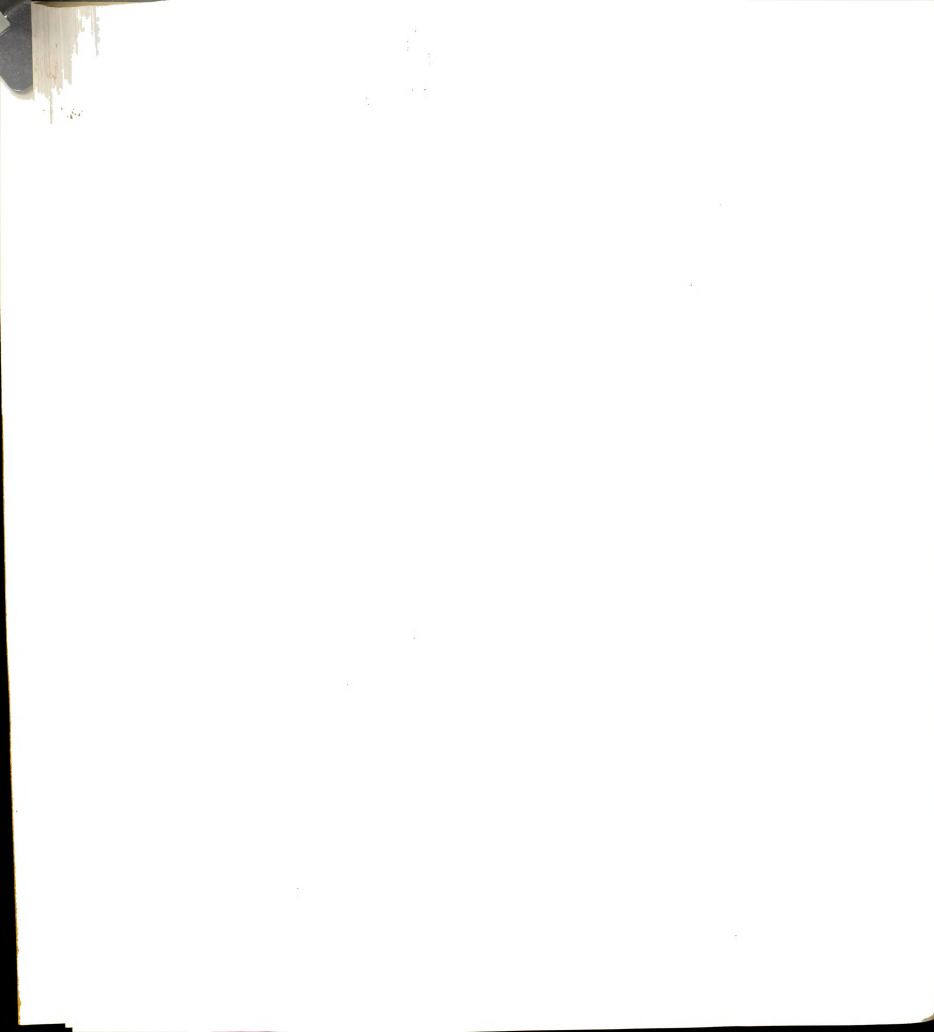


Figure VIII. Estimated labor use for enterprise groups in Region VI (Upper Peninsula) for 1959 and 1970-75 under alternative assumptions with respect to technological advance.



requirements. During the short pasture season, they used a nominal amount of labor. All the other livestock enterprises demanded only a little labor.

In 1959 the crop enterprises used more than 200,000 hours of labor from May to September. Two thirds of these can be accounted for by the activities on meadows and by roughage harvest. The rest of the labor went mainly to oats and potato cultivation in equal shares.

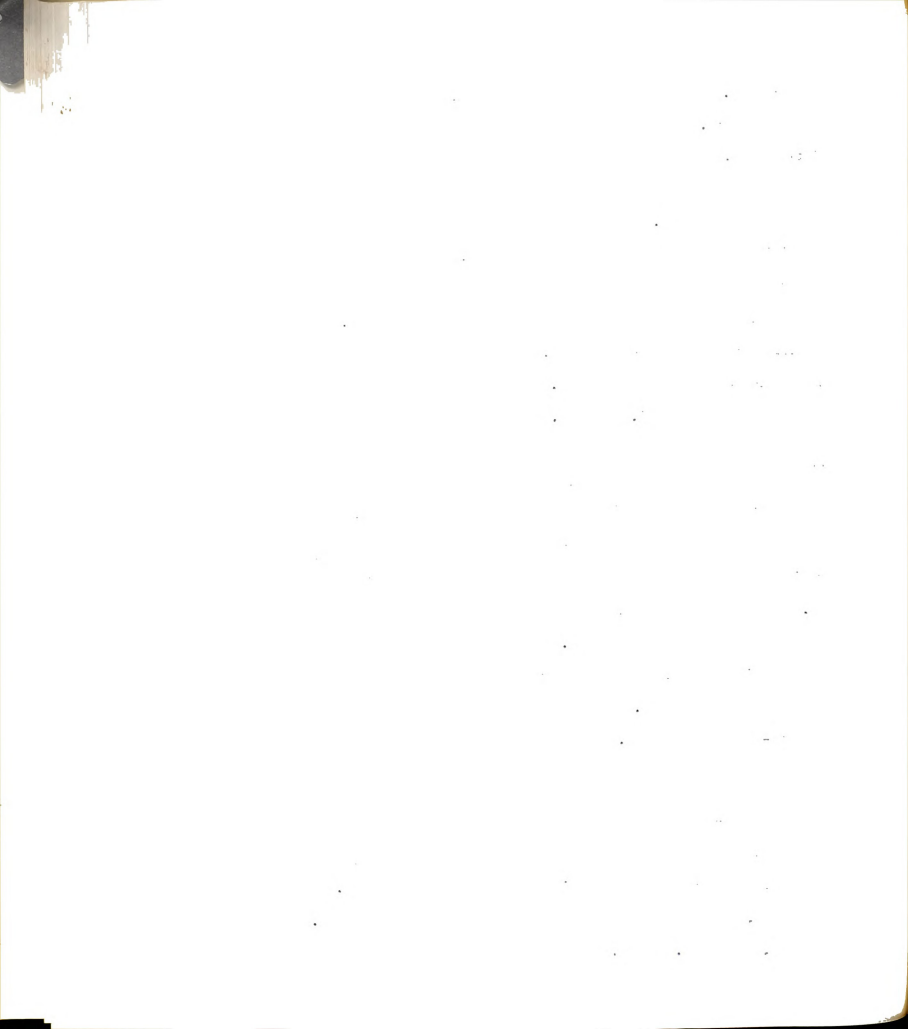
The only commercial fruit enterprise was strawberries. It explained nearly all of the work (430,000 and 200,000 hours) done in fruit enterprises in June and July. The harvest of apples in September-October demanded only 30,000 hours.

Analysis of Major Changes in the Labor Requirements for the State and its Regions by 1970-75.

This section discusses likely changes in monthly man-hour use in the state and each region during this decade if the technology and production change in the same fashion as was discussed in chapters II and III. As already mentioned, two alternate levels of technology are assumed for the period calculations. They may be considered as the boundaries within which economic and technological change most likely will place labor requirements. Special attention is given to the changes in peak man-hour requirements.

The State

In 1970-75 the combined labor requirements for the slower rate of technological advance are anticipated to lie for January to May and September to December about one fifth below 1959 requirements. In July and August, the reductions amount to one third of the 1959 level. Absolutely, between 2.5 and 3.5 million hours per month are expected to be



saved from September to March, between 5.5 and 6.5 million hours from April to June, and 8.0 and 9.5 million hours in August and July respectively.

The livestock enterprises will use approximately two million hours less labor each month under the assumption of a slower technological advance. Thus, from December to March, almost all the reductions of the labor requirements will be accounted for by the livestock enterprises. In April and May, crops will also contribute to the lower work load. The most spectacular overall reductions of 5.5-9.5 million hours expected for June, July, and August can be attributed in June to 50 percent by lower requirements for crops, in July to a 50 percent savings in the fruit enterprises, and in August to equal shares by all four enterprise groups. The expected lower labor needs of three million hours per month during September to November will be mainly due to savings in livestock enterprises supplemented by savings for vegetables and crops.

Under the alternative assumption of very fast technological advance and adoption of these technologies the combined labor demands will fall between 40-50 percent in January to March, July, and August, and between 27 and 40 percent in the other months. Absolutely the largest reduction of labor requirements is expected in July to August (in excess of 10 million hours each month). Cuts of labor input of 7 to 8 million hours are expected in April, May, September, and October, while during November to March the workload is anticipated to decline by 5 to 6.2 million hours each month.

All the livestock enterprises are expected to account for about 5 million hours of the reduction in labor needs each month from November to April, and during the summer for between 3 and 4.5 million hours.



Crops will contribute with 2-5 million hours to the explanation of lower labor demands from April to August with the larger reductions occurring in June and July. Fall months will register combined savings in crop enterprises of .5 to 1.5 million hours. Fruits will explain 5.5 and 3 million hours of the lower work load in July and August respectively. Vegetables will contribute to the labor savings especially during August (3 million hours), and September (1.5 million hours).

Region I (Southwestern Michigan)

The overall labor requirements of region I in 1959 were characterized by an accelerated build-up from January to July, and a similar decline for the second half of the year, interrupted only by another subpinacle in September. The labor demand rose threefold from a little over three billion hours in January and December. The picture for the future man-hour demands shows extraordinary reductions from April to August. Then the September peak is expected to be higher than the June peak by about one half million hours due to a relatively smaller decline of labor demand in September. One third of the over nine million hours in July is anticipated to be saved in 1970, while the corresponding figure for September is not even one fourth (or less than 2 million hours). Thus the peak in July will most likely lie below 6 million hours and the one in September between 6 and 6.5 million hours. The reductions for the other months of the year move between one fifth and one third (or .6 to 2.4 million hours) for the lower level of technological advance with the exception of February and October, when the reductions are 15 and 5 percent respectively. For the faster pace in technological adoption, the relative labor savings will fluctuate between 25 and 40

percent or .9 million and 2.6 million hours for all months excepting June and September.

What are the enterprise groups and the enterprises within them that will contribute most to the alterations from the 1959 level? The livestock enterprises are expected to register lower labor demands of between one fifth to one third (.4-.6 million hours per month) in the target period, depending upon which rate of technological advance takes place in the meantime. Their reductions are greater in the first four and last two months of the year. The dairy enterprise explains a good deal of the lower labor requirements in livestock, with reductions of one third to one fifth in labor inputs or 30,000-52,000 hours per month. They easily outweigh the increases of labor inputs of up to 15 percent or about 13,000 hours in some months in the beef cattle enterprises. Further reductions, as compared to the base year, are expected for the heifer enterprise amounting to one fifth to two fifths or 13,000-107,000 hours. The larger reductions are indicated for November until April and for the faster pace in technological advance. Due to the alteration in the farrowing system and a larger inventory of hogs, the variations in man-hour requirements are erratic, fluctuating from increased needs in July of 12,000-32,000 hours and smaller increases for October and November to decreased demands of 50,000-78,000 hours in March, April and December. Sheep are expected to have one fourth to seven tenths lower labor demands for all the months except July to September when labor inputs will most likely increase by one third to two and one third. The absolute magnitudes of those changes vary between minus 27,000 and plus 10,000 hours. The very important poultry enterprises (predominately layers) will also strongly manifest their divergence

from the 1959 labor demands. By the first half of the 70's the rapid technological advance suggests a 50 percent reduction in labor input, the moderate a 25 percent; i.e., labor savings of 9,000-18,000 hours are expected for every month.

The two peaks of the overall labor demands in July and September will be caused mainly by soaring labor needs in the fruit enterprises, although they will be 2 to 3 million hours below the 1959 July level. During the first five and last two months of the year, the divergence between the 1959 and the low and high level of technological advance will be below .2 and .25 million hours per month respectively. The gap is expected to widen from June to August. Thus the fruit enterprises will contribute significantly to lower labor needs in July and August. In October the demands for labor in orchards will most likely be unchanged. The large reductions of the labor inputs in June and July will be explained by savings in the strawberry harvest (most likely 100,000 hours for each of the two months), the raspberry harvest (most likely 560,000 hours for July), and the blackberry harvest (280,000 hours in July). All these reductions are topped by the huge savings during June (306,000 hours) and July (1.52 million hours) in the tart cherry harvest. Significantly lower labor demands of 165,000 and 220,000 hours are also expected in June and July in the apple and peach orchards. In August, the tart cherry and peach harvest are anticipated to use .6 million hours less labor, as will the grape, peach, and apple activities in September. The lower labor needs of the grape and plum harvest in October (90,000 hours) will be compensated for by inflated demands (plus 130,000 hours) for the apple and pear harvest in that month.

It is forecast that the crop enterprises in general will most

likely use .4 million to .8 million hours less each month from April to August by the first half of the 70's. For the other months the reductions will be nominal. The largest decline of man-hour requirements is expected for June, July and April, thus significantly contributing to the dwarfing of the peak demands of those months. In the April to June period the labor savings will account in corn alone for 350,000-400,000 hours each month. Small grains will contribute another 160,000 hours in April and meadows about 100,000 hours to the reductions. In June, haying, clover seed fields, and grass silage production will cut 400,000 hours from the 1959 requirements and 300,000 hours in July. In this month, activities in corn and grain fields will require 200,000 hours less than in 1959. In August, small grains and haying will each contribute 165,000 hours to the reductions of labor demands.

Labor savings in vegetable enterprises are expected to account for 200,000 to 300,000 hours each in May to July. The major impact is anticipated for August and September when .7 and .5 million fewer hours may be used in vegetable fields. Cucumbers alone are expected to require 515,000 and 200,000 hours less labor in August and September, respectively. The corresponding figures for tomatoes are 110,000 and 162,000 hours.

Region II (Western Michigan)

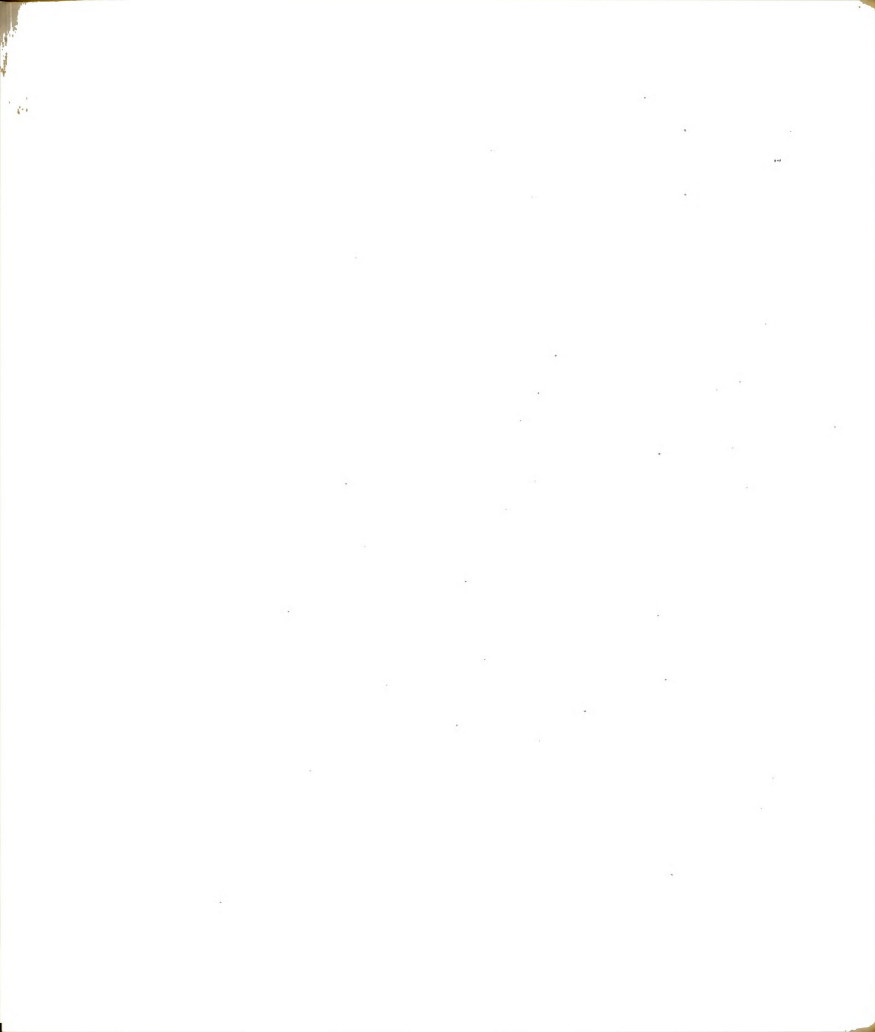
It is expected that in region II the overall labor requirements will be 20-40 percent lower in the target period compared to the 1959 level. April and August will show the largest reductions for both of the future stages of technology, while from June through September, the more rapid technological advance promises above average reductions in

labor requirements. Thus the peaks of April and June will be reduced significantly. For the moderate pace of adoption of technology, June through September will have labor demands at least one third higher than in the winter. Under the assumption of the rapid pace of technological advance only June and July will remain peak months with requirements approximately 40 percent above the average of the year.

All livestock enterprises together promise a fairly uniform reduction for each month for the 1970-75 period amounting to one fourth to one third of the 1959 base. Besides the reduced man-hour requirements per unit of livestock, the smaller headcount of dairy cows, heifers, sheep and poultry, will weigh more heavily than the addition in the beef enterprises. Dairy cows will most likely need 35-50 percent less labor, with outstanding reductions in May and September. Heifers will demand about one third fewer labor inputs every month, while higher beef cow inventories will call for a slightly increased labor demand especially during the off-pasture season. The sheep enterprise will require 7,000-10,000 hours less labor during the winter months. However, due to different lambing, the labor demands in the summer months may be somewhat higher. Fifty percent or 18,000-20,000 hours may be saved each month in layer activities.

The crop enterprises are expected to show reductions in excess of one fourth of the 1959 standard of the labor use in April and during June to August for both levels of technology. The outstanding enterprises contributing to the anticipated reduction of man-hour requirements are hay and grains. They are expected to register reductions of about 35-50 percent compared to the 1959 level, or 100,000-200,000 hours per month.

The fruit enterprises combined promise most of the reductions for



July and August which will occur by 1970-75. The tart cherry harvest is expected to use a little more than one third of the labor in 1970 and will easily offset the anticipated expansion of the sweet cherry cultivation. The net reduction during these two months will likely amount to 300,000 hours plus or minus 100,000 hours. Thus, one third of the July peak in these enterprises is expected to disappear, creating a smoother overall distribution of the labor needs in this area.

The largest factor of disturbance in the vegetable enterprises will involve cucumbers. Their labor requirements will be drastically reduced for the harvest in August due to an expected reduction of acreage and mechanized harvesting. This will eliminate the need of approximately 200,000 hours of labor in that month, thus removing the peak requirements of the vegetable enterprises. A slight depression will result in the overall labor requirements for August compared to the historical pattern and the adjacent months.

Region III (Northern Michigan, Lower Peninsula)

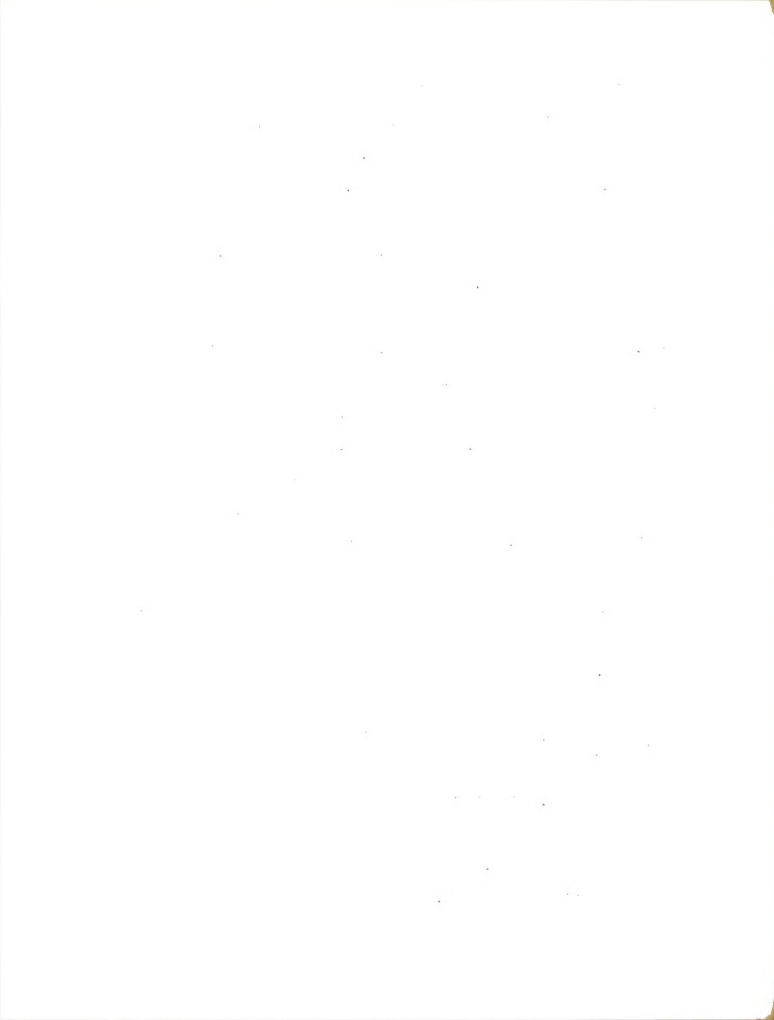
The labor use of region III was characterized, in 1959, by a peak that increased in June to August 2 to 4 times over the usual needs. It is anticipated that this peak will be far less pronounced during the target period rising in those months only one and one half to two and one half over the average labor demands for the rest of the year.

Most of this reduction will take place in the fruit enterprises. Tart and sweet cherries combined are expected to have labor demands of roughly one fifth, one third, and one half of the 1959 levels in June, July, and August respectively; this would correspond to labor savings of about .3, 1.6, and .5 million hours for these three months.



The alterations in the labor requirements for livestock enterprises will be distributed more evenly over the year. The least reductions are expected from July to October. Otherwise they will range between 150,000 to 250,000 hours each month. The important dairy enterprise is expected to register reductions in labor requirements of about 45 percent or between 135,000 and 168,000 hours per month, with the largest reductions in May. The heifer enterprise will show 35 percent lower labor demands or 35,000 hours for each month from December until April. For the remainder of the year, the relative reductions are expected to be somewhat smaller, while the absolute number of hours anticipated to be saved will range between 5,000 and 11,000 during the summer months and up to 30,000 in the fall. With the exception of midsummer the labor demands of beef cattle will most likely be 20 percent lower in 1970-75 than in 1959, thus requiring 10,000-14,000 hours less from November to June. The sheep enterprise is expected to register reduced demands reaching to 8,600 hours (or 64 percent in March) for November through June and 2,000-3,500 hours more in July and August. By 1970, the layer operations will use about 26,000 hours more labor each month.

In 1959 crop enterprises showed high labor inputs in April and from June to September. The expected reduction of the April peak by 200,000 hours can be attributed mainly to the lower labor needs of oats, potatoes, corn, and meadows. The lion's share of expected reductions in labor inputs from June to August will be achieved in haymaking, saving 100,000 to 200,000 hours monthly. However, 30,000 more hours are expected to go into haymaking in September. Potatoes will also contribute to the explanation of anticipated lower labor inputs from July to September



when 37,000-55,000 fewer hours will be required. Oats will save 70,000 in August.

Vegetables play a minor role in this region and no major changes in the labor use are foreseen for these commodities.

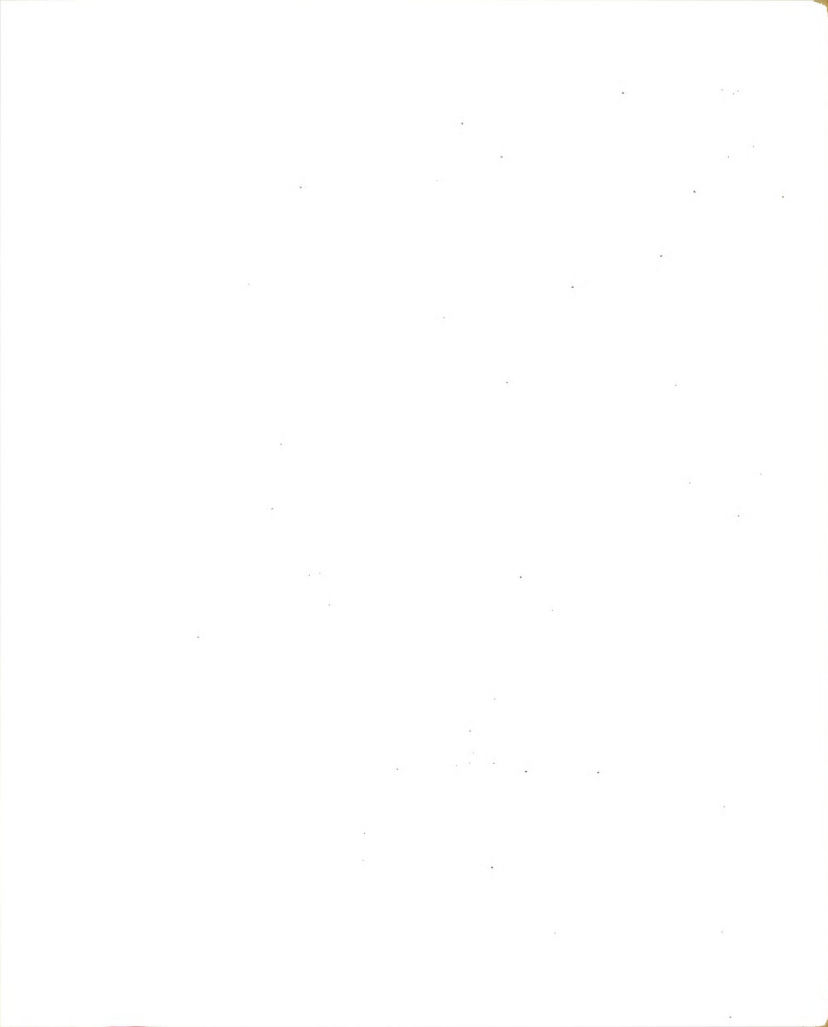
Region IV (Thumb, Saginaw Valley)

The overall labor requirements of region IV will show reductions between .5 and 1 million hours for each month except August for the moderate rate of technological advance and 1 million hours or more for the faster rate of advance. The August labor demands are expected to decline by one fifth or 2 million hours respectively, thus accentuating the shallow trough between the peak requirements in June and September-October. The spring activity pinnacle in April will lose some of its outstanding labor demands and will be more in line with those of the following months.

Livestock enterprises will contribute under the assumption of moderate technological advance .5-.7 million hours each month to the labor savings. The alternate prediction would yield monthly labor savings of .7-1.0 million hours. In general, the declines of labor inputs will tend to be smaller during May to October. The largest single enterprise explaining the lower labor inputs in livestock is that of the dairy cows. Depending upon the rate of technological progress .4-1.7 million hours less labor are forecasted for each month. Due to the inflated number of beef cattle, no significant changes in the labor needs of these enterprises are predicted. However, heifers will most likely demand over 100,000 hours less each month from November to April. During the summer, the reductions will be less pronounced, ranging from 15,000-25,000. The labor savings in April and October will lie between these winter and

summer extremes. Hogs will not show, as in other regions, a very uniform variation of the labor requirements. In most of the months the labor inputs will decline, as in March, April, and December (in excess of 16,000 hours). In July and October they may increase somewhat. None of these developments appear to aggravate peak labor requirements during the growing season. The sheep will require 6 to 16,000 hours less each month from November to June. During the summer months, insignificant increases in the labor demand may occur. The monthly labor demands for the poultry enterprises will most likely decline fairly uniformly between 70,000 and 90,000 hours.

Next in importance are the crop enterprises. Labor use in 1959 had two distinct peaks in June-July and September-October. April, August, and October promise labor savings by 1970 in the neighborhood of .5 million hours each, while savings in June and July of 1.0 and .7 million hours will help to explain the drastic reductions of the overall demands during these months. Lower labor needs in April will be largely due to the savings (440,000 hours) in corn, oats, and hay cultivations, which overbalance increases (64,000 hours) for the bean enterprises. Depending on whether technological progress in the sugar beet cultivation for the June activities is rapid or moderate, the total labor requirements also influenced by savings in the corn cultivation, may decline in that month by .250 to 1.4 million hours. The major reductions in July labor needs are for hay (400,000 hours), sugar beets (135,000 hours), small grains (130,000 hours), corn (47,000) and potatoes and beans (some 50,000 hours each). The crucial item for a successful and effective diminuation of the June-July peak will be improvements in sugar beet cultivation. In August, haymaking supposedly will require



300,000 hours less, the harvest of oats 218,000 less and the bean enterprise 140,000 fewer hours. Under these predictions, August will become a slack period for this region since about 1 million hours less labor will be needed than in adjoining months. October is expected to register big labor savings (300,000 hours) for the sugar beet harvest and smaller ones for corn (75,000 hours) and potatoes (66,000 hours). Corn silage and the bean enterprises will increase labor use by 150,000 hours.

The fruit enterprises are of little importance in area IV. Their high demands in July (200,000 hours) will diminish to two thirds of the 1959 level.

Region V (Southern Michigan)

The forecasts for the overall regional labor demands for 1970-75 by month show likely declines in the range of 1 to 1.3 million hours for January to March, September to December, and of 1.7 to 2.4 million hours for April to August. This implies higher reductions of the labor burden during the months with high requirements. The peak requirements will remain during September, June, and April but on an absolutely lower level of between 6 and 7.5 million hours as compared to 7.5 and 8.5 million in 1959. The relatively slack demand in May will be in accordance with the historical pattern. However, this is not true for August, when labor needs will drop to about 5 million hours from a little less than 6 million hours in July and in face of an increase to nearly 7 million hours in September. Livestock enterprises will contribute most to the overall reduction of expected labor needs from October through March. Livestock will share the reductions with crops from April to August, and also with vegetables in August and September.

As in other regions the reductions of the labor needs in the livestock enterprises of region V are more pronounced from November to May. For 1970-75 the labor inputs are expected to be about 3 million hours per month during September to April and about 2.5 million hours during the summer. Many of the prospective changes in the labor requirements for livestock can be explained by the variations of the labor demands of milk cows, which likely need .6 to .75 million hours less per month. The larger reductions in labor demands will come between September and May. Little variation in labor requirements for beef cows and feeder cattle are anticipated since higher headcounts will compensate for the potential labor savings per animal. An increase of a few thousand hours per month may be expected. On the other hand, heifers will have lower monthly labor demands of 19,000 to 150,000 hours for October to April and of 20,000 to 50,000 hours for May until September. The hog enterprise will display the erratic pattern as in other regions of lower labor inputs for a number of the months (up to 85,000 hours) and higher demands for July, October, and November (10,000 to 40,000 hours). February, May, and June will have no appreciable variation in labor needs. Generally, the sheep enterprise will require between 23,000 to 100,000 hours less labor per month from November to June with the larger reductions occurring during the winter months. Fall lamb feeding will increase July-September labor inputs by 13,000 to 32,000 hours each month compared to 1959. Thus, the hog and sheep enterprise will not interfere seriously with a more balanced work load during the growing season. The poultry enterprises are expected to use 80,000 to 155,000 hours less labor each month, with layers explaining nine tenths of the savings.

The crop enterprises will be next in importance with reductions

in labor needs during April to August and November. The foreseen reductions will be approximately 1 million hours each month for April to July (except for June), and 0.5 million hours in August and November. June will show the largest decline of labor needs with 1.3 million hours. January to March and September, October and December will not register any great variation from the 1959 labor requirements. Most of the reductions of labor needs during the spring activities are accounted for by the corn enterprises (1.1 million hours in April and May). In April and May, 250,000 hours are expected to be saved in the potato cultivation, while small grains will contribute another 150,000 hours to the savings during these two months. Expanded bean cultivation will likely require an additional 190,000 hours in the spring. Labor uses for June and July will be under the strong influence of savings in haymaking (.87 million hours), corn cultivation (.71 million hours), and small grain harvest (180,000 hours) thus explaining the erosion in the peak labor demands of June. Potato cultivation will then cut another 120,000 hours, fields of small legume seed 80,000 hours, and grass silage, 95,000 hours from the 1959 level of labor requirements. Reductions in labor inputs are also expected during August in the small grain harvest (220,000 hours), haying (245,000 hours) and in the potato cultures (83,000 hours). Corn silage harvest and the bean harvest will add about 275,000 hours during September and will thus negate the labor savings in small grain planting and potato harvest. In October, lower total labor demands will be brought on by lower labor needs in the corn and potato harvest.

In 1959, vegetable activities had a peak labor demand of 1.8 million hours in August, but the forecast for the early 70's calls for only about 1 million hours in August and September. The reductions

during the July-September period will come primarily from the pickling cucumbers (1.25 million hours) secondarily from tomatoes (320,000), and from onions (100,000 hours). Thus, mechanization of the cucumber cultivation and harvest will play the crucial role in the reduction of labor requirements of all farm enterprises.

The labor needs of fruit enterprises are not expected to change significantly in this region.

Region VI (Upper Peninsula)

In 1959 there were three months in which the total labor inputs were close to or exceeded one million hours in the Upper Peninsula; these were June, July and August. In 1970-75 the labor inputs are expected to have fallen by one fourth to one third, eliminating 200-300,000 hours each month from the work load. The savings will depend upon the month and the assumptions accepted with respect to technological progress. The larger reduction will occur during the peak summer requirements. However, the peak demand will remain from June to August, and will also include September.

The livestock enterprises combined will again account for four fifths of the total work load except from May to September; when crops and fruits will make up one third to one half of total labor requirements. All the livestock enterprises will likely require between 300,000 and 450,000 hours during the winter months and about 50,000 hours less during the summer. Most of the reductions will be achieved by the dairy enterprise between 150,000 and 185,000 hours monthly). Heifers will account for labor savings reaching 29,000 hours and layers for another 10,000 hours per month.



Crops will most likely register lower labor needs in April, May, and September amounting to 40,000 to 100,000 hours. From June to August the savings will reach 150,000 to 200,000 hours each month. Hay making will use 192,000, 136,000, and 92,000 hours less in June, July, and August, respectively, thus accounting for most of the labor savings. Potatoes and oats will reduce labor use further in these and other months of the growing season. Thus, labor inputs for crops will most likely be between 150,000 and 300,000 hours during the summer and be at 75,000 hours in April.

The only other enterprise group of any consequence during the June-August period will be the fruits. There may be a tendency for slightly higher labor needs during these months due to expanded strawberry cultivation.

Vegetables do not and will not play in the future an important role in the Upper Peninsula. Combined labor inputs for vegetables will reach only about 15,000 hours in the summer.

CHAPTER V

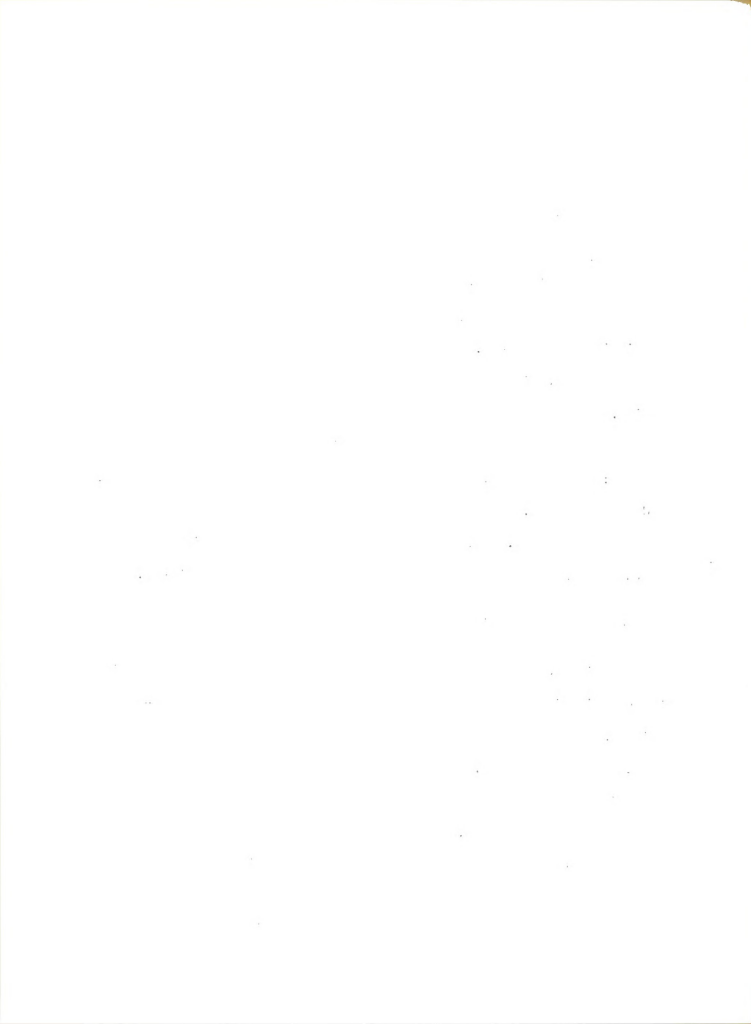
THE ESTIMATED AVAILABILITY OF LABOR BY TYPE FOR 1959 AND 1970-75

The previous chapters were concerned with establishing total man-hour use for different enterprises and their groups for several regions of Michigan for 1959-75. This chapter attempts to disaggregate the farm labor force into its components by type of labor for 1959 and the target period.

The agricultural work force is broken down into four major components: the operator, unpaid family members, regularly hired workers, and seasonal help. Their respective contributions to the total labor force are estimated. Later on, an attempt is made to provide estimates of the farm labor force of the first three components for 1970-75.

Procedure for Determining the 1959 Share of the Work Force by Type of Labor

This section discusses the method followed in order to establish the contributions of different classes of labor to the total man-hour requirements for the six regions of Michigan, giving them first for 1959 and then for the future. Within the monthly division, the order of presentation goes from operator, regularly hired, and unpaid family members to seasonally hired labor. Since all the man-hour requirements are expressed in hours per acre and region, the contributions of the different types of labor will be also stated in hours. In order to obtain the total of hours worked by any one of the types mentioned, data on the



number of persons in that class are needed as well as the average number of hours a person works per month. The Census supplies enumerations of full-time farm operators for 1959 by counties on Table 6. Preference is given to this enumeration since over half of the operators pursued off-farm work in 1959, especially those classified as poultry, other livestock, or cash grain farmers. The Census Table 6 gives, by county, the number of regularly hired workers, i.e., those who are employed more than 150 days. This statistic conforms also with the estimates of the Michigan Agricultural Statistics and therefore was accepted without change.

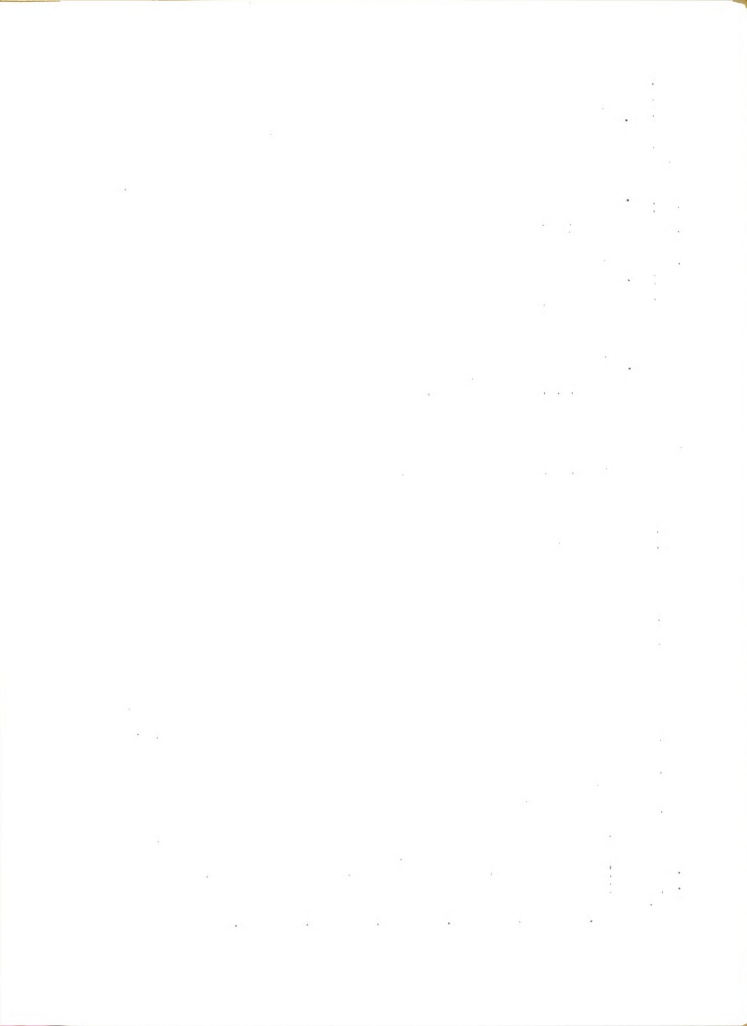
As could be expected, the number of unpaid members of an operator's family, who worked more than 15 hours in the week preceding enumeration in October and November is low relative to the rest of the year. Comparisons with the estimates of the Michigan Department of Agriculture made an adjustment necessary in order to reflect more realistically the number of unpaid family workers during the entire year. On the basis of data from the Michigan Department of Agriculture the Census figures were inflated by 1.35.

Seasonal workers are not well represented in the Census. Since the share of farm work done by this group is high during several summer months, the author considered it necessary to obtain data concerning their use elsewhere. The Michigan Employment Security Commission publishes its estimates of the number of seasonal workers in certain regions on a bimonthly basis in its annual Post Season Reports. Its estimates are broken down by spatial origin as to local, interstate, intrastate, and foreign migrants and reported in Table 5.1 on the following page. The regional subdivision of this agency could be transformed into the

Table 5.1. Number of seasonal farm workers by geographic origin by month and region in Michigan, 1963

<i>Region and Origin of Seasonal Worker</i>	<i>April</i>	<i>May</i>	<i>June</i>	<i>July</i>	<i>Aug.</i>	<i>Sept.</i>	<i>Oct.</i>	<i>Nov.</i>
I. Southwestern Michigan								
Local		1,235	702	3,188	6,097	4,078	2,170	306
Intrastate		207	163	797	1,438	934	455	43
Interstate		1,334	1,013	5,862	8,901	5,162	3,349	147
Foreign				600	2,878	1,746	112	17
II. Western Michigan								
Local	267	407	368	909	1,160	724	686	186
Intrastate	22	43	70	479	357	12	70	17
Interstate	28	102	180	2,247	1,679	252	324	78
Foreign				184	950	560	8	
III. Northern Michigan								
Local				1,583	1,344	280	173	57
Intrastate				3,125	1,375	50	135	18
Interstate				9,650	5,533	117	217	17
Foreign					33	17		
IV. Thumb, Saginaw Valley								
Local			200	609	614	211	183	158
Intrastate						8	8	
Interstate			317	1,061	1,067	400	175	50
Foreign				1,429	4,571	2,280		
V. Southern Michigan								
Local			74	112	321	842	734	99
Intrastate			13	47	68	139	158	14
Interstate			210	483	837	800	738	83
Foreign				825	3,206	1,440	9	2
VI. Upper Peninsula								
Local			233	867	800	2,192	1,892	
Intrastate								
Interstate								
Foreign								

Source: Derived from data in the files of the Michigan Employment Security Commission, Detroit.



area division of the present study.

The hours worked by farm labor diverge considerably between different types of farms. Farm account records from different types of farms for the years 1958-60 served as a basis for the average yearly work load of operators and unpaid family members for 1959. For permanently hired workers, data from the Michigan farm accounts¹ supplemented those from the statewide Census enumeration of Table 15. The annual work load was then distributed by months according to information obtained from Illinois farm account data which were the only detailed data available. Cross checks with aggregative information for Michigan confirmed the applicability of the Illinois findings for Michigan conditions.² In order to obtain the hours worked by these three groups of labor for a region during 1959, a weighted average had to be found for each of them expressing the types of farm mix for a region. The number of a specific type of farm is given in the Census Table 5 by counties. The percentage distribution of the types of farms by regions served as a weight to the monthly and annual hours which an operator, hired man, or family member worked. Then the results are multiplied by the number of operators, hired workers, and family members and the number of hours worked in that specific region by each of the groups is obtained. Table 5.2 shows the number of hours worked by permanent types of labor by region and month.

The number of seasonally hired workers in a particular month and region was determined the following way: the regional data were reported

¹Farming Today, Mich. State Coop. Ext. Service, Series for 1958-60.

²Hinton and Mueller, Detailed Cost Report..., op. cit., pp. 24 f. Farm Management Manual, op. cit., p. 18. Lard, op. cit., p. 153.

Table 5.2. Number of hours worked by permanent types of labor by region and month, 1959^{1,2}

Operator	Region	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Operator	Southwest Michigan	170	170	171	238	239	233	233	232	238	238	198	185
	Western Michigan	170	170	170	240	240	237	237	237	240	240	207	187
	Northern Michigan	173	173	173	238	238	235	235	235	238	238	200	185
	Thumb, Saginaw Valley	172	172	172	238	238	230	226	230	238	238	206	182
	Southern Michigan	162	162	162	240	240	238	236	234	240	240	202	172
	Upper Peninsula	167	167	167	241	241	237	237	237	241	241	210	181
Hired Labor	Southwest Michigan	172	172	173	213	215	216	217	220	225	224	189	172
	Western Michigan	173	173	173	213	220	217	217	217	220	220	187	173
	Northern Michigan	172	172	173	213	218	216	217	218	220	220	187	172
	Thumb, Saginaw Valley	167	170	170	212	220	216	216	216	220	220	187	167
	Southern Michigan	163	163	163	213	223	220	215	215	222	222	185	163
	Upper Peninsula	176	176	176	214	220	217	217	217	220	220	187	173
Unpaid family members of the operator	Southwest Michigan	28	28	28	76	84	100	103	86	85	99	51	28
	Western Michigan	30	30	30	80	80	102	105	87	83	100	53	30
	Northern Michigan	30	30	30	80	80	101	104	88	85	100	52	30
	Thumb, Saginaw Valley	30	30	30	80	81	102	104	87	84	98	52	30
	Southern Michigan	30	30	31	80	81	103	106	87	84	100	56	31
	Upper Peninsula	30	30	30	80	80	102	106	87	84	100	54	30

¹Number of hours worked is weighted by the type of farm mix in a particular region. The proportion of types of farms in a region was derived and computed from the U.S. Census of Agriculture 1959.

²It is assumed that in 1970-75 all three types of labor will work 25 hours less per month, from January to March and in November and December, and 18 hours less from April to October.

for the middle and end of each month. Then the average of these data multiplied by the number of hours worked in a month gave the number of hours worked by seasonal help in a particular month and region. Seasonally hired laborers work on the average, according to the information of the Employment Security Commission, 48 hours per week from June through September and 40 hours otherwise.

Procedure for Estimating 1970-75 Contribution to the Work Force
by Types of Labor

In recent years, cohort analysis of census data by age of farm operators has become a valuable tool in estimating the future number of them. The number of farm operators in a specific age group is a function of the farm-nonfarm earnings ratio. The estimated rate of survival of age groups provides for age-specific shifts in the supply of farm operators. Assuming that similar conditions for a given decade are similar to those in the past decades, an idea of the age distribution and number of operators can be obtained for the next decade. Such cohort analysis has been performed for Michigan.³ The developments on the state level are assumed to hold to the same extent for all of the regions. This implies that all the operators classified in 1959 as above 64 and 60 percent of those between 55 and 65 years of age will have retired. The operators of all other age groups beginning farming are assumed to equal the number of operators in those age groups ceasing to farm. Census county data treated in this way will yield the number of operators in a region by 1970-75. Following the historical decline of the length of the work week, it is further expected that, by then, operators will work

³Johnson, W.E., The Supply of Farm Operators, Ph.D. thesis, Dept. Agr. Econ., Univ. of North Carolina, 1963. Jones, B., op. cit.

on the average about 250 hours less per year than in 1959.

Due to lack of census data, similar procedures are not available for unpaid family members and hired workers. If the outmigration of unpaid family members continues as in the past, only 74 percent of the number available for farm work in 1959 will be at hand in 1970-75. Those remaining are also expected to work about five hours less per week than in 1959. Since the number of permanently hired workers has not changed significantly during the last 10 years and is not expected to change due to the loss of working family members, about the same number of them are expected to be on Michigan farms in 1970-75 as in 1959. As farm operators they too will work shorter hours.

The difference between the total availability of all labor in each region and month and the labor requirements was computed for 1959, leaving an unaccounted residual. This residual was expressed in percent of the total availability of permanent types of labor.⁴ The prospective labor requirements for 1970-75 in a particular region and month for both levels of technology were inflated by the percentage value of the 1959 residual. This then may be termed the anticipated total labor requirements for a month and region and be subtracted from the projected labor supply of the three permanent types of labor. A positive difference will indicate a surplus of manpower in that month and region. A negative difference will indicate a deficit.

A surplus of labor suggests that farmers may: (1) reorganize and make better use of the existing labor pool, (2) enjoy more leisure time, or (3) pursue off-farm employment opportunities. On the other hand, a

⁴Henceforth, it will sometimes be referred to as the "unexplained or unaccounted residual," which is a positive value. See Table 4.1 p. 120.

deficit implies that farmers have a choice among (1) reorganizing, such that the labor requirements in a particular period are diminished, (2) working longer hours, (3) more quickly adopting labor saving technologies, and (4) trying to hire more seasonal help.

The discussion of the share which a type of labor contributed or will contribute to the total work force will run in absolute and relative terms. The absolute magnitude is converted into man months which are defined as 200 hours of work. This constitutes approximately the weighted average hours worked per month of all types of laborers during the course of the year.⁵

Analysis of the Work Force for Michigan and its Regions, 1959

On the state level in 1959, operators furnished monthly between 76,300 and 81,800 man months of work from December to March, i.e., about four fifths of the available labor, while hired and family labor shared in making up the rest of the work force on farms (10,500 man months each). During April to June and November, operators contributed monthly about 108,000 man months, i.e., between two thirds and three fourths to the work force, with hired workers contributing 8-9 percent or 13,000 man months and family members almost the remaining (i.e., 20,000-36,000 man months). Seasonal help is unimportant during this time. In spite of the same absolute worktime done by operators (107,000 man months), their share of the work force declined for the summer to 55-65 percent. Then unpaid family members contributed one fifth each month of the work

⁵To further simplify the language, henceforth it will be referred to unpaid family members of the operator as "family labor" or "workers" and to farm workers employed in excess of 150 days per year as "hired workers" as distinguished from seasonally hired help.

force on farms (30-37,000 man months) and hired help 7-8 percent (13,000 man months). Table 5.3 shows the estimates of the relative share of work performed by types of labor in Michigan for 1959 and 1970-75.

The domestic seasonal work force provided monthly, between 273 and 3,656 man months in April to June and in November. The peak of its contribution was reached in July and August when over 32,000 man months were supplied by them, i.e., their share was nearly one fourth of the total work force. Less manpower came from this group in September (16,700 man months or 10 percent) and October (9,900 man months or five percent). Within the category of domestic seasonal workers, local laborers' share moved between 230 and 10,793 man months, i.e., 23-84 percent with the heavier engagement at the beginning and end of the season. Intrastate laborers' share lay between 19 and 4,590 man months, i.e., they accounted for 6-15 percent of the seasonal farm laborers except for November, when they had a larger relative commitment (28 percent). Intrastate workers had higher absolute contributions during the July to September period. Interstate labor furnished between 1,000 and 7,000 man months in May, June, September, and October. In July and August interstate labor contributed 18,500-20,000 man months. The proportion of interstate labor varied between 8-62 percent; the heavier contributions occurred in June to August. Foreign workers supplied monthly from July to September between 3,000 and 12,000 man months towards the work force; the greater share came in August and September. Estimates of the relative share of work performed by types of labor are reported on Table 5.3 for 1959 and 1970-75.

While the analysis of the work force on the state level furnishes some insights, the level of aggregation conceals relationships that are of tantamount importance on the regional level.

Table 5.3. Relative shares of work performed by different types of labor on Michigan farms, 1959 and projections for 1970-75¹

Month	Operator		Hired		Family		Seasonal		Foreign	
	1959	1970-5 L h	1959	1970-5 L h	1959	1970-5 L h	1959	1970-5 L h	1959	1970-5 L h
Percent										
January	78.6	84.8	10.6	13.4	10.8	1.8				
February	78.6	84.7	10.6	13.4	10.8	1.8				
March	78.5	84.7	10.6	13.4	10.9	2.0				
April	72.4	75.4	8.7	10.5	18.7	14.2	.2			
May	70.6	74.7	8.7	10.7	18.8	14.6	1.9			
June	66.8	67.0	8.3	9.7	22.6	17.6	2.3	5.9		
July	55.3	61.0	6.9	8.8	19.4	16.7	18.4	16.8	13.7	4.5 1.6
August	54.3	64.0	6.8	9.3	10.3	15.9	13.9	15.4	16.8	12.8 3.5 6.2
September	62.1	59.4	67.5	7.7	8.1	9.8	17.1	12.1	13.7	9.5 20.0 9.2 3.6
October	64.8	64.1	70.1	8.1	9.3	10.2	21.1	13.1	14.3	5.9 10.7 2.4 .1
November	74.6	72.0	79.8	9.2	10.1	11.5	15.3	7.8	8.6	.9 9.8 2.9
December	79.7	85.7		10.0	12.5	10.3	1.8			

¹ L in 1970-5 column refers to moderate rate of technological advance. h in 1970-5 column refers to rapid rate of technological advance.

2. The second part of the document focuses on the implementation of the proposed changes. It details the steps involved in the transition process, from the initial planning phase to the final execution. This section also addresses the potential challenges and risks associated with the changes, providing strategies to mitigate them.

3. The third part of the document discusses the impact of the changes on the organization's overall performance. It presents data and analysis showing the positive effects of the changes, such as increased efficiency and cost savings. This section also highlights the importance of ongoing monitoring and evaluation to ensure the changes continue to deliver the desired results.

4. The fourth part of the document provides a summary of the key findings and conclusions. It reiterates the importance of the changes and the need for continued commitment and support from all stakeholders. This section also offers recommendations for future actions and improvements.

5. The fifth part of the document is a conclusion that summarizes the main points of the document. It emphasizes the importance of the changes and the need for continued commitment and support from all stakeholders. This section also offers recommendations for future actions and improvements.

Table 5.4. Work performed by types of labor on Michigan farms in absolute and relative terms by month and region, 1959.

Region and type of labor	January 1000 hrs.	January %	February 1000 hrs.	February %	March 1000 hrs.	March %	April 1000 hrs.	April %	May 1000 hrs.	May %	June 1000 hrs.	June %
I Southwestern Michigan												
Operator	3,718	77	3,718	77	3,740	77	5,205	72	5,227	66	5,096	65
Hired	690	14	690	14	694	14	855	12	863	11	867	11
Family	431	9	431	9	431	9	1,170	16	1,293	16	1,540	19
Seasonal									477	6	388	5
Foreign												
II Western Michigan												
Operator	1,067	80	1,067	80	1,067	80	1,506	70	1,506	69	1,487	64
Hired	95	7	95	7	95	7	117	5	120	5	119	5
Family	177	13	177	13	177	13	471	22	471	21	600	26
Seasonal							55	3	95	4	128	5
Foreign												
III Northern Michigan												
Operator	1,196	81	1,196	81	1,196	81	1,646	73	1,646	73	1,625	69
Hired	102	7	102	7	103	7	127	6	129	6	128	5
Family	181	12	181	12	181	12	484	21	484	21	610	26
Seasonal												
Foreign												
IV Thumb, Saginaw Valley												
Operator	3,651	80	3,651	80	3,651	80	5,052	73	5,052	72	4,882	67
Hired	371	8	377	8	377	8	471	7	488	7	480	7
Family	532	12	532	12	532	12	1,418	20	1,435	21	1,807	25
Seasonal											107	1
Foreign												
V Southern Michigan												
Operator	4,860	78	4,860	78	4,860	78	7,199	73	7,199	73	7,139	69
Hired	732	12	732	12	732	12	956	10	1,001	10	988	9
Family	629	10	629	10	650	10	1,677	17	1,698	17	2,159	21
Seasonal											61	1
Foreign												
VI Upper Peninsula												
Operator	767	79	767	79	767	79	1,107	70	1,107	70	1,089	63
Hired	57	6	57	6	57	6	70	4	72	5	71	4
Family	151	15	151	15	151	15	403	26	403	25	513	30
Seasonal											48	3

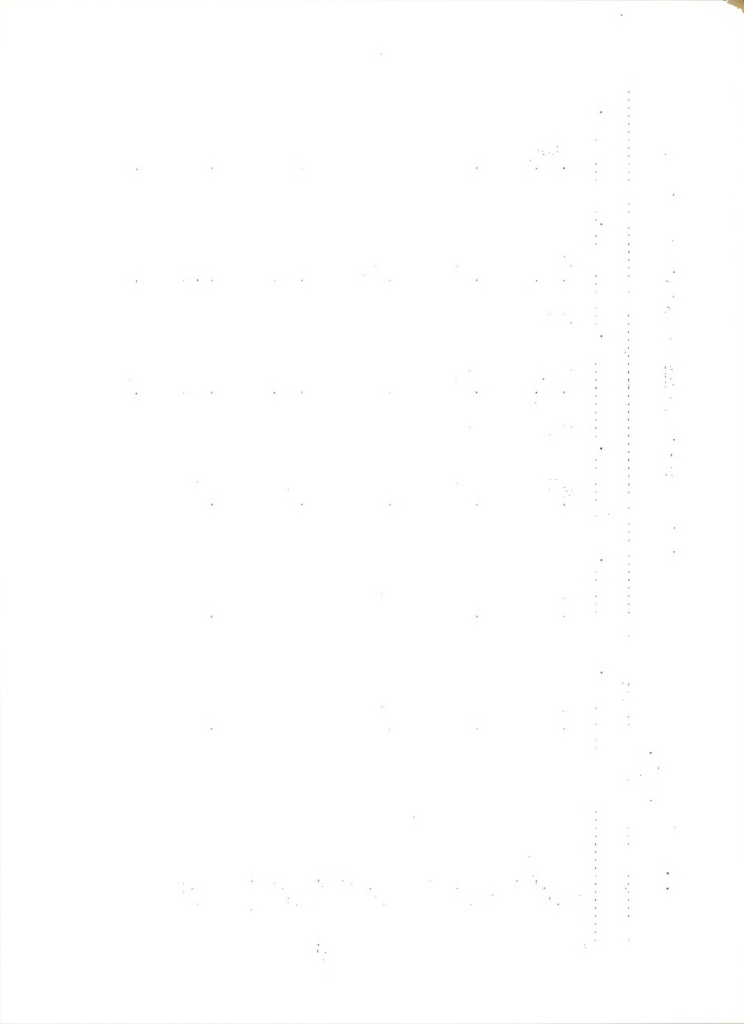


Table 5.4. Work performed by types of labor on Michigan farms in absolute and relative terms by month and region, 1959 (continued)

Region and type of labor	July		August		September		October		November		December	
	1000 hrs.	%	1000 hrs.	%	1000 hrs.	%	1000 hrs.	%	1000 hrs.	%	1000 hrs.	%
I Southwestern Michigan												
Operator	5,096	53	5,074	45	5,205	53	5,205	60	4,330	73	4,046	78
Hired	871	9	883	8	903	9	899	10	759	13	690	13
Family	1,586	16	1,324	12	1,309	13	152	18	785	13	431	9
Seasonal	2,032	21	3,357	30	2,095	21	1,028	12	85	1		
Foreign	124	1	594	5	360	4	19		3			
II Western Michigan												
Operator	1,487	49	1,487	50	1,506	62	1,506	63	1,299	74	1,173	81
Hired	119	4	119	4	120	5	120	5	102	6	95	7
Family	618	21	512	17	489	20	589	24	312	17	177	12
Seasonal	760	25	660	22	204	8	186	8	48	3		
Foreign	38	1	196	7	116	5	1					
III Northern Michigan												
Operator	1,625	30	1,625	41	1,646	69	1,646	67	1,383	76	1,280	82
Hired	129	2	129	3	131	5	131	5	111	6	102	7
Family	629	12	532	14	514	22	604	24	314	17	181	12
Seasonal	2,963	56	1,703	42	92	4	90	4	16	1		
Foreign			7		4							168
IV Thumb, Saginaw Valley												
Operator	4,797	62	4,882	60	5,052	66	5,052	69	4,372	76	3,863	81
Hired	480	6	480	6	488	6	488	6	415	7	371	8
Family	1,843	24	1,542	19	1,488	20	1,737	24	921	16	532	11
Seasonal	345	4	347	4	128	2	63	1	36	1		
Foreign	295	4	943	11	471	6						
V Southern Michigan												
Operator	7,079	67	7,019	66	7,199	68	7,199	68	6,059	75	5,159	79
Hired	965	9	965	9	997	9	997	9	830	10	732	11
Family	2,222	21	1,824	17	1,761	17	2,096	20	1,174	15	650	10
Seasonal	133	1	253	2	368	3	288	3	34			
Foreign	170	2	662	6	297	3	2					
VI Upper Peninsula												
Operator	1,089	58	1,089	60	1,107	54	1,107	55	965	74	831	80
Hired	71	4	71	4	72	3	72	4	61	5	56	5
Family	528	28	438	24	423	21	503	25	272	21	151	15
Seasonal	179	10	225	12	452	22	325	16				

The 1959 composition of the work force in region I (Southwestern Michigan) had a seasonal pattern similar to that of the state.⁶ The total work force has been 25,000 man months in each of the months from December to March. Operators accounted for 77-78 percent, hired labor for 13-14 percent, and family members for 8-9 percent. Between 20 and 38 percent (or 5,000-9,800 man months) of the total available labor was not accounted for by the computed demand for labor. The total monthly work force rose to between 30,000 and 39,000 man months from April through June and November. The operators' share in the work force had fallen to 65-73 percent. Hired laborers made up 11-13 percent and family members 13-22 percent of the work force. The monthly unexplained residual of labor supply over demand ranged from 20-29 percent (7,800-10,600 man months) except for June, when a small deficit occurred. From July to October the total monthly work force registered 50,000 man months. The share taken by operators and hired help declined to 45-60 percent and 8-10 percent respectively. Family members kept their contributions between 11 and 17 percent. During summer and fall, interstate migrants accounted for 50-60 percent of the seasonal labor's share of the work force. The local labor pool usually supplied from one third to two fifths of the seasonal help with a larger contribution in November. Intrastate migrants contributed between 7 and 9 percent to the seasonal workers. The difference between availability and demand diminished to zero in June and July and was in September, 24 percent (or 8,900 man months). However, it had large values in August and October (46 and 40 percent or 17,800 and 15,245 man months respectively). This may be explained by the many less desirable stoop labor tasks in the

⁶Table 5.4 on pages 167 and 168 give the absolute and relative estimates of work performed by month and types of labor in region I for 1959.

vegetable and berry fields, which are shunned by permanent types of labor and for which seasonal workers are hired.

During the winter months (December to March) the work force in region II (Western Michigan) amounted to about 6,700-7,200 man months.⁷ Of this amount, approximately 80 percent could be attributed to operators, 7 percent to hired labor and 13 percent to family labor. The excess of availability over requirements ranged from 1,450 to 2,350 man months. April, May, October, and November had a total work force each of 9,000 to 12,000 man months, of which only 2-7 percent went to seasonal workers. Of the work force, between 63 and 74 percent can be traced to operators, 5-7 percent to hired, and 17 to 24 percent to family laborers. In these months between 2,900 and 5,000 man months of the available labor were not accounted for. During June to September, the work force fluctuated from 11,700 to 15,100 man months. Fifty to sixty-five percent of this quantity was accounted for by operators, 4-5 percent by hired labor, and 17-25 percent by family labor. The remainder of 6-29 percent can be ascribed to seasonal labor; their highest contribution occurred in July and August. Foreign nationals accounted for 4.5 and 6.5 percent of the work force in August and September. Of the seasonal work force, local labor held the bigger share (in excess of 60 percent) early and late in the season, while in July and August interstate migrants contributed 61 and 52 percent respectively to the supply. Intrastate migrants were confined to a minor role, not exceeding 13 percent. In the summer the unexplained portion

⁷Table 5.4 on pages 167 and 168 give the absolute and relative estimates of the work performed by month and types of labor in region II in 1959.

of the availability of the farm labor pool amounted to between 4,000 and 6,200 man months.

Region III (Northern Michigan) showed a monthly work force of approximately 8,000 man months from November until March.⁸ Operators accounted for 76-81 percent of the work force, hired labor 6-7 percent, and family labor 12 to 17 percent. During the winter 2,600 to 4,200 man months of the available labor were left unexplained. A work force of about 11,700 man months was calculated for April, May, September, and October. Sixty-seven to seventy-six percent of the work force could be attributed to operator, 5-6 percent to hired labor, and 21 to 24 percent to family help. An insignificant share of seasonal help was employed in September and October (2-4 percent). During these spring and fall months, the unexplained residual amounted to between 3,500 and 6,600 man months. June and August have had a labor force of 12-20,000 man months and July of 26,700 man months. Operators accounted in July and August for only 30 and 40 percent respectively, and family labor for 12 and 14 percent. The share of the total work force of hired help shrank to 3-4 percent. But 55 and 43 percent respectively can be traced to seasonal domestic labor in July and August. In these two months, 67 percent of this group of farm workers came from other states, 11-16 percent from the local labor pool and 17-22 percent from other places in Michigan. Later in the year, the local labor played a more important role by replacing out of state migrants. During the summer between 620 and 300 man months of the available farm labor could not be accounted for.

In region IV (Thumb-Saginaw Valley) operators supplied about four

⁸Table 5.4 on pages 167 and 168 give the absolute and relative estimates of the work performed by month and types of labor in region III in 1959.

fifths and hired and family labor about one tenth each to the farm work force between December and March.⁹ The difference between availability and demand for labor during these months was between 7,600 and 9,500 man months. April, May, and November saw a labor force between 28,000 and 34,100 man months, with operators supplying 72-76 percent, hired labor 7 percent and family labor 20-23 percent. The unexplained residual came to between 7,000 and 13,000 man months. During June to October the work force amounted to 36,400-41,000 man months. Operators furnished 60-69 percent, hired help 6-7 percent and family labor 19-24 percent. The share taken by seasonal help climbed to 16 percent in August and stood at 7-8 percent in July and September. In these three months out of state migrants made up two thirds of the seasonal work force and local labor the remaining one third. During the summer season the excess of requirements over availability stood between 6,800 and 14,300 man months.

Region V (Southern Michigan) showed a labor force of approximately 31,700 man months in each month from December to March.¹⁰ Seventy-eight percent of this came from operators, 11 percent from hired help and 10 percent from family members. In these months the unexplained residual came to between 7,000 and 10,500 man months. May, October and November each registered available farm labor of 40,500-52,900 man months, of which about 70 percent was filled by operators, 10 percent by hired help, and 15-25 percent by family labor. Now the excess of requirements over availability came to between 7,700 and 18,200 man months. In April and in June to September, the work force amounted to 49,200-53,600 man months.

⁹⁻¹⁰ Table 5.4 on pages 167 and 168 give the absolute and relative estimates of the work performed by month and types of labor in regions IV and V in 1959.

Operators contributed 65-73 percent, hired labor 9-10 percent, family labor 17-12 percent; seasonal labor furnished 3-9 percent, with a heavier engagement in August and September. In these two months, one half to two thirds of the seasonal help came from interstate migrants, one fourth to one half from local workers, and the remainder from intrastate migrants. In August, foreign migrants accounted for their greatest share (7 percent) of the total labor. The summer registered an unaccounted residual of 11,100 to 16,200 man months.

Region VI (Upper Peninsula) has had a work force of 4,900-6,500 man months per month from November to March.¹¹ Three-fourths to four fifths of the burden was carried by operators, 5-6 percent by hired labor, and 15-20 percent by family labor. In the winter the unexplained residual came to between 1,400 and 2,900 man months. April, May, and October registered a monthly labor force of 7,900-10,000 man months. In April and May 70-75 percent of the farm labor came from operators; in October operators furnished only 55 percent. Hired workers supplied about 5 percent and family labor 25 percent. Seasonal help, all of it from the local labor pool, accounted for 16 percent in October. These spring and fall months had an unaccounted residual of 3,700 to 4,300 man months. The summer showed a labor force of 8,600-10,300 man months; 54-63 percent of the supply of labor was attributed to operator labor, 4 percent to hired, and 20 to 30 percent to family labor. Seasonal help, exclusively from local sources, accounted for an increasing share (3-22 percent) as the season progressed. During the summer the unexplained residual amounted to between 2,200 and 3,900 man months.

¹¹Table 5.4 on pages 167 and 168 give the absolute and relative estimates of the work performed by month and types of labor in region VI in 1959.

Possible Availability of Farm Workers for Off-Farm Work, 1959

In 1959 on the aggregate state level, year around farm labor appeared to be least available for further off-farm work in the months of November to April, and June. This can be explained by pressing tasks on the farms, especially in April, June, and November and extensive off-farm work during the winter months. It is somewhat surprising that, for the state as a whole, 40-60,000 man months are unaccounted for by the computations during the remainder of the year. When the magnitudes were considered by months relative to the total labor availability on farms, June registered only 14 percent unaccounted time, while March, April, July, September, and November had 20-30 percent and the other months 30-36 percent.

What are the factors that can explain these discrepancies between budgeted labor demands and availability of labor in a particular month?

(1) There are the omissions, i.e., the enterprises, that were not considered in the calculations, such as forestry, green house operations, etc. which, however, should not account for a very significant part with the exception of Northern Michigan and the Upper Peninsula. Activities connected with crop failure and idle land were also omitted, and these areas comprised nearly 1 million acres in 1959. (2) It is suspected that farm labor has a considerable amount of forced idle time, due to inclement weather conditions. (3) Availability for farm work may have been overestimated which would imply that farm labor pursues more off-farm employment. Alternatively, seasonal help may have worked less than 40 or 48 hours per week as assumed; this was reportedly the case during the cherry harvest in 1964. The possibility of errors in the estimates may account for an insignificant amount. (4) Farmers as poor risk

takers, may prefer a labor reserve during critical months of planting, cultivating and harvesting of crops and caring for livestock. This may also explain why farmers may like to keep seasonal workers for several days in a slack period, since they fear not having them available for the next peak labor requirement. This seemed to be the case in August and perhaps also in October. But there appears to be no justification for a labor reserve from November to March, since there does not seem to be much chance of profitably employing the available labor on the farm. Reorganization of farm enterprises has restraints given by climate and market. It is hypothesized that during these months a certain fraction of the idle labor would have been available for off-farm employment, if opportunities would have existed. Again, it is emphasized that this is a grossly simplified analysis on the state level. It is believed that farms existed which could not spare any labor during these winter months. On the other hand, there were farms which easily could spare one man for a month.

Turning now to the discussion of the probable availability of the farm work force for off-farm employment in region I (Southwestern Michigan), it is observed that in 1959, 50 percent of the operators (excluding fruit and vegetable farmers) had some off-farm work.¹² It is ventured that from October to February good additional possibilities existed. The unaccounted surplus ranged from 7,740 to 15,245 man months (or 29-38 percent of the labor force) the latter occurring in October. During the growing season only August seems to have been a slack month allowing off-farm employment, since 17,800 man months or 32 percent of the total

¹²Loomis, R.E., McKee, D.C., Bonnen, J.T., "The Role of Part-Time Farming in Agricultural Adjustment in Southern Michigan," Quarterly Bulletin, Mich. State Univ., 44/4, May 1962, pp. 645-6.

labor force is unaccounted for.

Region II (Western Michigan) showed some scattered slack periods throughout the growing season. These may be the result of rapid technological advance without complete reorganization of the farm enterprises with respect to the labor utilization. Thus, August, October, and May have had a widely underutilized farm labor force which is evidenced by the excess of available labor over requirements of 42-50 percent or 5,000-6,300 man months. It is difficult to find any off-farm work opportunities for such disconnected periods.

Region III (Northern Michigan) appears to have had most of its farm labor underutilized from July to February and in May. During these months the unexplained residual exceeded 35 percent and reached 76 percent in August (2,600-8,800 man months.) Another possibility is that this region has not kept up with the standard technological advance assumed for the state, and still employs more labor per acre or head of livestock than the other regions nearer to the metropolitan areas in southern Michigan. It is a fact that the lack of sufficient nonfarm employment in the northern part of Michigan has kept more workers on farms and thus makes their employment on farms comparatively more attractive since the hourly wage level is 5-10 cents below the one in the more industrialized regions of Michigan.¹³ Also, forestry and tourism activities play an important role on farms in regions III and VI.

Although about 40 percent of the farm operators (except those of specialized poultry, fruit, or vegetable farms) had in 1959, some off-farm employment,¹⁴ Region IV (Thumb-Saginaw Valley) showed some limited

¹³Elterich, Johnson, Call, op. cit., pp. 35 f.

¹⁴Loomis, McKee and Bonnen, loc. cit.

possibilities for off-farm employment during December to February when the utilization of labor on farms dropped to about 40 percent of availability. May and August appear to have been slack months in farm activities, but the shortness of the period and the need for a plentiful farm labor supply in following months did not seem to justify off-farm employment.

It appears that in 1959, not much further off-farm employment was possible in Area V (Southern Michigan). In that year, more than two fifths of the crop and livestock farmers already had some nonfarm work.¹⁵

Surprisingly, the Upper Peninsula (Region VI) had large unexplained residuals, especially during the second half of the year although seasonal workers were hired. The same reasoning as for region III seems to apply here to some extent. Another study shows labor utilization to be even lower.¹⁶ Unfortunately, nonfarm work possibilities are limited in this area, necessitating migration to other parts of the country. Due to uncertainty in work possibilities and milieu, greater capital outlays, and other institutional restraints migration is much less attractive to potential movers.

Estimated Availability of Farm Workers for Off-Farm Work and Need for Seasonal Labor Under Alternate Assumptions for 1970-75

The preceding has provided a basis for evaluating the supply and demand conditions of farm labor on a monthly basis in Michigan and its regions for 1970-75 under alternative assumptions concerning the technological advance.

¹⁵Ibid.

¹⁶Knudtson, A.C., and Cox, R.W., "Upper Midwest Agriculture: Structure and Problems," Upper Midwest Economic Study, Study Paper No. 3, Jan. 1962, pp. 18 ff, 30, 33.

The following statements can be made with respect to the need for seasonal help under the moderate rate of technological advance when the state as a whole is considered. From June on until November, Michigan agriculture will be in need of a significant number of seasonal workers. In particular, the deficit of manpower is estimated to be largest in September with 30,000 man months. While, traditionally, the peak requirement has occurred in July or August, it will shift to September. July is expected to show a deficit on farms of about 20,000 man months, while in August and October the need is for 13,500 man months of seasonal help. Both June and November are anticipated to require approximately 8,000-9,000 man months more labor than is judged to be available.

These figures compare very favorably with the average need for seasonal manpower during the 1950's. The absolute magnitude of seasonal workers will be relatively much smaller, (70-100 percent) from June until August. Subsequent months will show significantly smaller reductions (25-50 percent) or the same amount of seasonal help as in November of 1959. Supposedly, April and May will no longer require seasonal help. From December to March, surplus or deficit of farm labor in the state is so small that neither off-farm employment nor seasonal help is expected.

Assuming that in 1970-75 as many intrastate seasonal workers are willing to work on farms as in 1959, the need for out-of-state migrants will arise in June and from August to November. The peak will be reached in October when over 10,000 out-of-state migrants will be needed. In September and November about 8,700 and in June approximately 5,300 men will have to come from sources outside of Michigan. Comparing these

figures with the ones from 1959, no uniform picture is obtained. Generally, it can be said that June and the fall months will require a much greater number of out-of-state migrants. However, in July and August only a fraction of the interstate migrants of 1959 will find work on Michigan's farms in 1970-75.

Assuming the faster pace of technological advance, the demand expected for seasonal help on the state-wide basis will vanish except for September, when about 11,500 man months of seasonal labor will be needed. The months in which a considerable surplus of farm labor would justify off-farm employment, would only be January, February, and April to June. If in 1970-75 as many intrastate seasonal workers are willing to work on farms as in 1959, then only in September will a need arise for 4,400 interstate migrants.

It should be pointed out that those figures do injustice to reality, since they assume that a perfect farm labor market exists, i.e., that operators, hired, and family workers immediately move to another region of Michigan if they happen to be idle, and help their colleagues there. Obviously, this is and will not be the case. Therefore, the subsequent discussion on the regional level should be more revealing and realistic. The reader is referred (1) to Table 5.5 showing alternate projections concerning the work performed by types of labor, month and region for 1970-75 and (2) to Table 5.6 reporting the periods of need for seasonal farm workers or periods of probable underutilization of permanent types of farm labor in 1970-75 by region.

If a moderate advance of technology is assumed, it can be hypothesized that region I (Southwestern Michigan) will have a demand for 2,800 to 3,900 seasonal workers in June and July and 7,700 to 9,700 men

Table 5.5. Projections of the work performed by type of labor, per month and by region, Michigan, 1970-75

Region, Type of Labor and Type of Estimate ¹	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	Thousands of hours											
I Southwestern Michigan												
Operator	2,728	2,728	2,746	4,138	4,157	4,044	4,044	4,026	4,138	4,138	325	3,010
Hired	590	590	594	783	791	795	799	811	831	827	658	590
Family	34	34	34	661	752	935	969	775	764	923	296	34
Seasonal L					140	566	775	1,930	3,535	1,535	301	
h								381	1,405			
II Western Michigan												
Operator	746	746	746	1,142	1,142	1,127	1,127	1,127	1,142	1,142	936	833
Hired	81	80	81	107	110	109	109	109	110	110	89	81
Family	21	22	22	270	270	366	379	301	283	356	122	22
Seasonal L						220	591	367	337	18	131	
h							181	48	152			
III Northern Michigan												
Operator	836	836	836	1,243	1,243	1,226	1,226	1,226	1,243	1,243	989	904
Hired	87	87	88	116	119	118	118	119	120	120	96	87
Family	22	22	22	275	275	369	382	311	297	364	120	180
Seasonal L					60		1,884	1,040	170			
h							919	389				
IV Thumb, Saginaw Valley												
Operator	2,715	2,715	2,715	4,063	4,064	3,916	3,842	3,916	4,064	4,064	3,343	2,900
Hired	315	322	322	431	448	440	440	440	448	448	360	315
Family	66	66	66	813	826	1,101	1,127	906	865	1,049	354	66
Seasonal L						567			872	572	479	
h									220			
V Southern Michigan												
Operator	3,491	3,491	3,491	5,658	5,658	5,607	5,556	5,505	5,658	5,658	4,511	3,746
Hired	619	619	619	875	920	907	884	884	916	916	718	619
Family	78	78	93	962	977	131	1,365	1,071	1,024	1,272	481	93
Seasonal L						54	63		1,447	1,715	958	
h									543		49	
VI Upper Peninsula												
Operator	551	531	531	833	833	818	818	818	833	833	691	583
Hired	49	49	49	64	66	65	65	65	66	66	53	48
Family	19	19	19	231	231	312	324	257	246	305	108	19
Seasonal L												
h												

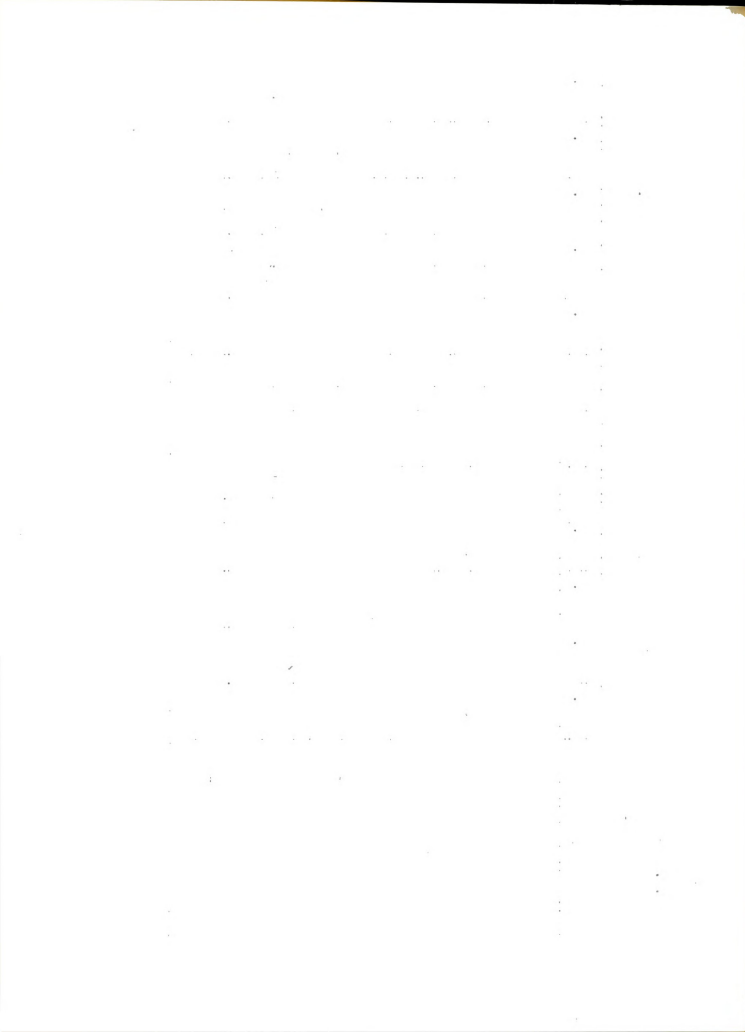
¹L refers to a moderate rate of technological advance. h refers to a rapid rate of technological advance.



Table 5.6. Projected need for seasonal farm workers or underutilization of permanent types of farm workers under alternative assumptions regarding technological advance, by month and region, Michigan 1970-1975¹

Region and Nature of Estimate		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
		:	:	:	:	:	:	:	:	:	:	:	:
		:	:	:	:	:	:	:	:	:	:	:	:
Man month = 200 hours													
I	Southwestern Michigan	1970-75 h:-	406:-	-1,671:-	-1,460:	928:-	700:-	-2,829:-	-3,873:-	-9,651:-	-14,676:-	-7,675:-	-1,504:
		1970-75 L:	1,631:	985:	837:	4,315:	3,739:	2,273:	3,568:-	-1,905:-	7,027:	307:	1,857:
		:	:	:	:	:	:	:	:	:	:	:	:
II	Western Michigan	1970-75 h:-	596:-	-697:-	-822:	9:	929:-	-1,098:-	-2,957:-	-1,836:-	1,687:-	88:-	655:-
		1970-75 L:-	131:-	29:-	230:	872:	818:	271:-	906:-	240:-	764:	1,223:	260:
		:	:	:	:	:	:	:	:	:	:	:	:
III	Northern Michigan	1970-75 h:-	684:	797:-	-834:	309:	1,229:-	300:-	-9,418:-	-5,196:-	852:	369:-	54:-
		1970-75 L:	91:	21:-	152:	1,294:	2,208:	1,030:-	-4,593:-	-1,946:	203:	1,998:	869:
		:	:	:	:	:	:	:	:	:	:	:	:
IV	Thumb, Saginaw Valley	1970-75 h:	378:	159:-	618:	1,209:	1,905:-	-2,837:-	-2,160:	273:-	4,360:-	-2,862:-	-2,360:
		1970-75 L:	2,269:	2,232:	1,256:	4,084:	5,960:	5,961:	3,430:	3,460:-	1,098:	1,160:	1,067:
		:	:	:	:	:	:	:	:	:	:	:	:
V	Southern Michigan	1970-75 h:-	-1,698:-	-2,482:-	-2,948:	694:	2,086:-	271:-	317:	1,030:-	7,236:-	-3,573:-	-4,790:-
		1970-75 L:	886:	989:-	327:	4,366:	6,826:	6,421:	4,678:	5,731:-	2,716:-	-2,910:-	243:
		:	:	:	:	:	:	:	:	:	:	:	:
VI	Upper Peninsula	1970-75 h:	95:-	90:-	25:	1,455:	1,550:	630:	610:	1,795:	1,525:	2,890:	510:
		1970-75 L:	310:	305:	200:	1,935:	1,985:	1,380:	1,380:	2,465:	1,640:	3,345:	1,060:
		:	:	:	:	:	:	:	:	:	:	:	:

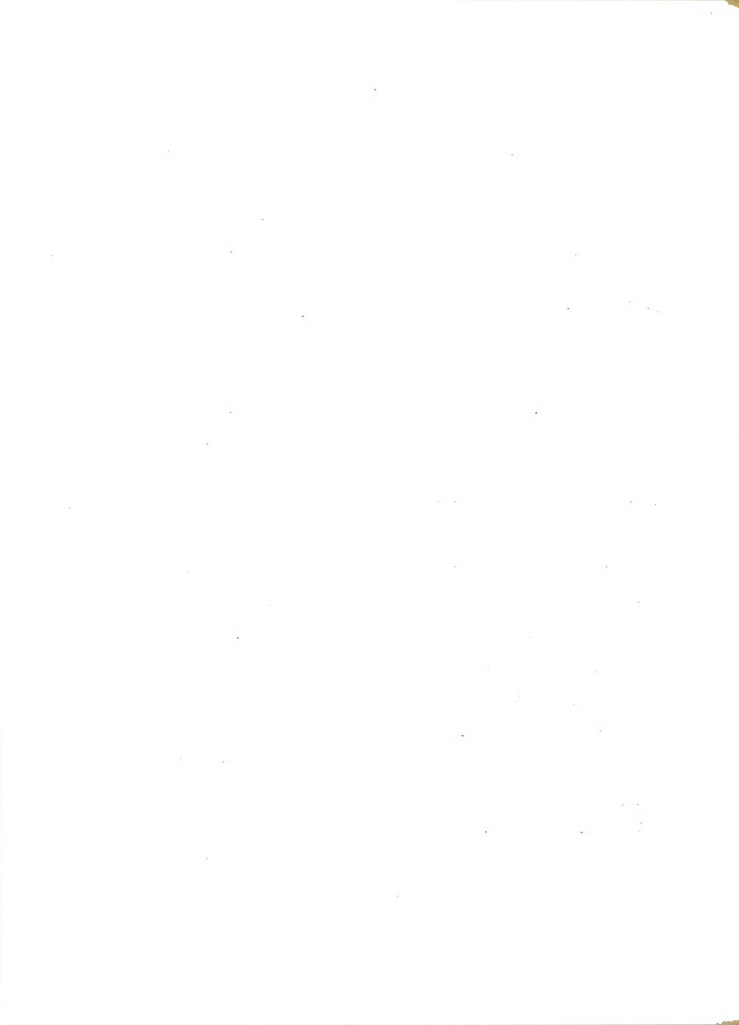
¹ A minus sign indicates need for seasonal farm workers, no sign underutilized farm workers.



in October and August, respectively. The largest deficiency in manpower on farms is expected for September, when about 15,000 seasonal farm workers will be needed. The anticipated demand for seasonal hands is not uniformly lower than in 1959, but rather higher in June and October and approximately 50 percent lower in July and August. Also, the peak requirements will have shifted from August to September. From November to May there is a good chance that the available farm labor pool on farms will be satisfactory to handle the work load. If the 1959 conditions regarding seasonal farm labor still persist in 1970-75, the Michigan seasonal labor pool will be sufficient to satisfy the requirements in July and August. During June, September, and October, 33-50 percent of the seasonal force will have to be out-of-state labor.

Under the alternate assumption of rapid technological advance region I will have a significant shortage of farm labor only in September. Then about 7,000 seasonal workers are needed, a number that could not be satisfied by intrastate migrants alone if similar conditions are assumed concerning their availability as existed in 1959. About one third of this gap would have to be filled by out-of-state migrants. During the remainder of the year expected supply and demand conditions will be in line with each other, allowing perhaps, off-farm employment in April and May and from November to January.

Under the assumption of a moderate pace of technological advance region II (Western Michigan) is expected to have a demand reaching as high as 3,000 workers. This will be the case in July, when the new peak requirements for seasonal help will occur (27 percent of the expected total labor requirements). Although the results show, with the exception of April and May, a need for additional help, the need will be



most urgent from June to September. Then the labor deficit exceeds 1,100 man months. The August and September needs for seasonal help range from 1,700 to 1,800 man months (or nearly 20 percent of the total monthly demand). The June demand for seasonals is expected to be approximately twice as large as in 1959. However, the subsequent three months show sizeable reductions in the need for seasonal hands and most likely, the region will have to resort to interstate migrants to satisfy the demand in August and September. From November to March, the calculations register the need for additional help of 400-800 men or about 12 percent of the total computed labor demand. It is, of course, not very realistic to assume that seasonal help will be needed on Michigan farms during the winter. Either the organization of the farm will be adapted to the available labor, the remaining work force work longer hours than estimated, or the assumed rate of outmigration will not quite materialize.

Under the alternate assumption of accelerated technological advance, region II will have a need for seasonal manpower only from July to September. July and September will require between 700 and 800 additional men, a number that probably could be secured from the local labor pool. Low utilization of the existing permanent labor pool is expected for April, May and October, when about 200-350 men could theoretically pursue off-farm employment. For the remaining months the surplus or deficit of permanent farm labor will be insignificant.

Considering now region III (Northern Michigan) and assuming a moderate technological advance the anticipated need for seasonal workers seems most urgent in July and August. Then 5,200 to 9,400 additional workers will be required. Assuming a similar distribution between the locational origin of the seasonal work force as it prevailed in 1959, a

large proportion of the seasonals demanded in August will have to come from other states. In September and during January to March, 700-850 seasonal workers are expected to be needed to fill the computed gap between demand and available farm labor. Again it does not seem to be reasonable that during the wintertime a need for seasonal help would occur. The reader is referred to the reasoning given on this point under the discussion of region II.

Accelerated technological change will considerably reduce the need for seasonal farm workers, leaving only 4,600 and 1,900 respectively to be hired in July and August mostly from Michigan sources. Low utilization of the projected available farm labor is expected from April to June and from October to December.

Region IV (Thumb-Saginaw Valley) has a need for seasonal help from June through November with the exception of August if a moderate technological advance takes place. The requirements for temporary workers are increased several times in June, and October as compared to the 1959 conditions. September and November have a slightly increased demand for seasonal workers, while August will not require any temporary help, although it was in 1959, the month with the peak requirements for seasonal workers. Twenty-two to twenty-nine hundred seasonal farm workers will be sufficient for each of the months of June, July, October and November. In September, over 4,300 men will be required, the new peak for seasonal help in this region. In view of the fact that June and August to November fall into the period when Michigan will have a deficit in manpower on farms, it is anticipated that interstate migrants will be needed. During the remainder of the year calculated requirements and available farm labor appear to be fairly well in line, not allowing any

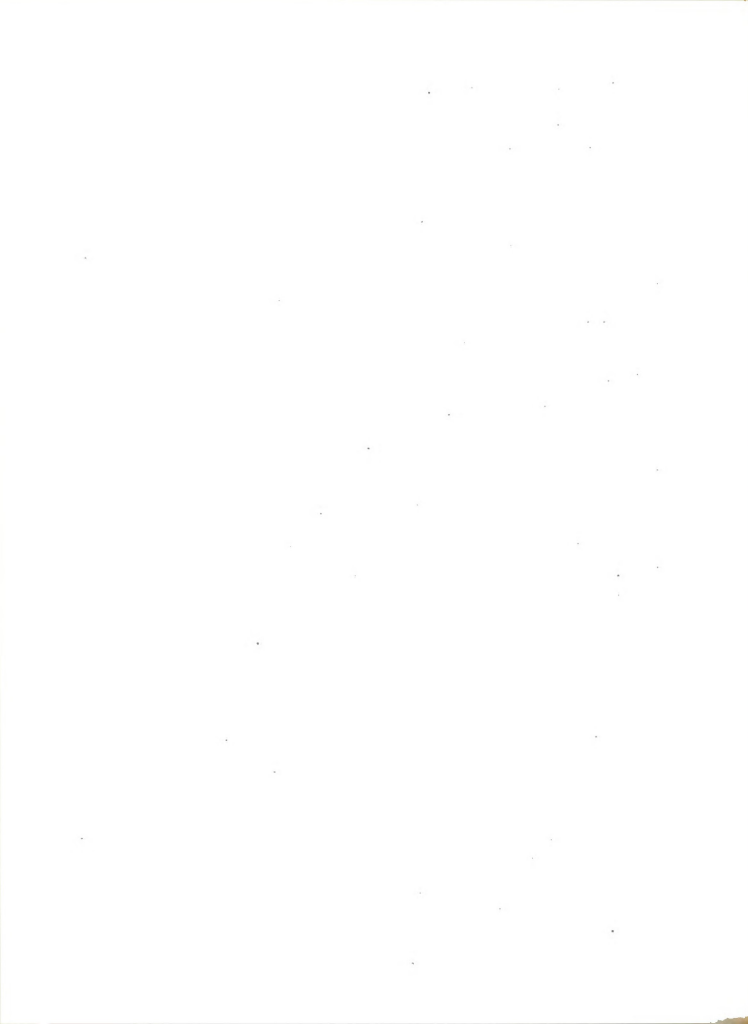
extensive off-farm employment.

Under the alternate assumption of accelerated technological advance region IV won't develop any significant need for seasonal help throughout the year, with the possible exception of September, when some seasonal help will be required. Quite differently, off-farm employment seems to be given with the exception of September, October, and November. During these months at least 2,500 men could take up industrial employment.

Region V (Southern Michigan) will have a demand for temporary farm workers during fall and winter if a moderate technological advance is assumed. Compared to 1959, the need for seasonal farm workers will more than double during the fall. The peak will occur in 1970-75 in September instead, and not in August as in 1959. It is ventured that out-of-state migrants (perhaps even foreign nationals) will have to be recruited to fill the gap in needed over available labor. The deficiencies will amount to 7,200, 3,600 and 4,800 men in September, October and November respectively. During the winter months 1,200-3,000 additional men will be necessary to do the projected work load on farms, if the permanent farm labor force does not work longer hours than assumed.

Under the alternate assumption of accelerated technological advance, region V will develop no significant demand for seasonal labor except in September. Then, 2,700 seasonal workers will be needed. Some of them will have to come from other states than Michigan. The rate of labor utilization from April to August will leave something to be desired; perhaps more than one thousand farm workers could pursue off-farm employment.

Region VI (Upper Peninsula) will not need any seasonal farm workers under either one of the assumptions concerning the speed of technological advance. In April, May and in August to October about 1,000 farm workers could pursue off-farm employment.



CHAPTER VI

SUMMARY AND CONCLUSIONS

Highlights of the Findings

Before summarizing the detail of the study, some important overall results will be presented in condensed form.

From 1959 to 1970-75, the total labor requirements of Michigan agriculture will most likely be reduced by two fifths. None of the regions is expected to have higher labor needs. The number of operators will fall by about one fifth, the number of family members over one fourth, while the number of permanently hired labor on farms is expected to decline very little. The largest reduction of around 50 percent is anticipated for seasonal workers.

Generally, the labor use will be reduced more during the months with peak requirements than in the off-season periods. In spite of the continued trend towards specialization in production on the farm level, the seasonal labor demands will be less pronounced due to labor saving technologies. The peak labor requirements will shift from July-August to September for the state.

By 1970-75 all four enterprise groups will use less labor. The livestock enterprises will show the most evenly distributed reductions; they will be about one quarter. Crop enterprises will need one fourth to one third less labor in spring and summer but as much or more labor



during the balance of the year. Fruit enterprises will register reductions of one third in spring and fall, and one half only in the middle of the year while during the winter nearly as much labor will be needed. Vegetable enterprises will show labor savings between one quarter and one half during summer and fall.

It is expected that operators will do three fourths of the work on Michigan farms by 1970-75 instead of a little above two thirds as in 1959. Year around hired help will also do more of the work (11 percent vs. 9 percent) while the family members share of the work load is expected to drop from 16 to 8 percent. The absolute amount of seasonal labor will certainly decline but its relative share of the labor on farms may remain unchanged.

Many agriculturalists feel that the changes with respect to the labor use will be in the direction and of the magnitudes cited. In this study, enterprise after enterprise and activity after activity were analyzed, and the feasibility of many technological advances were studied. These detailed, systematic investigations both substantiate and quantify the "educated guesses" of the agriculturalists.

More Details

The objectives of this study were (1) to analyze the labor use for the principal enterprises of Michigan agriculture and (2) to estimate labor use for Michigan agriculture for 1970-75 under alternative assumptions with respect to the speed of adoption of existing technology and the perfection of technologies in the developmental stages.

It was deemed useful to consider two rates of adoption and development of technologies. One assumes a moderate rate of technological advance as it took place during the past decade; the other assumes a

rapid rate of technological advance as it is expected to be forthcoming with a better diffusion process, better educated farm managers, and changed economic relationships. Thus, these two estimates can be considered as upper and lower limits to the prospective labor use in particular enterprises or regions of Michigan as reported in Chapters III and IV respectively. The labor requirements by 1970-75 will most likely fall between these bounds.

As a by-product, the study assessed the seasonal and spacial distribution of the regional demand for labor and determined the proportions of permanent and seasonal types of labor in the farm work force. As the study was designed on a regional basis, it entails a degree of aggregation which may obscure some of the changes that are important on the individual farm.

There are two areas to comment upon in the ensuing pages. (1) The major findings with respect to requirements for seasonal labor and the possibility for off-farm employment of farm laborers during the target period. (2) The shortcomings of and possible improvements in (a) the data, and (b) the procedure employed.

This thesis should be considered as drawing upon the results of numerous other research endeavors in an attempt to integrate the findings in order to arrive at predictions of future labor requirements for Michigan agriculture. It might be appropriate to mention that many of the studies cited stress the fact borne out by the investigations, that fixed resources (land, capital or labor), influence strongly the existing and future organization of a farm and its enterprise mix.¹

¹Lard, op. cit. Petit, op. cit.

This would imply that as long as most of the labor force in agriculture must be considered a fixed resource, its presence today influences production in subsequent years. In the absence of continued strong outmigration, labor may retard production adjustments badly needed for agriculture. Hence, programs designed to provide for and to facilitate the outmigration of people presently committed to farming should improve the economic position of the remaining people in agriculture. Price supports that keep more resources in farming than needed to satisfy the demands of the economy appear less suited to lead to adjustment in agriculture.

Early in the thesis, the extent of production for each product (regional enterprise sizes) was predicted considering national, state, and regional trends. It was forecast that corn, beans, and sugar beets would expand, that small grains would barely hold their own but that all other crop enterprises would show smaller acreages. Vegetables and fruits in general will continue to be of great import in parts of Michigan. While the numbers of milk cows and sheep are anticipated to follow the downward trend of the past, beef enterprises are expected to show large additions to their headcounts. A moderate increase is expected in hog production with not much change in poultry inventories.

Substantial reductions in labor requirements for almost all enterprises in the future were predicted in Chapter III. During the past decade, U.S. agriculture has managed to increase the output per man-hour substantially. This resulted from the lack of suitable farm workers at comparatively low wages -- they have been pulled away from farms into industry -- and from the factor cost product price relationships, which forced farmers to produce greater outputs more efficiently with less manpower. These pressures lead some farmers to adopt machinery and make

sizeable investments in spite of the availability of still useable and not yet depreciated equipment, and other fixed inputs - among them farm labor - that have an opportunity cost or salvage value outside farming far inferior to their earnings in their present uses in agriculture. In view of the extensive investments still usable, other farmers did not feel motivated to turn to the technologies that might generate returns to the factors employed in the production process comparable to the returns in off-farm employment.

The present study shows that technological developments will make it possible in the future to produce more farm products with a considerably smaller number of man-hours. It is obvious that the demands concerning the skill and education of all the farm workers will have to be upgraded since they have to operate and service much more intricate and complicated machinery. This variable has not been quantified in the thesis.

Chapter IV established the regional work load of the different areas for 1959 and 1970-75 assuming two levels of technological advances. It was emphasized that some enterprises will play a crucial role in the projections of the labor demands. Among the crop enterprises sugar beets will hold a key position in labor demands of May, June, and July. Rapid technological advance in corn cultivation will make it possible to expand acreages and simultaneously decrease labor used for this crop. Among the vegetables, cucumbers are expected to influence strongly the labor savings in July and August. The fruits will have three very important enterprises which will have a crucial effect upon the labor demands. On the one hand, sweet and tart cherries will show considerable labor savings between June and August. On the other hand, apple



orchards will require at least as much labor in April, September, October, and November, and more in August. In the livestock enterprises, labor savings for dairy cows will be partly compensated for by increased labor needs of beef cattle.

It was found that operators and family labor carried the major burden of the work load in each region with the exception of one or two months during the summer. It was pointed out that in almost all regions farm labor was underutilized during some of the months of the year, predominately during the winter season. To conclude that these farm laborers will work elsewhere assumes a willingness to earn additional income instead of remaining idle and the possibility of finding off-farm work of some kind in the locality. Concern was voiced over the fact that employment may be available for unconnected periods and for only short terms. Further, some of the older operators may have difficulties in securing even short or part time jobs for reasons of age.

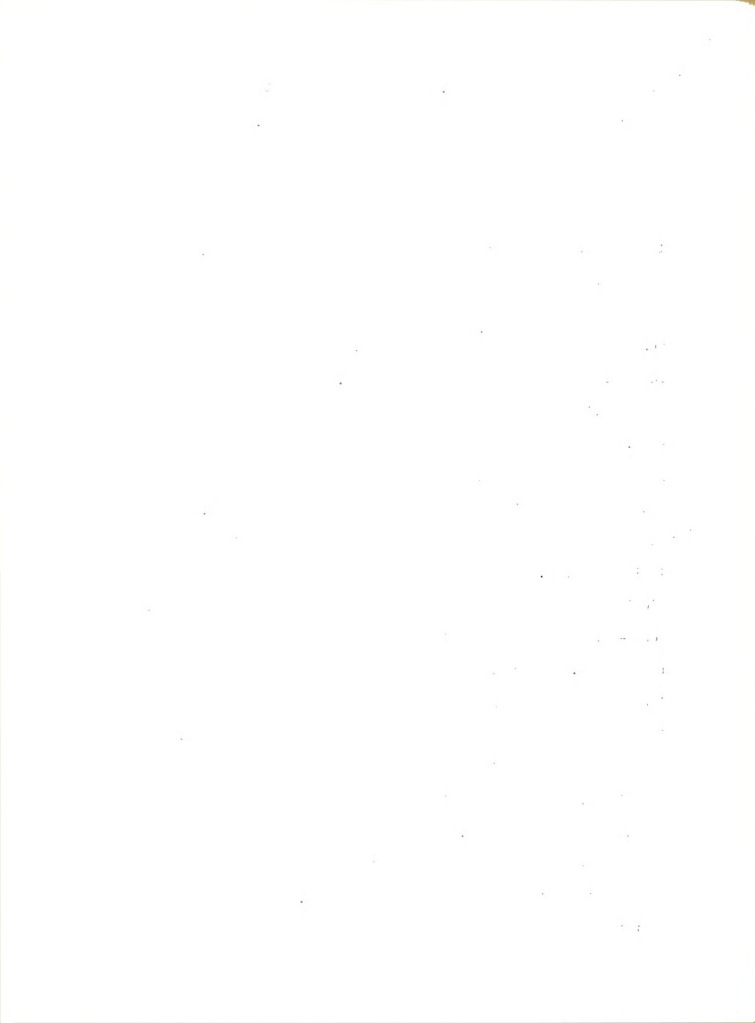
The results of the thesis establish the changes expected in the regional labor demands for 1970-75. One development points to the fact that (1) the peaks for labor demands will be lower and (2) the distribution of the labor needs during the course of the year will be more even. It is predicted that the peaks in farm labor demands will be shifted in some instances to other months under the assumed changes in technology, regional enterprise size and product mix. The shift from the late July-early August peak (cherry harvest) to a September peak (apple harvest) in the regions with extensive fruit acreages is an example. Concomitantly, a general decline of the importance of migratory labor is anticipated. This implies that foreign labor may not be needed at all in the target period, provided domestic seasonal labor is as



plentiful as it was in 1959. This assumption is difficult and beyond the scope of this study to confirm or to discredit. It's validity will be determined outside the realm of agriculture as the availability or domestic seasonal labor depends upon the industrial employment situation and the supply conditions in other labor markets, including the institutional restraints prevalent and typical for those markets.

In Chapter V, it was predicted that the labor use in 1970-75 on Michigan farms will decline by about one third during the first six months of the year as compared to 1959. From July and August, labor needs are expected to fall by two fifths. During the fall months the labor savings are anticipated to be smallest and between 20 and 25 percent. If technological advance is moderate during the intervening years, Michigan agriculture will need 8-30,000 seasonal workers per month from June to November with the most urgent demand in September. The need for seasonal help will be reduced to 12,000 men conjecturing rapid technological advance. Assuming that during summer and fall as many people in Michigan will be willing to work temporarily on farms as in 1959, a need for 5-10,000 out-of-state migrants will develop, especially from September to November. However, it will be difficult to gainfully employ as many interstate migrants also in July and August, when the state labor pool is expected to be sufficient to satisfy the farm labor needs.

Southwestern Michigan will show labor savings of one fourth to two fifths, with the exception of April, May, July, and August, when they reach or exceed one third. Mainly minimum tillage practices will be responsible for the lower labor needs in the spring, while mechanized cherry harvest will bring most of them in the summer. The latter also largely explains the labor savings of one third anticipated for western Michigan



in July and August. Tree shakers used in cherry orchards in July and August will cause the most significant reductions (between 40-50 percent) in the labor use in the northern part of the Lower Peninsula. The remaining areas of the Lower Peninsula (Southern Michigan) and the Thumb) will register fairly evenly distributed labor savings of about one fourth, which will rise to one third only in August due to reductions of the labor needs in the pickle harvest. Reductions of about one fifth of the labor demands are anticipated to come from livestock enterprises mainly the dairy herds. For the Upper Peninsula the labor savings will amount to one fourth to one third and are expected to come predominately from livestock enterprises (dairy herds).

Limitations of the Data

One objective of the study was to find representative man hour requirements for the farm enterprises in order to arrive at the total used for the regions. It is obvious from the nature of the study, that some of the estimates involve considerable judgment. Though this is a limitation to the labor coefficients, the author has anxiously consulted the literature and experts in the fields before deciding upon a particular estimate or estimating procedure in a manner which gives these estimates considerable interpersonal validity and objectivity. The author would agree that one can probably arrive at better estimates after searching further than he did; however, he also feels that the point was reached where the returns to additional investigation no longer covered the costs given his budget of time and resources. The same arguments apply to the estimates of regional enterprise sizes for the target period, the seasonal labor distribution, and the anticipated availability of different classes of labor during the target period.



Possible Improvements in Data and Methods

The author feels that improvements in this type of study could be made along several lines.

Concerning data: (1) Estimates and availability of data with respect to management time need urgent improvements. This is also true for data on idle time forced upon farm workers due to inclement weather conditions. (2) More detailed microdata for particular sizes of farm enterprises, scale economies, and for several representative types of farms in all regions of Michigan would improve the findings and predictions concerning the need for seasonal help or possibilities for off-farm work. (3) Improved predictions with respect to demand at each regional and national level could assist in arriving at better estimates of state and area enterprise size.

Concerning method: In the future, as more detailed data become available, one limitation of the approach used in this study - the inability to disaggregate the estimates so as to reach conclusions relevant to different sizes and types of farms - may be eliminated. A method which would provide such estimates would be the use of linear programming to derive estimates of the expected demand for labor on individual types and sizes of farms. A model maximizing the net returns could be constructed. Activities should be included allowing for off farm employment and for hiring of temporary help. Restrictions for available permanent farm labor and credit (at the farm level) and land (at regional level) would have to be introduced. Input coefficients would have to be consistent with the technologies available in the future and ^{provisions} promises made for farm consolidations. The output coefficients should be adapted to the future price and yield conditions.



However, procedures to aggregate linear programming results on interregional levels are still in the developmental states and are not yet satisfactory. The present study should be useful both before and after such more refined methods become operational.



APPENDIX



Table A Total labor use under alternative assumptions concerning technological advance by enterprise group, month and region for 1959 and projections for 1970-75¹

Region and Enterprise Group	1970-75		1959		1970-75		1959		1970-75		1959		1970-75	
	L	h	L	h	L	h	L	h	L	h	L	h	L	h
Thousands of hours														
I Southwestern Michigan														
January														
Livestock	2,500	1,951	1,685	2,518	2,021	1,669	2,702	2,125	1,849	2,654	2,065	1,892		
Crops	132	134	134	138	138	138	182	189	184	1,615	1,056	960		
Vegetables	19	16	16	49	44	42	82	73	67	327	282	244		
Fruits	461	429	396	586	590	540	913	662	568	1,163	1,082	825		
May														
Livestock	2,276	1,788	1,552	2,201	1,791	1,540	2,051	1,685	1,530	2,209	1,805	1,558		
Crops	1,306	916	785	1,944	1,303	1,050	1,601	1,170	1,044	1,076	778	697		
Vegetables	1,121	991	773	942	828	623	828	691	538	1,497	850	688		
Fruits	1,041	844	739	2,894	2,343	2,044	5,236	3,035	1,983	2,890	1,632	1,083		
June														
July														
August														
September														
Livestock	2,414	2,033	1,747	2,412	2,004	1,755	2,592	2,106	1,795	2,527	1,965	1,701		
Crops	1,301	1,200	1,209	1,106	1,035	839	1,167	962	863	159	160	160		
Vegetables	1,432	1,024	849	480	376	307	56	47	45	26	23	18		
Fruits	2,945	2,735	1,952	1,629	1,889	1,263	440	380	270	494	327	293		
October														
November														
December														

Table A Total labor use under alternative assumptions concerning technological advance by enterprise group,
month and region for 1959 and projections for 1970-75¹ (continued)

Region and Enterprise Group	1959		1970-75		1959		1970-75		1959		1970-75	
	L	h	L	h	L	h	L	h	L	h	L	h
Thousands of hours												
II Western Michigan	January			February			March			April		
	877	676	588	882	687	588	938	728	638	918	743	652
	38	37	37	39	38	38	52	53	51	486	327	301
	2	2	2	3	3	3	4	3	3	13	9	9
Fruits	33	36	52	41	45	40	54	49	43	88	82	67
May												
May			June			July			August			198
Livestock	774	584	506	718	567	495	667	525	474	696	550	488
Crops	292	215	188	724	509	407	612	444	375	466	326	288
Vegetables	27	18	16	59	50	43	150	110	81	322	133	99
Fruits	87	85	73	429	414	364	731	511	364	237	188	121
September												
September			October			November			December			
Livestock	790	644	544	817	656	576	921	730	620	891	684	598
Crops	505	449	480	266	247	207	228	193	173	45	44	44
Vegetables	191	111	89	23	22	19	5	4	4	3	3	3
Fruits	129	146	105	102	133	86	29	29	20	33	35	31

Table A Total labor use under alternative assumptions concerning technological advance by enterprise group, month and region for 1959 and projections for 1970-75¹ (continued)

Region and Enterprise Group		1959		1970-75		1959		1970-75		1959		1970-75		1970-75	
		L	h	L	h	L	h	L	h	L	h	L	h		
Thousands of hours															
III Northern Michigan		January		February		March		April							
		777	639	541	783	648	541	829	677	587	811	695	603		
		29	25	25	30	26	26	45	43	38	441	271	255		
		1	1	1	2	2	2	4	3	3	13	10	8		
		115	121	107	150	144	130	183	145	134	275	219	178		
		May		June		July		August							
		676	552	475	626	546	466	579	511	454	605	541	466		
		222	141	125	657	448	365	589	383	319	476	295	256		
		31	25	20	29	23	18	55	40	33	87	44	38		
		246	221	188	927	667	583	2,861	1,427	927	1,077	647	397		
		September		October		November		December							
		683	612	517	711	617	538	809	672	569	783	631	547		
		473	372	407	200	145	118	105	84	81	35	31	31		
		52	27	23	13	10	8	4	4	3	2	1	1		
		235	286	199	220	289	189	67	71	51	115	115	99		

Table A Total labor use under alternative assumptions concerning technological advance by enterprise group, month and region for 1959 and projections for 1970-75¹ (continued)

Region and Enterprise Group	1959	1970-75	1959	1970-75	1959	1970-75	1959	1970-75	1959	1970-75	1959	1970-75
	L	h	L	h	L	h	L	h	L	h	L	h
Thousands of hours												
IV Thumb, Saginaw Valley												
Livestock	2,588	1,943	1,671	2,596	1,963	1,667	2,784	2,066	1,802	2,657	2,095	1,830
Crops	187	215	215	194	222	222	254	298	288	2,012	1,656	1,497
Vegetables	10	11	10	20	20	20	33	32	29	91	74	68
Fruits	17	13	12	21	22	18	30	24	19	52	52	41
May												
Livestock	2,266	1,657	1,424	2,124	1,631	1,406	1,987	1,512	1,349	2,083	1,587	1,390
Crops	1,875	1,752	1,429	3,295	2,963	1,824	2,757	2,298	1,783	2,014	1,518	1,403
Vegetables	179	154	126	307	301	255	611	509	371	1,129	505	389
Fruits	54	48	41	178	162	140	202	142	104	98	66	44
September												
Livestock	2,347	1,855	1,540	2,434	1,895	1,643	2,712	2,092	1,764	2,616	1,968	1,707
Crops	2,729	2,581	2,514	2,897	2,772	2,452	1,582	1,490	1,279	226	258	258
Vegetables	682	431	336	146	133	110	36	35	33	13	13	12
Fruits	129	142	97	108	142	90	21	24	13	14	12	12
October												
Livestock	2,347	1,855	1,540	2,434	1,895	1,643	2,712	2,092	1,764	2,616	1,968	1,707
Crops	2,729	2,581	2,514	2,897	2,772	2,452	1,582	1,490	1,279	226	258	258
Vegetables	682	431	336	146	133	110	36	35	33	13	13	12
Fruits	129	142	97	108	142	90	21	24	13	14	12	12
November												
Livestock	2,347	1,855	1,540	2,434	1,895	1,643	2,712	2,092	1,764	2,616	1,968	1,707
Crops	2,729	2,581	2,514	2,897	2,772	2,452	1,582	1,490	1,279	226	258	258
Vegetables	682	431	336	146	133	110	36	35	33	13	13	12
Fruits	129	142	97	108	142	90	21	24	13	14	12	12
December												
Livestock	2,347	1,855	1,540	2,434	1,895	1,643	2,712	2,092	1,764	2,616	1,968	1,707
Crops	2,729	2,581	2,514	2,897	2,772	2,452	1,582	1,490	1,279	226	258	258
Vegetables	682	431	336	146	133	110	36	35	33	13	13	12
Fruits	129	142	97	108	142	90	21	24	13	14	12	12

Table A Total labor use under alternative assumptions concerning technological advance by enterprise group, month and region for 1959 and projections for 1970-75¹ (continued)

Region and Enterprise Group	1959		1970-75		1959		1970-75		1959		1970-75		1959		1970-75	
	L	h	L	h	L	h	L	h	L	h	L	h	L	h	L	h
Thousands of hours																
V Southern Michigan																
Livestock	3,986	3,110	2,716	4,022	3,209	2,686	4,311	3,374	2,969	4,200	3,358	3,037				
Crops	270	308	308	279	316	316	373	412	411	3,275	2,448	2,208				
Vegetables	17	14	14	45	37	36	75	62	55	230	169	150				
Fruits	54	40	39	68	68	55	86	69	54	139	144	114				
May																
June																
Livestock	3,547	2,784	2,433	3,366	2,723	2,386	3,071	2,525	2,332	3,286	2,690	2,369				
Crops	2,859	2,277	1,964	3,809	2,897	2,265	3,141	2,491	2,158	2,198	1,671	1,524				
Vegetables	376	291	244	583	517	432	975	772	601	1,812	908	721				
Fruits	139	136	118	371	350	304	368	293	220	189	184	132				
July																
August																
September																
October																
Livestock	3,688	3,089	2,670	3,703	3,058	2,705	4,126	3,359	2,874	4,046	3,155	2,751				
Crops	2,834	2,860	2,856	2,499	2,540	2,142	2,320	2,129	1,884	322	362	362				
Vegetables	1,469	986	810	404	293	247	46	38	37	24	20	17				
Fruits	393	451	311	333	431	272	70	76	43	46	40	38				
November																
December																

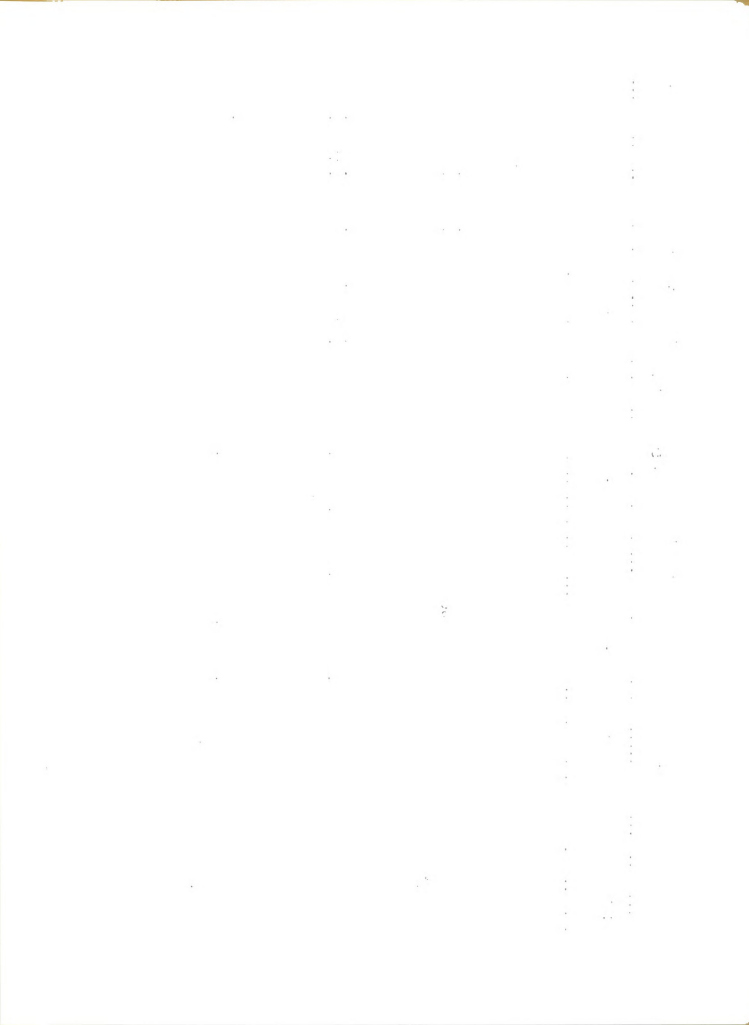
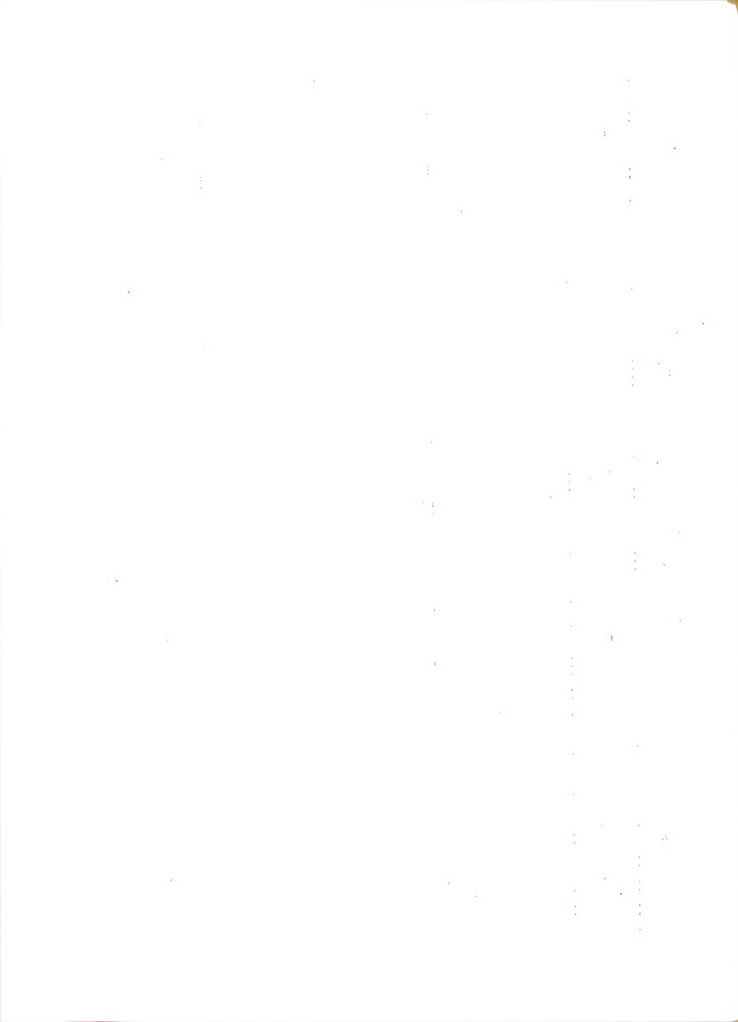


Table A Total labor use under alternative assumptions concerning technological advance by enterprise group, month and region for 1959 and projections for 1970-75¹ (continued)

Region and Enterprise Group	1959		1970-75		1959		1970-75		1959		1970-75		1959		1970-75	
	L	h	L	h	L	h	L	h	L	h	L	h	L	h	L	h
Thousands of hours																
VI Upper Peninsula	January				February				March				April			
	May				June				July				August			
	September				October				November				December			

¹L in 1970-75 column refers to moderate rate of technological advance. h in 1970-75 column refers to rapid rate of technological advance.



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1. The first part of the paper is devoted to a general discussion of the problem of the existence of solutions of the system of equations (1) for arbitrary values of the parameters α and β . It is shown that the system has solutions for all values of the parameters α and β if the function $f(x)$ is continuous and has a bounded derivative.

2. In the second part of the paper the problem of the existence of solutions of the system of equations (1) for arbitrary values of the parameters α and β is solved. It is shown that the system has solutions for all values of the parameters α and β if the function $f(x)$ is continuous and has a bounded derivative.

3. In the third part of the paper the problem of the existence of solutions of the system of equations (1) for arbitrary values of the parameters α and β is solved. It is shown that the system has solutions for all values of the parameters α and β if the function $f(x)$ is continuous and has a bounded derivative.

4. In the fourth part of the paper the problem of the existence of solutions of the system of equations (1) for arbitrary values of the parameters α and β is solved. It is shown that the system has solutions for all values of the parameters α and β if the function $f(x)$ is continuous and has a bounded derivative.

5. In the fifth part of the paper the problem of the existence of solutions of the system of equations (1) for arbitrary values of the parameters α and β is solved. It is shown that the system has solutions for all values of the parameters α and β if the function $f(x)$ is continuous and has a bounded derivative.

6. In the sixth part of the paper the problem of the existence of solutions of the system of equations (1) for arbitrary values of the parameters α and β is solved. It is shown that the system has solutions for all values of the parameters α and β if the function $f(x)$ is continuous and has a bounded derivative.

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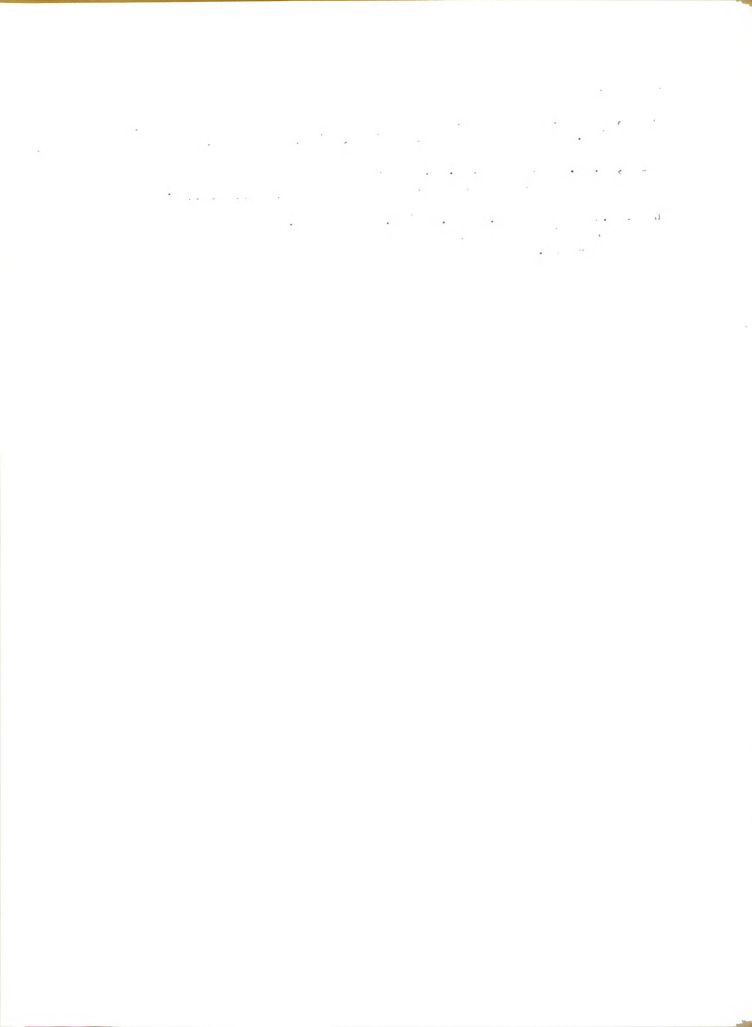
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