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EDUCATION FOR A CHANGING WORLD OF WORK, REPORT OF THE PANEL OF CONSULTANTS ON VOCATIONAL EDUCATION. APPENDIX II, MANPOWER IN FARMING AND RELATED OCCUPATIONS.

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THE EFFECTS OF ECONOMIC PROGRESS ON THE STRUCTURE OF AGRICULTURE, THE AMOUNT AND QUALITY OF HUMAN RESOURCES EMPLOYED IN FARMING AND RELATED OCCUPATIONS, AND EDUCATIONAL IMPLICATIONS OF AGRICULTURAL CHANGES ARE REPORTED. MECHANICAL, BIOLOGICAL, AND CHEMICAL CHANGES IN AGRICULTURAL TECHNOLOGY, WHICH PROVIDED INCENTIVES TO INCREASE THE SIZE OF THE FARM FIRM AND TO DECREASE THE AMOUNT OF LABOR USED IN RELATION TO CAPITAL AND LAND IN FARM PRODUCTION, IMPROVED PRODUCTION FASTER THAN THE DEMAND FOR AGRICULTURAL PRODUCTS WHICH RESULTED IN DOWNWARD PRICE TRENDS. THE NUMBER OF FARMS DECREASED 36 PERCENT BETWEEN 1940 AND 1960. A LOW DEMAND FOR FARM LABOR IS REFLECTED BY A LOW HOURLY RETURN COMPARED WITH OTHER EMPLOYMENT. PROJECTIONS INDICATE THAT LESS THAN ONE-FOURTH OF THE FARM POPULATION WHO WERE BETWEEN 5 AND 14 YEARS OLD IN 1960 WOULD REMAIN IN THIS POPULATION IN 1980. MIGRATION FROM FARMS IS PROJECTED TO BE APPROXIMATELY 6.4 MILLION PERSONS IN THE 1960'S IF PRESENT EMPLOYMENT AND EARNINGS CONDITIONS REMAIN STABLE. ALTHOUGH AGRICULTURAL RELATED OCCUPATIONS IN SUPPLY, MARKETING, OR PROCESSING ESTABLISHMENTS HAVE PROVIDED EMPLOYMENT FOR SOME LABOR RELEASED FROM SOME EDUCATIONAL IMPLICATIONS ARE--(1) MORE HIGHLY TRAINED FARMERS WITH MANAGERIAL ABILITY ARE NEEDED, AND (2) AGRICULTURAL CURRICULUMS SHOULD REFLECT TECHNOLOGICAL AND OCCUPATIONAL CHANGES. THE COMPLETE REPORT IS AVAILABLE AS VT 005 454, A SUMMARY AS VT 001 796, AND OTHER APPENDIXES AS VT 001 306 AND VT 005 456. THIS DOCUMENT IS AVAILABLE FOR 35 CENTS FROM SUPERINTENDENT OF DOCUMENTS, U.S. GOVERNMENT PRINTING OFFICE, WASHINGTON, D.C. 20402. (EM)

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EDUCATION
FOR A CHANGING WORLD OF WORK

APPENDIX II

Manpower in Farming and Related Occupations

Report of the Panel of Consultants on Vocational Education Requested by the President of the United States

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE · U.S.A.

This publication (OE–80025) is Appendix II of "Education for a Changing World of Work" (OE–80021). Although bound separately, Appendix II is a part of the full report of the Panel of Consultants on Vocational Education presented to the U.S. Department of Health, Education, and Welfare, Office of Education, Washington 25, D.C.

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Report, Publication No. OE–80021, 296 pp., $1.25.

Appendix I, *Technical Training in the United States*, by Lynn A. Emerson, Publication No. OE–80022, 170 pp., $1.25.

Appendix II, *Manpower in Farming and Related Occupations*, by C. E. Bishop and G. S. Tolley, Publication No. OE–80025, 51 pp., 35 cents.

Appendix III, *The Economic and Social Background of Vocational Education in the United States*, by Harold F. Clark—*A Sociological Analysis of Vocational Education in the United States*, by Wilbur B. Brookover and Sigmund Nosow—*The Case for Education for Home and Family Living*, by Bernice Milburn Moore—*The Contribution to the National Economy of the Use of Resources Within and By the Family*, by Elizabeth E. Hoyt, Publication No. OE–80026, 91 pp., 50 cents.

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

OE-80025

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By C. E. Bishop and G. S. Tolley

Report of the Panel of Consultants
on Vocational Education
Requested by the President
of the United States

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education

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Foreword

In his Message to Congress on American Education, February 20, 1961, President John F. Kennedy said:

> The National Vocational Education Acts, first enacted by the Congress in 1917 and subsequently amended, have provided a program of training for industry, agriculture, and other occupational areas. The basic purpose of our vocational education effort is sound and sufficiently broad to provide a basis for meeting future needs. However, the technological changes which have occurred in all occupations call for a review and re-evaluation of these acts, with a view toward their modernization.
>
> To that end, I am requesting the Secretary of Health, Education, and Welfare to convene an advisory body drawn from the educational profession, labor, industry, and agriculture, as well as the lay public, together with representatives from the Departments of Agriculture and Labor, to be charged with the responsibility of reviewing and evaluating the current National Vocational Education Acts, and making recommendations for improving and redirecting the program.

On October 5, 1961, The White House announced that the Secretary of Health, Education, and Welfare had appointed the President's Panel of Consultants on Vocational Education.

The Panel began work with its staff in Washington, D.C. on November 9-11, 1961. Subsequently the Panel met on March 7-10, May 3-5, July 14-16, September 15-18, October 6-7, October 27-28, and concluded its review at a final meeting, November 26-27, 1962.

The Panel conferred with various consultants and commissioned special studies in addition to those prepared by its staff, and the Division of Vocational and Technical Education, Office of Education, U.S. Department of Health, Education, and Welfare. The Panel also convened for its guidance a number of special conferences on the educational aspects of our national manpower resources and requirements.

The Panel of Consultants has thus had advice, suggestions, and recommendations from many persons representing a cross-section of the American people: those who produce and distribute the goods and services which the Nation requires; those who are responsible for the educational development of the Nation; and those who take a general interest in the Nation's social and economic well-being. The members of the Panel themselves are a representative group of citizens who believe in the importance of education and who have tried to use reliable information and methods of analysis in order to formulate the recommendations which are presented in its report.

Benjamin C. Willis
Chairman

MANPOWER IN FARMING AND RELATED OCCUPATIONS

Under conditions of rapid economic progress agriculture undergoes changes which have important implications to the education and training of rural youth. The manner in which economic progress affects the structure of agriculture and the amount and quality of human resources employed in farming and related occupations is the focal point of this paper. Emphasis also is placed upon the implications of the changes in structure of U.S. agriculture to the educational needs of farm youth.

The Changing Structure of U.S. Agriculture

Economic progress makes its impact upon agriculture through technological improvements in the production of farm products and through improvements in the organizational structure of the industry. These improvements have their roots deeply imbedded in agricultural research and education. Research in the mother of invention. Technological innovation and improvements in organizational structure are the progeny of enlightened, progressive entrepreneurship. Research and education, therefore, are the sources of agricultural progress.

Inherent in the nature of agricultural progress are changes which have important implications upon the types of research and educational programs which are needed by rural people. Consequently, an understanding of the processes of economic progress in agriculture is essential to an analysis of the types of educational programs that are most appropriate for farm youth.

The initial impact of most of the economic progress in U.S. agriculture is made through mechanical, biological, and chemical changes in technology.[1]

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[1]E.O. Heady, "Basic Economic and Welfare Aspects of Farm Technological Advance," Journal of Farm Economics, XXXI (May 1949): 293-317.

Improvements in biological and chemical technology greatly increase the productivity of capital relative to the productivity of labor and land and thereby encourage the substitution of capital for labor and land in the production of farm commodities.

The incentive to substitute capital for labor is perhaps even more pronounced in the case of mechanical innovations. Most mechanical innovations greatly decrease the amount of labor needed for a given output of farm products. However, these innovations provide strong incentives to expand output. New machinery typically requires rather large outlays of capital. In view of the large investments required, mechanical innovation may result in increased unit costs of production unless the farmer expands output to spread the overhead costs over a larger volume. In most instances, it is not profitable to purchase newly developed machinery and equipment unless the size of the business unit is expanded. Mechanical innovations, therefore, generally result in increased production per farm.

Biological and chemical innovations have essentially the same effect. Innovations of these types reduce unit costs of producing the commodities to which they are adapted and provide incentives to expand production. Moreover, the increase in the productivity of labor generated by these innovations makes it possible for the farmer to increase his output. In short, there are inherent in modern technological progress strong forces which provide incentives for the farm firm to increase the size of its business.

Innovations which improve the organizational structure of agriculture also are predominantly labor-saving. Innovations of this type generally increase the productivity of management, thereby enabling the farmer to expand output per unit of managerial time. They place a premium upon managerial ability and encourage specialization in production. These innovations, therefore, provide

strong incentives for additional education and training. The increased productivity of management associated with these innovations may facilitate the substitution of capital for labor in farming. In any event, innovations in organizational structure provide strong incentives to increase the size of the farm business.

In summary, technological innovations of the mechanical, biological, and chemical nature and innovations in the organizational structure of agriculture all set in motion forces which provide incentives to increase the size of the farm firm. Furthermore, each of these innovations provides incentives to decrease the amount of labor used in relation to capital and land in the production of farm commodities.

The limit upon the amount of labor which can be employed efficiently in agriculture is determined by growth in the demand for farm products and changes in the relative productivity of labor and other farm resources. The demand for farm products in the United States grows slowly. As an economy undergoes economic progress, per capita incomes increase. However, not all industries benefit to the same extent. Expenditures per capita for food and fiber do not increase in proportion to the increases in per capita real income. In the United States where per capita real income is high the demand for food and fiber increases very little, if at all, in response to increases in per capita real income. The major factors increasing the demand for food and fiber are growth of the population and expansion of foreign markets.

The technological and organizational revolutions which have been taking place so rapidly in the United States since 1940 have enabled farmers to expand farm production at a much higher rate than the demand for farm products was increasing. Accordingly, there has been downward pressure upon the prices of

farm commodities and farmers have turned with increasing speed to cost-reducing innovations in an effort to maintain or expand farm incomes.[1]

Consequently, since 1940 U. S. agriculture has released labor in unprecedented numbers. The increased productivity of land and the substitution of capital for land has been equally dramatic. Even so, it is estimated that approximately 1.4 million man equivalents of labor currently are underemployed on the nation's farms[2] and that the nation has 50 million acres of excess cropland.[3] On balance, the nation can readily meet its demands for food and fiber with substantially less land and labor than currently exists in agriculture.

Since 1940 the changes outlined above have been taking place at an increasingly rapid rate in the United States. The number of farms in the United States reached a peak of 6.8 million in 1935. Thereafter, the number of farms decreased to 3.7 million in 1959.

Accompanying the decrease in number of farms and the labor used on farms has been a large increase in size of farm as expressed in acreage and investment (Table 1). In 1960 the number of farm workers was 36 percent less than in 1940.[4] The man hours of farm work decreased even more dramatically, reflecting greater underemployment of farm labor. In 1960 the man hours of farm work was 49 percent less than in 1940.[5] In the meantime, the productivity per hour of farm labor in the U. S. increased threefold.[6]

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[1] W. W. Cochrane, Farm Prices - Myth or Reality. University of Minnesota Press, 1958, Chapter 5.

[2] Orville L. Freeman, Address before Independent Bankers Association, Washington, D. C., April 21, 1961, p. 1

[3] Food and Agriculture - A Program for the 1960's, U. S. Department of Agriculture, Washington, D. C., March, 1962, p. 2.

[4] Farm Labor Situation, Economic Research Service, USDA Statistical Bulletin No. 233.

[5] Changes in Farm Production and Efficiency, Farm Economics Division, Economic Research Service, USDA, July, 1961, p. 46.

[6] Ibid., p. 40.

Table 1. Changes in Size of Farms in the United States, 1940-1960

Year	Man hours of work per farm	Acreage per farm	Investment per farm 1947-49 prices
1940	3,357	174	$13,118
1950	2,813	215	16,979
1960	2,783	302	23,744

Sources: Changes in Farm Production and Efficiency, Farm Economics Division, Economic Research Service, USDA, July, 1961, p. 34; Agricultural Statistics, 1959 (Washington: Government Printing Office, 1960), p. 437; Balance Sheet of Agriculture 1961, Economic Research Service, USDA, August, 1961, p. 17.

Changes in the relative amounts of labor, land, and capital used on farms are depicted in Table 2. Labor as a percent of total inputs has decreased by almost one-half since 1940 while capital as a percent of inputs almost doubled.

Table 2. Percent of Total Annual Inputs of Agriculture Represented by Labor, Land and Capital, 1940-60

Year	Labor	Land	Capital	All inputs
1940	58.6	9.1	32.1	100.0
1945	52.5	8.9	38.7	100.0
1950	41.8	8.9	49.3	100.0
1955	35.0	8.6	56.5	100.0
1960	30.1	8.5	61.4	100.0

Source: E. O. Heady, "Management in Relation to Agricultural Adjustment and Economic Growth," paper presented at workshop on Measurement of the Management Input sponsored by the Agricultural Policy Institute and the Southern Farm Management Research Committee, New Orleans, La., March, 1962, p. 4.

The information presented above demonstrates clearly that there are powerful forces at work altering the structure of U. S. agriculture. The structural

changes are based in research and educational programs which increase the productivity of farm resources. On the other hand, because the productivity of all resources does not increase in the same proportion, the forces set in motion incentives to change the combination of inputs used on farms. In particular, economic progress in agriculture manifests itself in pronounced reductions in the demand for farm manpower and increases in the demand for capital.

It is clear from the above analysis that in gauging the future manpower needs of agriculture emphasis must be placed upon the structural changes which will take place during the period under consideration. In the following pages projections are made for major changes expected to take place between 1960 and 1970, and there is consideration of implications for the demand for manpower on farms and in farm related occupations.

The Demand and Supply for Labor Resources in Farming

Farm labor currently receives a much lower return per hour than comparable labor receives in other major sectors of the U. S. economy.[1] This condition reflects a relatively low demand for labor and underemployment of labor on farms.

The amount of labor which is employed in agriculture is influenced by the technology which is available, the costs of adopting labor-saving techniques and the return received for labor used on farms compared with the return for comparable labor in nonfarm employment. Over the long pull labor should move from farms to nonfarm employment until the return received for labor in agriculture is approximately equal to the return received for comparable labor in other parts of the economy.

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[1]C. E. Bishop, "Special Problems and Policy Needs of Southern Agriculture," Proceedings of Farm Policy Review Conference, Agricultural Policy Institute, Raleigh, N. C., November, 1961, pp. 213-215.

The departments of Agricultural Economics of the land-grant colleges and the U. S. Department of Agriculture are cooperating in a series of farm adjustment studies to determine the number of farm families in each of the major geographic regions of the nation which agriculture can support with a return to labor and management approximately equal to that received by comparable labor in other employment. The research on these studies has progressed in three economic areas of the South to the point that estimates have been developed of the number of families for which agriculture in the three areas can yield a return to operator labor and management of $4,500. The studies which have been completed emphasize the need for large increases in size of farms. In each of the areas it will be necessary to recombine the small farms and to decrease the number of farm families approximately one-half in order to obtain a return of $4,500 for labor and management.[1] Through the adoption of labor-saving techniques of production, the amount of labor used in agriculture would decrease in about the same proportion as the number of farms.

The conclusions of the above studies emphasize dramatically the fact that much less manpower will be needed in agriculture in the future. Studies which have been made in other areas of the United States corroborate these findings. Most such studies suggest that the number of farms needs to be reduced approximately one-half in order to increase the return for labor in agriculture to the same level enjoyed by similar labor in other employment.

How many farming opportunities will the U. S. have in 1970? It is entirely unreasonable to expect agriculture to make drastic adjustments of the order

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[1]J. S. Plaxico and J. W. Godwin, "Adjustments for Efficient Organization of Farms in Selected Areas of the South," Southern Agriculture - Its Problems and Policy Alternatives, Agricultural Policy Institute, Raleigh, N. C., January, 1961, pp. 120-144.

outlined above in a short period of time. Realistically, man-hours used in farm production may be expected to decrease about 20 percent during the sixties.[1] This projection is shown in the upper part of Figure 1. It is based in part on an analysis of amounts of livestock and crop production needed for 1970 domestic and export demands taking account of population, income and other factors influencing disappearance. Man-hours per unit of output were projected for major components of production in view of recent trends and prospective adoption of new technologies. Man-hours per unit multiplied by the production estimates gave the projection shown in Figure 1 of 7.4 billion man-hours likely to be devoted to farming in 1970.[2]

The lower parts of Figure 1 throw light on how numbers of persons engaged in farming may be expected to decline along with the decline in man-hours. The total number of farms may decline from 3.70 million in 1959 to 2.65 million in 1970. The rural farm male population contains the farm operators, family workers and hired workers who are the chief suppliers of agricultural labor inputs. The number of farm males is expected to decline from 6.96 million in 1960 to 4.75 million in 1970.[3]

The adjustments leading to the decline in agricultural labor inputs will include substantial progress in reducing the number of small, low-income family farms. It is shown in Table 3 that in 1959 there were 1.6 million commercial family farms in the nation which produced less than $10,000 of products for sale. Considering the nation as a whole, the farms which have been producing

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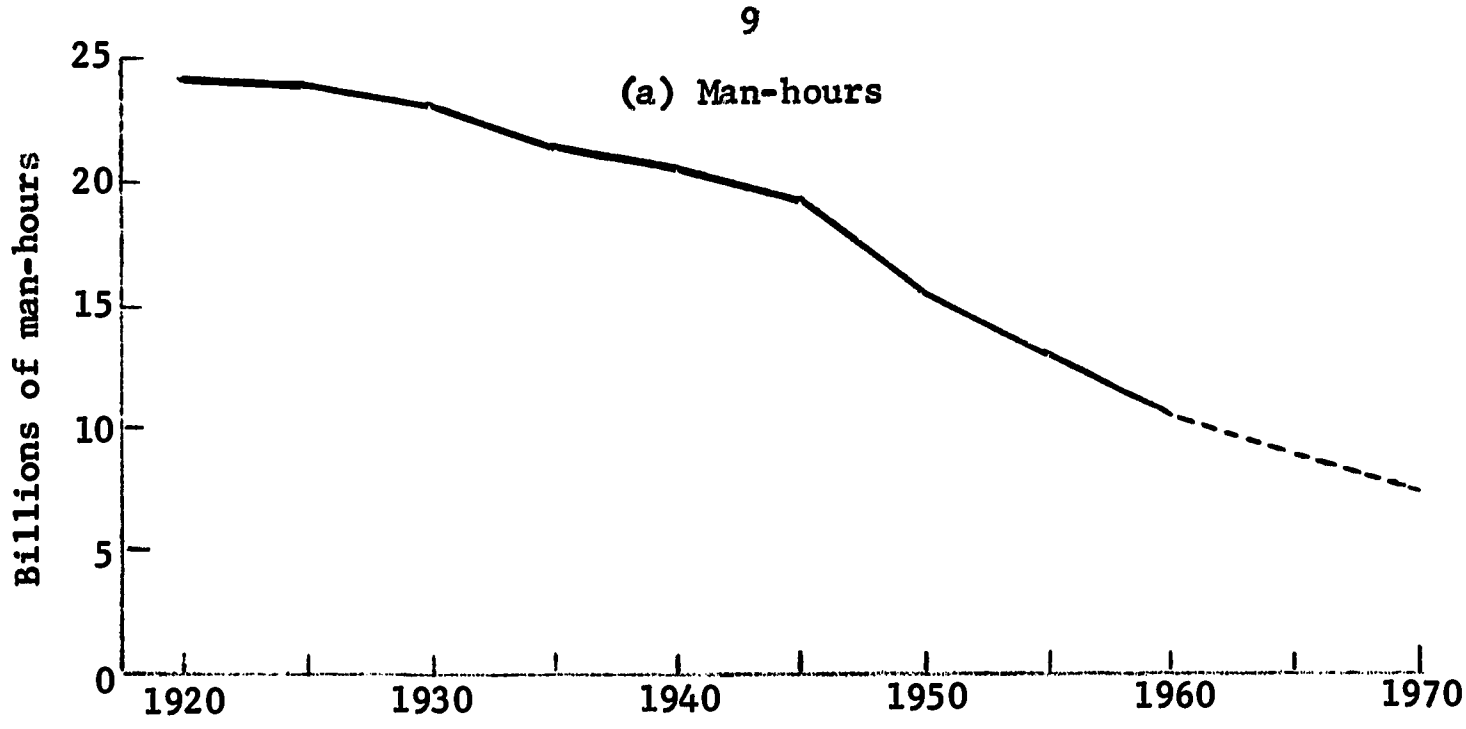
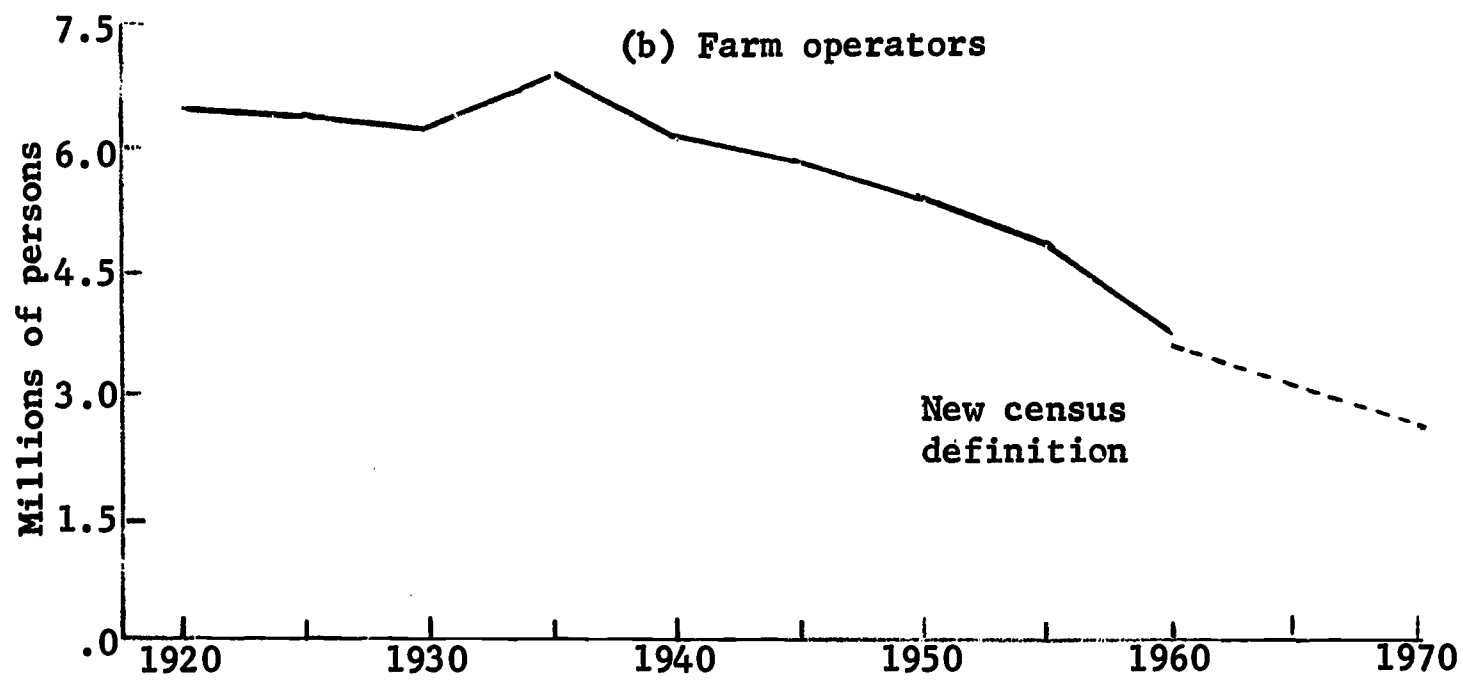
[1]The U. S. Department of Labor has made a projection of a 17 percent decrease in the number of farmers and farm workers during the 1960's. See Manpower Challenge of the 1960's, U. S. Department of Labor, 1960.

[2]See Supplement A to this paper for further details of the man-hours projection.

[3]See Supplement C for further details of the projections of number of farms and of rural farm males.





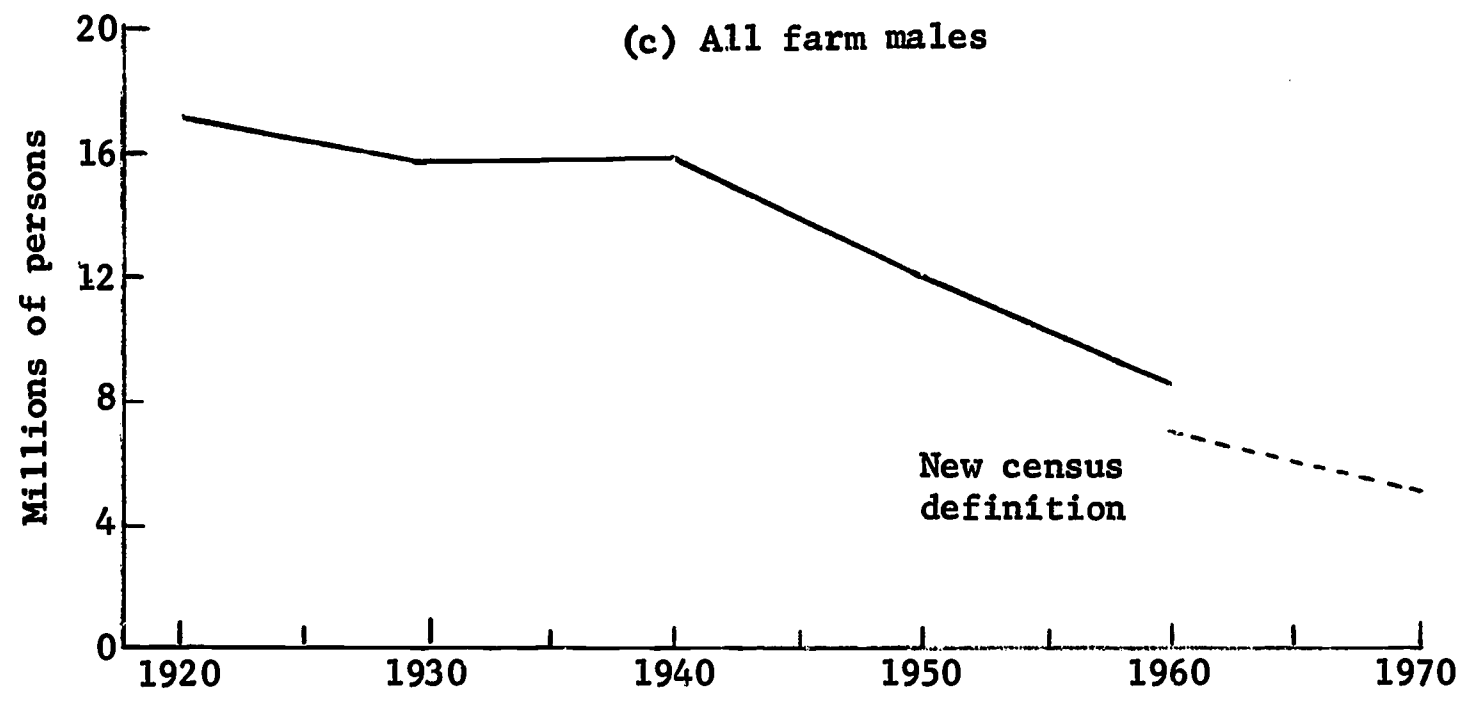


Figure 1. Man-Hours, Farm Operators and All Farm Males, 1920-1970

Table 3. Estimates of Commercial Farms Grouped into Family and Larger than Family Farms, United States, by specified years[1]

Commercial farms	1949	1959[4]	Percentage change from 1949 to 1959	
			Increase	Decrease
	Thousands		Percent	
Family size:[2]				
$10,000 or more marketings	334	680	104	--
Less than $10,000	3,138	1,582	--	50
Total	3,472	2,262	--	35
Larger than family:[3]				
$10,000 or more marketings	150	114	--	24
Less than $10,000	84	36	--	57
Total	234	150	--	36
All	3,706	2,412	--	35

[1]Estimates developed by R. Nikolitch, adjusted for 1959 farm definition.
[2]Using less than 1.5 man-years of hired labor.
[3]Using 1.5 man-years or more of hired labor.
[4]Preliminary estimates.

Source: John M. Brewster, "The Changing Organization of American Agriculture," paper presented to the Agricultural Committee of the National Planning Association, October 29, 1961, p. 15. These data have not been adjusted for changes in prices received and prices paid by farmers during the 1950's, and no adjustment has been made for the reduction in labor hired on farms which was associated with the increased mechanization of farm production.

less than this volume of products have been decreasing sharply in number. In striking contrast, family commercial farms which produce more than $10,000 of marketings annually are increasing. The number of family operated commercial farms producing $10,000 worth of marketings or more doubled between 1949 and 1959. The number of family operated commercial farms producing less than $10,000 of marketings decreased 50 percent.

In 1959 there were 680,000 family operated farms producing $10,000 or more of marketings. It is unlikely that the rate of increased in these farms which occurred during the 1950's will be maintained throughout the 1960's. Brewster has estimated that it would be possible for the nation to reorganize its 1.6 million commercial family farms which produce less than $10,000 of marketings into 660,000 units which produce the equivalent of $10,000 of marketings by

1975.[1] If the economy operates with reasonably full employment, it should be possible to achieve approximately two-thirds of this increase by 1970. It is quite conceivable, therefore, that in 1970 the nation could have approximately 1.1 million farms which produce the equivalent of $10,000 of marketings in 1959 prices. Without an extraordinarily high rate of growth the nation would continue to have approximately 525,000 farms in 1970 which would produce less than $10,000 of marketings. When these are added to the 1.1 million farms which can produce the equivalent of $10,000 of marketings or more, it is estimated that the nation could have 1.6 million commercial family farms in 1970.

The supply of labor for farming will depend in part upon the number of youths entering the labor force and the rate at which they are attracted into nonfarm employment. In 1960 there were 1.5 million rural farm males 10 to 19 years of age.[2] Assuming normal life expectancy, approximately 1,475,000 of these may be expected to survive the decade. These young men can be considered as potential farm operators for 1970. How many commercial family farms will be available to them?

A relatively high percentage of the family farms producing $10,000 or more of marketings in 1959 were operated by farmers in the older age groups. Accordingly, it can be expected that during the decade a substantial number of these farms will become available to new operators as a result of death or retirement of the present operators. Under the assumption that all these farmers will retire at age 65 and that death rates will be in accordance with the life expectancy tables, it is estimated that 150,000 commercial family farms now

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[1]John M. Brewster, "The Changing Organization of American Agriculture," paper presented to the Agricultural Committee of the National Planning Association, October 29, 1961, p. 15.

[2]Census of Population, 1960, General Social and Economic Characteristics, P.C.(1).

producing $10,000 or more of marketings will become available to new operators during the decade. It appears, therefore, that there will be approximately ten potential young farmers for each farm producing $10,000 or more of marketings which will become available to new operators during the 1960's (Table 4).[1]

Table 4. Number of Farm Boys as a Percent of Openings on Farms with $10,000 or More of Marketings

Region	Rural farm boys 10-19 years of age, 1960[1]	Farm operators to be replaced 1960-69	Percent
West	132,306	27,983	21
North Central	567,552	65,742	12
South	703,806	40,772	6
Northeast	96,591	15,756	16
Total	1,500,255	150,253	10

[1]We are indebted to Karl Shoemaker and Ed Callahan of the Federal Extension Service for these data. The data are from Census of Population, 1960, General Social and Economic Characteristics, P.C.(1).and from life expectancy tables.

The pressure of farm youth upon opportunities for profitable commercial farming varies greatly among regions. In the South, there may be 17 young potential farm operators for every farm of $10,000 or more of marketings vacated by its present operator through death or retirement. At the other extreme in the West there will be only five young men on farms for every farm producing $10,000 or more of marketings which will be vacated by an operator in the present decade.

When one considers effects of the reduction in number of smaller commercial farms, the excess supply of manpower becomes even more obvious. Under the assumptions made above approximately 1.06 million small family farms would be

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[1]See also Supplement Tables B-1 through B-4.

recombined into 440,000 larger family units by 1970 thus eliminating 620,000 small farms. Using the life expectancy tables, it is estimated that 330,000 of the operators of farms producing less than $10,000 of marketings will retire or die during the present decade. Therefore, a balance of 290,000 operators would be displaced from small commercial farms. Those displaced will compete with rural youths for remaining farming opportunities and add to off-farm migration pressures. Adding to the 290,000 farm operators who would be displaced the 1,325,000 young men who will be coming into the labor force, and who will not be able to obtain family farms with $10,000 or more of marketings, we find that nonfarm jobs will be needed for at least 1,615,000 farm males during the present decade.[1]

In addition to the commercial family farms discussed to this point, there were about 1.3 million farms in 1959 consisting mostly of part-time and part-retirement farms. Farm operators form only about one-half the farm labor force, as they are supplemented by about an equal number of family workers and hired farm workers. Considerations similar to those already discussed for commercial family farm operators apply to many of these other groups in the farm labor force.

How will the prospective decline in the farm labor force be distributed among age groups? Because the occupational outlook of rural farm youths largely depends on the answer to this question, the regional projections shown in Table 5 were made. The first column of Table 5 shows by age group how many persons who were farm males in 1960 are expected to be alive in 1970 applying survival

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[1]The Committee for Economic Development report, "An Adaptive Program for Agriculture," July, 1962, projects a somewhat greater transfer of labor but it assumes a complete adjustment in number and size of farms during the next five years.

Table 5. Regional Projections to 1970 for Males Remaining on Farms and Migrating Off Farms

Age in 1960	Number of 1960 rural farm males surviving to 1970	Number expected to be rural farm males in 1970	Implied off-farm migration
		Thousands	
		Northeast	
5-14	99	47	52
15-24	66	29	36
25-34	43	38	5
35-44	54	46	7
45-65	86	74	14
Regional totals	348	234	114
		North Central	
5-14	610	268	342
15-24	367	139	228
25-34	241	219	22
35-44	319	288	31
45-65	533	493	41
Regional totals	2,070	1,407	664
		West	
5-14	142	58	84
15-24	83	24	59
25-34	55	46	9
35-44	74	64	10
45-65	118	92	25
Regional totals	472	284	187
		South, White	
5-14	470	188	282
15-24	338	59	279
25-34	178	112	66
35-44	248	194	53
45-65	457	414	44
Regional totals	1,691	967	724
		South, Nonwhite	
5-14	221	70	151
15-24	131	8	124
25-34	49	21	28
35-44	55	37	17
45-65	93	67	26
Regional totals	549	203	346
U. S. totals	5,130	3,095	2,035

Source: See Supplement C.

ratios mentioned earlier. The second column shows the number of males in each age group who are expected still to be in the farm population in 1970 in view of prospective declines in farm numbers. This column extends to 1970 relationships from regression analysis that indicate how changes in farm numbers are distributed among farm operators in each age group. The regression analysis employing data back to 1920 indicates that declines in farm numbers are distributed fairly predictably among age groups.[1] For every region, reduction in entry into farming in younger age groups is the predominant adjustment to a decline in the total number of farms. However, older age groups participate in declines to some extent. This can occur through farm-to-nonfarm occupational changes of the operators and through earlier retirement. Father-son arrangements and other methods whereby young men acquire capital help to account for the fact that some of them successfully compete against older operators for farming opportunities and in this way spread part of the adjustment to the older age groups. The third column of Table 5 is the difference between the first two columns. That is, it shows the net migration to the nonfarm population by rural farm males that will be required if the projected farm adjustments take place.

To help bring out the significance of Table 5 for the planning of educational effort, consider farm males who were 15 to 24 years old in 1960. For the North Central and Northeast regions, the number expected to survive to 1970 is over twice the projected number of farm males for that age group. Roughly, then, one might say that in the North Central and Northeast possibly one-half of the surviving farm males 15 to 24 years old in 1960 might be expected to remain in the farm population over the next ten years. By the same

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[1]See Supplement C.

logic, for the West, one in three may remain. The ratio for southern whites is one in five. The extreme is found for southern nonwhites, only one in sixteen of whose survivors are expected to remain in the farm population.[1]

Even more dramatic results are implied for the farm males who were 5 to 14 years old in 1960. Their prospects for careers in farming depend importantly on happenings beyond 1970. The discussion has emphasized that impacts of technological efficiencies will be only partly worked out by 1970, and so it is reasonable to assume continuation of the same type of adjustments in the 70's as in the 60's. The projected magnitudes for 1970 were used as a base for projections to 1980 using the same methodology as for the 1970 projections of Table 5. This enables us to trace the prospects of rural farm males who were 5 to 14 in 1960 through their years of major career choice. Thus, from Table 5, for the North Central and Northeast, the 5 to 14 year old farm males in 1960 surviving to 1970 are expected to outnumber the projected number of farm males in that age group by about two to one, i.e., there will have been net migration of one-half of them. Then the projection from 1970 to 1980 was used to find the prospects of farm males who will be 15 to 24 years old in 1970. The

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[1]The earlier discussion comparing commercial family farm vacancies and consolidations with number of farm youths gave measures of the extremeness of competition that will exist in the future for the declining number of farming opportunities. That is, the earlier discussion gave measures of pressure and not estimates of actual adjustments. The present discussion related to Table 5 gives estimates of actual adjustments ensuing from the pressure. Many of the jobs that farm youths will find in farming will unfortunately not be as remunerative as operating commercial family farms producing $10,000 or more of marketings. Table 5, therefore, gives projections for total rural farm males, a group which greatly outnumbers operators of commercial family farms. As just brought out in the preceding paragraph of the text, some youths will successfully wrest farming opportunities from older operators so the entire brunt of declining farm numbers will not be on youths.

Finally, it should be noted that in the earlier discussion of commercial family farms the age grouping of young farm males was 10-19 years old, whereas the present discussion based on Table 5 will consider the two groupings 5-14 and 15-24 years old.

projection to 1980 revealed that about one-half of those 15 to 24 years old in 1970 who survive the following decade may remain in farming. In other words, for the North Central and Northeast regions, roughly one-half of one-half, or one fourth, of those survivors who were 5 to 14 years old in 1960 are expected still to be in the farm population by 1980. Applying this same type of analysis to the other regions indicates that only about one survivor in six of those 5 to 14 years old in 1960 in the West will be in the farm population by 1980. For southern whites, perhaps one in ten have this prospect. Similarly, only about one southern nonwhite survivor out of every ten who was 5 to 14 years old in 1960 is expected to remain in the farm population.

The Demand for Manpower in Farm Related Occupations

One of the major aspects of economic progress in agriculture is the increased specialization of farms and the transfer of tasks formerly performed on farms to nonfarm firms. During periods of technological change and economic progress, therefore, the agribusiness sector expands and provides employment for part of the labor released from farms.

As was pointed out earlier the demand for farm products does not grow in proportion to the increases in incomes of consumers in the United States. The demand for marketing and processing services, however, grows at a much more rapid rate than the demand for farm products. Likewise, as agriculture becomes more specialized, farmers turn to the nonfarm sectors of the economy for chemicals, equipment and other supplies. Purchased inputs increased approximately 15 percent during the 1950's compared with a 17 percent decrease in the quantity of nonpurchased inputs used in farm production.[1] The farm supply sector has grown and has provided employment for some of the labor released from farming.

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[1] Agricultural Outlook Chartbook, 1962, Table 4, p. 51.

As a result of the growth in farm related industries more people are employed in the processing and marketing of farm products than are employed on farms.[1] Expansion of employment in farm supply industries and in marketing and processing industries has provided jobs for many farm people. In many farm related industries some knowledge of technical agricultural subjects and a general understanding of the processes of agricultural development are highly desirable. The types of training and experience needed, however, are not necessarily the same as that needed in farm employment.

Only rough estimates are possible of the extent to which farm background and training are of value in nonfarm agribusiness jobs. The occupations usually classified as related to agriculture in vocational studies account for a small fraction of nonfarm agribusiness jobs.[2] Two influences on future employment in agricultural supply industries may be noted that tend to offset each other. First, though the use of purchased inputs in farming will continue to increase, the fact that dealer organizations already exist and can expect at least a few productivity increases will tend to retard employment growth. Second, handling of materials and supplying services as a substitute for price competition among dealers are activities where productivity gains are slow. The demand for these services with only slow productivity increase will be a factor tending to make employment grow. The demand for services by food processors and distributors will continue to grow. But distributive education or other nonfarm training

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[1]See J. H. Davis and R. A. Goldberg, A Concept of Agribusiness (Boston: Alpine Press, 1960), p. 11.

[2]A recent study gives a typical list of farm related occupations: farm machinery or equipment salesman or fieldman, hauling agricultural supplies of outputs to be sold, farm equipment repair, landscape work, bulk milk tank truck operator, dairy plant technician, representative of processing firm, horticultural sales, produce grader, farm and garden supplies, farm auction employee, agricultural credit, hatchery employee, farm custom work. See Tom, Hill and Greene, Employment Opportunities in Certain Occupations Related to Farming, Rural Education Department, Cornell University, June, 1961, p. 9.

may be better preparation for these jobs than training for the relatively unskilled jobs open to those with high school agricultural training.

Table 6 shows recent trends in farm related industries based on three- and four-digit industry classification using data from the Census of Business and the Census of Manufactures. With base year of 1958 equal 100, the index for aggregate employment shown in Table 6 was 95 for the period 1947-48. Extrapolation of the trend for twelve years into the future would mean an employment index of about 106 in 1970. This implies there will be about 100,000 new jobs by that time.

Farm Population as a Supplier of Nonfarm Labor

Thus far we have treated the farm manpower analysis as if adjustments could be made freely within agriculture. Actually, the ability of agriculture

Table 6. Employment in Farm Related Industries

Industry	1947-48	1958
Manufacturing		
Meat products	274,493	311,758
Dairy products	283,431[1]	293,802
Canned and frozen foods	201,109	223,323
Grain mill products	123,507[1]	118,984
Fertilizers	20,357	18,728
Fertilizers, mixing only	11,615	12,161
Farm machinery	94,144	75,273
Wholesale trade		
Groceries and related products	462,484	478,443
Farm products raw materials	101,425	116,896
Farm and garden machinery equipment	23,891[1]	21,006
Farm supplies	21,102	21,507
Retail trade		
Farm equipment dealers	79,625[1]	81,044
Hay, grain, feed stores	60,011	58,083
Other farm, garden stores	12,381	23,778
Totals	1,769,575	1,854,786

[1]1954 estimate used because 1948 estimate not available or estimates from 1947 and 1948 censuses not comparable to 1958.
Sources: Census of Business; Census of Manufactures.

to make adjustments and to increase the productivity of farm labor is influenced greatly by the level of economic activity and employment opportunities in nonfarm industries. A recent study indicates that migration is highly sensitive to the level of unemployment.[1] During the past thirty years the median rate of employment in the U. S. economy has been 5.3 percent. When the rate of unemployment is greater than this, labor is backed up in agriculture which is willing to migrate to nonfarm areas in large numbers even though the earnings of farm workers increase relative to the earnings of nonfarm workers. On the other hand, when the rate of unemployment is less than 5 percent, the rate of migration is responsive to changes in the earnings of nonfarm workers relative to the earnings of farm workers. As the earnings in nonfarm occupations increase compared with the returns for labor on farms, the rate of migration increases.

During the 1940's approximately 9.5 million persons migrated from farm to nonfarm residences. The annual rate of migration during the 1950's was the same as during the 1940's, viz. 3.5 percent; but since the farm population was less, migration decreased to approximately 8 million.[2]

Projections were made of the number of people who would migrate from farms to nonfarm residences during the 1960's under the assumption that the rate of unemployment in the economy is kept below 5 percent. If relatively full employment is maintained and the earnings of nonfarm workers continue to rise relative to the earnings of farm workers as they have during the last 30 years, migration from farms will continue at a high rate. Under these conditions the migration is projected to be approximately 6.4 million persons with an upper limit of 7.1

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[1]C. E. Bishop, "Economic Aspects of Changes in Farm Labor Force," Chapter 4 in Labor Mobility and Population in Agriculture. Center for Agricultural and Economic Adjustment, Iowa State University Press, Ames, Iowa, 1961.

[2]Farm Population Estimates 1950-59, AMS-80, USDA, February, 1960.

million and a lower limit of 5.8 million.[1] Farm migrants will face heavy competition for nonfarm jobs during the last half of the decade of the 1960's when the increased birth rates following World War II will be reflected in large annual additions to the labor force. Actual migration, therefore, will be especially sensitive to the level of unemployment and to the training and skills of potential migrants.

Implications of Structural Changes to Educational Needs of Farm People

Several significant points emerge from the above analysis which are relevant to the structure of educational programs for farm youth. First, it is clear that the nation will need more not fewer highly trained efficient farmers in the future. The growth of efficient family farms is very pronounced. The increased complexity of farming operations associated with improvements in technology and the increased investment per farm accompanied by greater specialization in production can be expected to continue. These developments emphasize the premium which will be placed upon managerial ability in agriculture during the next decade. Knowledge and flexibility will become even more important than they have been in the past. Ability to adapt quickly to changes in technological and economic conditions will be the test of success in farming.

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[1]The general consistency of these figures with Table 5 is seen by noting that the 2.03 million off-farm migration for the U. S. given in Table 5 applies only to males who will be 15 years old and over in 1970, whereas the above estimates pertain to males and females of all ages. It should be emphasized that the above estimates do not consider the effects of special educational and training programs as an incentive for migration of farm youth. Obviously, the ability of farm youth to compete for nonfarm jobs will be enhanced by additional education and by special vocational training for nonfarm jobs. Under conditions of relatively full employment, migration would be increased by programs of this type. See, for example, C. E. Bishop and G. S. Tolley, "The South's Economic Future: A Challenge to Education," Educational Needs for Economic Development, Agricultural Policy Institute, North Carolina State College, June, 1962, pp. 11-15.

Developments of the kind outlined above emphasize the need for greater understanding of the basic fundamentals of science and a sound understanding of the forces governing the operation of the economy. In the future farmers will need a better understanding of the principles of plant and animal growth, of the chemistry and physics underlying the physiological development of farm products, a better understanding of business principles and of how the economic system functions and the ability to grasp new ideas and apply them quickly in practical farm situations.

Agriculture is a highly dynamic, rapidly changing industry which has a higher investment per worker than nonfarm industries taken as a whole. Further increases in the size and complexity of farming operations will be a necessary part of a solution to the "farm problem." If farmers and farm workers are to receive returns for their labor and management which are equal to those received in other occupations, they must have equal managerial ability and productive capacity. Hence, they must have approximately equal educational and training experiences.

It is through the training and occupational choices of the youth that greatest adjustment in resource use will be attained. After an occupation has been selected and investments made, labor mobility is decreased. Unfortunately, farm youth receive less formal education than the youth living in nonfarm residences. The attrition rate in high schools is higher for farm youth, fewer of them attend college and the attrition rate in college is higher than for the sons and daughters of persons employed in other occupational groups.[1] The smaller investment in education of farm youth undoubtedly impedes agricultural adjustment.

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[1]C. E. D., "An Adaptive Program for Agriculture," op. cit., pp. 34, 35.

In the future, more farm operators will need the equivalent of college training. A 1959 study shows that only 32 percent of the rural farm high school seniors definitely planned to attend college.[1] The study also points out that of the rural farm residents enrolled in college in 1959 only 10 percent were majoring in agriculture.[2] Hence, only about 3 farm youth in 100 of college age are attending college and majoring in agriculture. Very few of these will choose farming as a major occupation. During the 1960's there will be good opportunities on family commercial farms for several times as many rural farm males as are now majoring in agriculture in colleges and universities. The nation is a long way from producing a generation of college-trained farm operators.

The picture is quite different at the high school level. The typical vocational agricultural program includes activities beamed at the needs of regularly enrolled high school day students, young farmers who have recently graduated from high school or others who are operating farms and evening classes for adult farmers.

Enrollment in vocational agricultural programs grew rapidly from 1920 through 1950.[3] During the last decade, enrollment in evening and young adult programs has largely stabilized, and growth in the day programs in high schools has been small. In 1960, approximately 464 thousand males were enrolled in high school vocational agricultural classes. In addition, there were 66 thousand enrolled in the young adult programs and 267 thousand enrolled in the evening programs. The young adult and evening programs are conducted almost

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[1] Educational Status, College Plans and Occupational Status of Farm and Nonfarm Youth, October, 1959. Series Census-ERS(P-27) No. 30, p. 22.

[2] Ibid., p. 21.

[3] Annual Report of State Boards for Education, U. S. Department of Health, Education and Welfare, Office of Education, Washington, D. C., 1961, p. 25.

entirely for farm operators. The day programs, on the other hand, are for high school students. Most of these have not selected a vocation.

Data are not readily available with which to estimate the number of farm youth who obtain training in vocational agriculture. With normal attrition, enrollment in the freshman year would be substantially greater than in the other years of high school. Therefore, although there were 464 thousand males enrolled in vocational agriculture in 1960, the number of high school students who had received one or more years of training in vocational agriculture undoubtedly was greater than 464 thousand. In 1960, there were approximately 600 thousand rural farm males of high school age. Less than 90 percent of these were enrolled in high school. It is obvious, therefore, that a very high percentage of the rural farm males attending high school receive some training in vocational agriculture.

Clearly, the number of students enrolled in vocational agriculture classes far exceeds the number who may expect to find opportunities for employment as operators of efficient commercial family farms. Yet, a rather high percentage of those receiving training in vocational agriculture have been employed in farming and in farm related occupations. A compilation of the results of studies analyzing the occupations of former vocational agriculture students between 1918 and 1960 shows that one-third of the former students were farming and approximately 8 percent were employed in farm related occupations when the studies were made (Table 7).[1] The variations among regions likely reflect differences in farming opportunities and differences in the emphasis placed upon vocational agricultural training in the high schools of the regions. Apparently,

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[1]These data were compiled from Summaries of Studies in Agricultural Education, Office of Education, U. S. Department of Health, Education and Welfare. The compilation of data by region and state is presented in Supplement D.

a higher percentage of the students in the South enroll in vocational agriculture and there are relatively fewer good farming opportunities in the region.

Table 7. Regional Distribution of Former Vocational Agricultural Students Engaged in Farming and Farm Related Occupations (1918-1960)

Region	Number of students	Percent farming when studied	Number of students	Percent in farm related occupations when studied
Northeast	15,180	33.2	14,068	10.0
North Central	35,482	37.6	29,028	8.7
South	104,437	27.7	90,848	6.8
West	15,009	50.8	3,517	7.4
U. S.	170,108	33.3	137,461	7.6

The studies which were made of students since 1946 were analyzed separately to determine whether changes had taken place since World War II. The results were similar to those obtained for the period 1918-1960.

A number of studies have been made of the employment experiences of students who completed three or more years of training in vocational agriculture. Summaries of these studies reveal no significant difference in employment in farming and farm related occupations from studies of all students receiving some training in vocational agriculture.

At the time of the inception of the agricultural education and training programs they were regarded largely as means of disseminating information to farmers relative to production practices which appeared to be profitable on farms in the communities concerned. The programs served as an arm for extending the results of applied research to the farm fields. In the early stages of agricultural development this was the means through which quick results could be obtained in increasing the productivity of agricultural resources.

As research has increased the tempo with which new knowledge is created, and as agriculture has been subjected to recurring and ever pressing needs for adjustment, this approach to the education of rural youth has become hopelessly obsolete. Production practices change very rapidly in modern agriculture. A premium is placed upon early adoption of new technology. Profits are quickly dissipated as innovations become widely adopted. Vocational education programs cannot equip modern farmers with the technical competence needed to evaluate and adopt those practices which are most appropriate to modern agricultural production unless a scientific orientation is provided in the training programs. Farmers must be provided with a foundation knowledge of science and decision theory to enable them to select from the growing stream of technology those techniques which are most appropriate to individual farm situations and to adjust farming operations accordingly.

In view of the increased complexity of modern agriculture greater emphasis in vocational agricultural programs is being placed upon the biological processes of growth and how they can be modified through the application of science. Modern curricula also include an extensive appraisal of career opportunities in farming and in related occupations. Increasingly, training in farm business analysis, accounting, planning techniques, and supervised farm practice work are being postponed until the junior and senior years when a larger proportion of the students are seriously considering careers in farming.

The young farmer programs and evening adult classes also are being modernized in line with the changes taking place in the structure of agriculture. Adjustments tend to take place increasingly on an area basis. Opportunities for profitable adjustment on individual farms are determined in large part by the adjustments which neighboring farmers are willing to make. In view of these facts and the tendency of farmers to specialize to a greater degree in

the production of two or three commodities, the young adult and evening programs now are being conducted largely on a type-of-farming basis. These programs are vocationally oriented and specialized. They emphasize forces changing technology and economic conditions confronted by the industry concerned as well as production practices.

In spite of the progress that is being made in updating vocational agricultural curricula, however, the high school programs of many communities are still very much out of keeping with the changing structure of the U. S. economy. It is indeed deplorable that under the local option provisions, many high schools require all freshmen boys to enroll in agriculture. As recently as 1960, 42 percent of the high schools teaching vocational agriculture in North Carolina required all freshmen boys to enroll in agriculture.[1] Some understanding of the processes of changes in rural America and of the necessity for adjustment to these changes is desirable for all rural youth. Under no conditions, however, should high schools structure their training programs on the assumption that all farm boys will remain on farms.

Summary

As farmers become better educated and more efficient managers, the number of farming opportunities will become even more limited but the number of efficient commercial family farms will increase. Efficient farmers who are able to take advantage of the economies associated with mechanical and organizational innovations will be able to produce on a more competitive basis than the operators of small inefficient farms.

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[1]G. B. James, unpublished research on vocational agriculture curricula, State Department of Education, Raleigh, N. C., 1960.

Much of the structural adjustment taking place in agriculture in the future will occur through a transfer of farm youths to other occupations. This fact must be recognized in our educational programs. Better education and training of farmers will speed up this process. It is folly to think that all rural youth will have an opportunity to operate profitable commercial farms or that they will find attractive employment in farm related occupations. The processes of growth and development dictate that this shall not be the case.

It is in these forces of growth and development that employment opportunities are created for the farm youth who migrate. As consumers experience increased incomes, they bid up the prices of nonfarm goods and services relative to the prices of farm goods and services. This action provides incentives to expand the production of nonfarm commodities thereby creating employment opportunities for migrants from farms. If a vast majority of the farm youths are to participate fully in the fruits of economic progress, they must be equipped with the education and training which are necessary to enable them to meet the qualifications for employment in those occupations which will be most rapidly expanding during the next decade. In the past a large proportion of the migrants from farms to urban areas have been unskilled and poorly equipped for productive employment in nonfarm occupations. Numerous studies have demonstrated that the demand for workers in the U. S. economy will grow most rapidly in occupations requiring the most education and training. Those who migrate from farms will encounter less difficulty in obtaining employment in nonfarm occupations if they are provided with the requisite skills and training.

The returns from education in the United States are high. As the economy grows in complexity and a greater premium is placed upon the ability to adjust rapidly to changing technological and economic conditions, the returns will continue to be high. Educational programs should be judged not on the basis

of the number of youths who select particular occupations or the service of the programs to particular occupational groups but on the basis of the service which the programs render to society as a whole. Certainly, by increasing the productivity of farmers and by enabling agriculture to release labor to the nonfarm sectors of the economy, the agricultural education programs have made it possible for our society to enjoy an unparalleled variety and volume of nonfarm goods and services as well as an abundance of food and fiber. In one sense, perhaps the greatest contribution of agricultural education programs has been to make possible the conversion of millions of farmers into nonfarmers. But, it should be emphasized that the improved managerial ability and increased productivity of labor resources emanating from the agricultural education programs only make the conversion possible. To date, the nation has failed to provide the nonfarm employment opportunities and the nonfarm training and skills needed to effect the transition in numbers sufficient to maintain reasonable returns for resources employed on farms. Unless a higher rate of employment is maintained in the economy and unless better vocational training is provided to rural youth who are potential migrants to nonfarm employment, much of the fruits of the agricultural education program will continue to be dissipated in underemployment of labor on farms.

SUPPLEMENTS

to

MANPOWER IN FARMING AND RELATED OCCUPATIONS

C. E. Bishop and G. S. Tolley

SUPPLEMENT A. 1970 MAN HOURS IN AGRICULTURAL PRODUCTION

The man-hours projection shown in Figure 1 is based on a study in progress by Warren E. Johnston at North Carolina State College entitled, "A Projection Sensitivity Study for U. S. Agriculture." The major assumptions underlying the projection are as follows.

Total demand projections for 1970 are made for the four feed grains: wheat, cotton, soybeans, and hay. Existing price relationships are assumed to prevail in the year of projection and population and per capita incomes are projected at rates of growth observed in the 1950's. The event of a major war or economic depression is precluded. Projected commodity requirements are given in Table A-1.

These eight major crops utilized about a quarter of all man-hours used in farm work during the last decade. In 1960, 2.4 billion of the 10.3 billion man-hours, and in 1950 3.8 billion of the 15.2 billion man-hours of labor used in agriculture was employed in the production of these commodities. The past 10 year declines in man-hour requirements per unit of production are extrapolated but slowed down where the extrapolated estimates were proportionately greater than those of the preceding decade. Man-hour requirements per unit of production for 1958-60 and 1970 and the total man-hour requirements for these crops based upon projected demands are given in Table A-2.

The demand for livestock and livestock products was projected for 1970 under the same assumption underlying the crop demand projection above. The index of farm production is estimated to increase to an index value of 155 (1947-49=100) by 1970. This is in comparison to an index of production for 1960 of 129. Man-hour requirements are to decline about in the order of the trend in the 1950's when requirements were decreased by about 30 percent in the eleven years from 1949 to 1959. Man hours employed in the production of

major livestock and livestock products are estimated to decline to about 3,875 million hours for 1970 from 4,571 million in 1959 and 5,260 in 1949.

Man-hour requirements in production of other farm commodities are projected to follow the same trend as the eight major crops. These requirements are for production of crops other than the eight major crops discussed above and for some lesser livestock and livestock products. In 1949, such production utilized about 6.3 billion man hours of farm labor and in 1959 some 3.6 billion man hours were thusly utilized. Estimated requirements for 1970 are 2,020 million man hours.

In total, 7,362.5 million man-hours of labor is projected to be employed in farm work in 1970. This estimate implies that agricultural production will require about three billion less man hours of labor in 1970 than were utilized in 1960 when 10,310 million man hours were so used.

Table A-1. Projected Commodity Requirements for Domestic and Export Disappearances in 1970

Commodity or commodity group	Estimated demand requirements, 1970
Feed grains	162.3 mil. tons
Wheat	1228.0 mil. bushels
Cotton	14.7 mil bales
Soybeans	816.3 mil. bushels
All hay	135.7 mil. tons

Table A-2. Man-Hour Requirements per Unit of Production and Projected Man-Hours of Farm Labor for the Production of the Eight Selected Crops for 1970

Commodity or commodity group	Unit of production	Man-hour requirements per unit of production		Man-hour requirements for 1970
		1958-60	Projected 1970	
				Million
Feed grains	ton	6.03	3.00	486.9
Wheat	bu.	.14	.08	98.2
Cotton	bale	61.72	35.00	514.5
Soybeans	bu.	.18	.10	81.6
All hay	ton	3.31	2.11	286.3
Total				1,467.5

SUPPLEMENT B. SURVIVORS TO 1970 OF COMMERCIAL FAMILY FARM OPERATORS BY REGION

The Census of Agriculture provides data on the number of farmers by volume of sales of farm products and age of the farm operator. The number of family farms producing $10,000 or more of marketings is increasing rapidly, presumably reflecting the ability of these farms to meet expenses for family living, production expenses, and to provide a base for growth and development. The realized net farm income for farms with this volume of marketings would average approximately $3600 annually. Considering the income received from nonfarm sources, the net family income would average approximately $5400. It was assumed that farms of this size and larger would continue to increase in number. Accordingly, farms of this size were assumed to provide attractive employment opportunities for farm youth.

Life expectancy rates, by age in 1960, were applied to the operators of farms marketing $10,000 or more of products to estimate survival of the operators. It was assumed that all operators would retire upon reaching 65 years of age. The procedure used, therefore, overestimates the number of farms which will be available to the extent that operators who reach 65 do not retire and to the extent that farms now marketing $10,000 or more of products are combined during the decade.

Estimates of the number of farms which would become available under the above assumptions are presented by region in Tables B-1 through B-4.

Table B-1. Number of Farms with Sales of $10,000 or More by Age of Farm Operator, Southern Region,[1] 1959

Age of farmer	Number of farms with sales of $10,000 or more[2]	Farmers expected to die or retire 1960-69	
		Percent	Number
Under 25	2,647	1.8[3]	48
25-34	24,150	2.6[3]	628
35-44	52,611	6.1[3]	3,209
45-54	60,328	14.6[3]	8,808
55-64	37,677	30.1[3]	11,341
65 and over	16,738	100.0[4]	16,738
			40,772

[1]Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia, Maryland, and Delaware.

[2]Census of Agriculture, 1959, Vol. I, State Tables 17.

[3]From life expectancy table.

[4]All are assumed to die or retire in 10 years.

Table B-2. Number of Farms with Sales of $10,000 or More by Age of Farm Operator, Northeastern Region,[1] 1959

Age of farmer	Number of farms with sales of $10,000 or more[2]	Farmers expected to die or retire 1960-69	
		Percent	Number
Under 25	1,069	1.8[3]	19
25-34	10,563	2.6[3]	275
35-44	19,170	6.1[3]	1,169
45-54	19,863	14.6[3]	2,900
55-64	15,117	30.1[3]	4,550
65 and over	6,843	100.0[4]	6,843
			15,756

[1]Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and Pennsylvania.

[2]Census of Agriculture, 1959, Vol. I, State Tables 17.

[3]From life expectancy table.

[4]All are assumed to die or retire in 10 years.

Table B-3. Number of Farms with Sales of $10,000 or More by Age of Farm Operator, North Central Region,[1] 1959

Age of farmer	Number of farms with sales of $10,000 or more[2]	Farmers expected to die or retire 1960-69	
		Percent	Number
Under 25	7,354	1.8[3]	132
25-34	73,405	2.6[3]	1,909
35-44	124,736	6.1[3]	7,609
45-54	110,328	14.6[3]	16,018
55-64	65,211	30.1[3]	19,629
65 and over	20,445	100.0[4]	20,445
			65,742

[1]Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.
[2]Census of Agriculture, 1959, Vol. I, State Tables 17.
[3]From life expectancy table.
[4]All are assumed to die or retire in 10 years.

Table B-4. Number of Farms with Sales of $10,000 or More by Age of Farm Operator, Western Region,[1] 1959

Age of farmer	Number of farms with sales of $10,000 or more[2]	Farmers expected to die or retire 1960-69	
		Percent	Number
Under 25	1,142	1.8[3]	21
25-34	15,360	2.6[3]	399
35-44	33,635	6.1[3]	2,052
45-54	34,538	14.6[3]	5,043
55-64	23,036	30.1[3]	6,934
65 and over	13,534	100.0[4]	13,534
			27,983

[1]Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.
[2]Census of Agriculture, 1959, Vol. I, State Tables 17.
[3]From life expectancy table.
[4]All are assumed to die or retire in 10 years.

SUPPLEMENT C. PROJECTIONS OF RURAL FARM MALE POPULATION BY REGION AND AGE

The projections of farm operators and total rural farm males shown in Figure 1 were obtained as a by-product of the procedures leading to the more detailed farm male projection of text table 5. The number of rural farm males of working age is not the most accurate of several available indicators of people engaged in agriculture, but it and the number of farm operators are the only series with extensive information by both region and age. The conclusions about occupational trends of major concern in this study are not believed to be importantly affected by having to rely heavily on these series.

The first column of Table 5 survives to 1970 the rural farm males reported in the 1960 Census of Population. Life expectancy tables were used. An alternative method is to use census survival ratios, but the required tabulations for this method were not published from the 1960 census at the time of this study.

There are several steps in the derivation of column two of Table 5. Here is a description of the regressions carried out for each region estimating how farm operators of various age groups share in changes in the total number of farms:

> To measure the effect on each age group and to use decade changes going back to 1920, a regression analysis was formulated and applied to each age group. The hypothesis is that the number of farmers in a given age group depends on the number ten years younger ten years earlier and on the change in total number of farm operators of all ages. The following equation reflects this hypothesis in a form suitable for logarithmic line fitting:
>
> $$\frac{x_t}{y_{t-10}} = a \left[\frac{z_t}{z_{t-10}} \right]^b ,$$
>
> where x_t is number of farm operators of a given age group, y_{t-10} is cohort value ten years previously, and z_t and z_{t-10} are total numbers of farm operators. The parameter a may be viewed as the normal cohort ratio between adjacent age

> groups in that it estimates the ratio expected in absence of change in total number of farm operators. The a's obtained by considering different age groups thus give the cohort pattern of net entry and exit expected in absence of aggregate change in farm numbers. This formulation visualizes the observed cohort patterns to result from this normal pattern as subjected to modification in each past decade by changing farm numbers. The parameter b gives the modification. It is the elasticity of the number of farm operators in age group with respect to total farm numbers.
>
> The a's and b's for each age group were estimated by running regressions separately for whites and nonwhites for the census South. There were five observations per regression corresponding to five decadal changes (t equals 1920, 1930, 1940, 1950 and 1959). For the dependent variable ratio to number of farmers ten years younger a decade earlier was used in each case except for the group under 25 where division by zero would be implied. It was supposed that operators under 25 would tend to be sons of farm operators who were 25-44 ten years earlier. The latter grouping was accordingly used as the divisor for those under 25.[1]

The paper just quoted presents the regression results for the South. In the present study, the method was extended to all the regions. The regressions were used to make alternative projections to 1970 by setting the independent variable (Z_{1970}/Z_{1960}) at several different levels. The farm operator cohort ratios thus estimated were applied to the numbers in each cohort in 1959 to arrive at projected 1970 numbers of farm operators by age group.

The 1960 ratio of rural farm males to farm operators for given age groups was assumed to prevail in 1970, and application of these ratios to the farm operator projections gave the 1970 estimates of farm males. The projection presented in Table 5 was chosen from among the alternatives mentioned in the preceding paragraph to achieve maximum consistency with the man hour projection

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[1]G. S. Tolley and H. W. Hjort, "Relative Position of Southern Agriculture--Its Bearing on Area Development," presented at meetings of the Association of Southern Agricultural Workers, Jacksonville, Florida, February, 1962.

described in Supplement A and with the several other analyses of agricultural change contained in the paper.

The final column of Table 5 is the difference between the first two columns and estimates of net migration of the farm males. On the basis of the 1970 estimates shown in Table 5 and some assumptions--needed to complete the 1970 picture--about numbers of farm males who would be under 15 years old in 1970, a projection to 1980 was made by the same procedure as just described for the 1970 projections. This provided the results given in the text about what might happen by 1980 to farm males who were 5-14 years old in 1960.

SUPPLEMENT D. OCCUPATIONAL EXPERIENCE OF FORMER VOCATIONAL AGRICULTURE STUDENTS

The data used in the analysis of occupational experiences of former vocational agriculture students were obtained from annotated bibliographies of studies in agricultural education published in "Summaries of Studies in Agricultural Education," a series of reports issued by the Office of Education. The various studies were undertaken by different agencies and in different years. The years of training in vocational agriculture, the time which had elapsed since training and the occupations included in the farm related category were not the same in all studies. In spite of efforts to achieve comparability, therefore, the data in the following tables should be considered as rough approximations of the occupational experiences.

Table D-1. Regional Distribution of Former Vocational Agricultural Students Engaged in Farming (1918-1960)

Region	Number of studies	Number of students	Students by states within region	Number farming when studied	Percent farming when studied
North-east	18	15,180	Me. 747, Mass. 2293 N. J. 271, N. Y. 9983 Pa. 856, Vt. 1030	5,044	33.2
North Central	34	35,482	Ill. 3419, Ind. 2271 Iowa 219, Kan. 836 Mich. 1245, Minn. 1740 Mo. 13,550, Neb. 530 Ohio 6648, S. D. 1582 Wis. 3442	13,329	37.6
South	39	104,437	Ala. 679, Ga. 857 Ky. 22,650, La. 683 Md. 2615, Miss. 5869 N. C. 782, Okla. 348 S. C. 166, Tex. 1169 Va. 67,695, W. Va. 924	28,979	27.7
West	10	15,009	Ariz. 206, Colo. 93 Idaho 1339, Mont. 926 Nev. 133, Ore. 2430 Utah 9141, Wyo. 744	7,622	50.8
U. S.	101	170,108		54,974	33.3*

*When the Puerto Rico study (1454 students) and two other studies in the United States (47,177 students, which included students from several states in different regions are included, 35.9 percent of the total number of 213,739 students studied were reported to be engaged in farming.

Table D-2. Regional Distribution of Former Vocational Agricultural Students Engaged in Farm Related Occupations (1918-1960)

Region	Number of studies	Number of students	Students by states within region	Number in farm related occupations when studied	Percent in farm related occupations when studied
North-east	14	14,068	Me. 747, Mass. 2293 N. J. 271, N. Y. 9457 Pa. 270, Vt. 1030	1,413	10.0
North Central	23	29,028	Ill. 3094, Ind. 1635 Kan. 836, Mich. 1149 Minn. 644, Mo. 13,550 Neb. 167, Ohio 3500 S. D. 1582, Wis. 2764 Iowa 107	2,538	8.7
South	24	90,848	Ala. 679, Ga. 597 Ky. 22,529, La. 343 Md. 1226, Miss. 5869 N. C. 671, Tex. 1169 Va. 57,765	6,170	6.8
West	6	3,517	Ariz. 206, Colo. 93 Idaho 1339, Mont. 802 Ore. 333, Wyo. 744	259	7.4
U. S.	67	137,461		10,380	7.6*

*When the Puerto Rico study (1454 students) and one other study in the United States (30,662 students) including students from seven states in three regions are included, 8.7 percent of the total number of 169,577 students studied were reported to be engaged in farm related occupations.

Table D-3. Regional Distribution of Former Vocational Agricultural Students Engaged in Nonfarm Occupations (1918-1960)

Region	Number of studies	Number of students	Students by states within region	Number in nonfarm occupations when studied	Percent in nonfarm occupations when studied
North-east	12	11,112	Me. 747, N. J. 271 N. Y. 9824, Pa. 270	5,582	50.2
North Central	23	30,194	Ill. 2949, Ind. 1635 Iowa 107, Kan. 836 Mich. 941, Minn. 644 Mo. 13,550, Neb. 530 Ohio 6533, Wis. 2469	12,883	42.7
South	24	34,682	Ala. 679, Ga. 560 Ky. 22,650, La. 414 Md. 2615, Miss. 5382 N. C. 782, Tex. 236 Va. 957, W. Va. 407	19,828	57.2
West	6	12,325	Ariz. 206, Colo. 93 Idaho 1339, Mont. 802 Utah 914, Wyo. 744	4,905	39.8
U. S.	65	88,313		43,198	48.9*

*Includes military personnel. Thirty-six studies reported 11.9 percent of the 115,203 students studied in the military service. When the Puerto Rico study (1454 students) and one other study in the United States (14,619 students) which included students from states in all four regions are included, 44.4 percent of the total number of 104,386 students studied were reported to be engaged in nonfarm occupations.

Table D-4. Regional Distribution of Former Vocational Agricultural Students in College, Unknown and Deceased (1918-1960)

Region	Number of studies	Number of students	Students by states within region	Number in college, unknown or deceased when studied	Percent in college, unknown or deceased when studied
North-east	7	12,034	Me. 747, Mass. 2157 N. Y. 8860, Pa. 270	931	7.7
North Central	14	27,487	Ill. 2949, Ind. 1635 Kan. 836, Minn. 644 Mo. 13,010, Ohio 6262 Wis. 2151	4,022	14.6
South	17	85,855	Ala. 180, Ga. 162 Ky. 22,650, La. 343 Md. 2521, Miss. 4826 N. C. 578, Tex. 236 Va. 53,952, W. Va. 407	4,521	5.3
West	4	2,297	Colo. 93, Idaho 1339 Mont. 121, Wyo. 744	491	21.4
U. S.	42	127,673		9,965	7.8*

*The Virginia study of 53,952 students accounted for only 38 percent of the students in farming, farm related occupations, military service and deceased. If this study is excluded, the percentage of students in college, unknown and deceased for the South becomes 9.1 percent, and 11.3 percent for the remaining 41 studies.

Table D-5. Regional Distribution of Former Vocational Agricultural Students Engaged in Farming (1946-1960)

Region	Number of studies	Number of students	Students by states within region	Number farming when studied	Percent farming when studied
North-east	4	10,241	Me. 747, N. Y. 8464 Vt. 1030	3,183	31.1
North Central	10	9,530	Ill. 325, Ind. 1635 Kan. 836, Mo. 670 Ohio 3378, Wis. 2686	3,140	32.9
South	5	2,610	Ga. 162, Miss. 2019 N. C. 429	861	33.0
West	1	93	Colo. 93	33	35.5
U. S.	20	22,474		7,217	32.1

Table D-6. Regional Distribution of Former Vocational Agricultural Students Engaged in Farm Related Occupations (1946-1960)

Region	Number of studies	Number of students	Students by states within region	Number in farm related occupations when studied	Percent in farm related occupations when studied
North-east	3	10,041	Me. 747, N. Y. 8264 Vt. 1030	1,025	10.2
North Central	8	8,527	Ind. 1635, Kan. 836 Mo. 670, Ohio 3378 Wis. 2008	781	9.2
South	4	2,499	Ga. 162, Miss. 2019 N. C. 318	239	9.6
West	1	93	Colo. 93	11	11.8
U. S.	16	21,160		2,056	9.7

Table D-7. Regional Distribution of Former Vocational Agricultural Students Engaged in Nonfarm Occupations (1946-1960)

Region	Number of studies	Number of students	Students by states within region	Number in nonfarm occupations when studied	Percent in nonfarm occupations when studied
North-east	3	9,211	Me. 747, N. Y. 8464	4,742	51.5
North Central	8	8,527	Ind. 1635, Kan. 836 Mo. 670, Ohio 3378 Wis. 2008	3,605	42.3
South	5	2,610	Ga. 162, Miss. 2019 N. C. 429	1,437	55.1
West	1	93	Colo. 93	30	32.3
U. S.	17	20,441		9,814	48.0*

*Includes former students in military service when studied. Fifteen and three-tenths percent of the 16,775 students studied in 13 different studies conducted between 1946 and 1960 were in military service.

Table D-8. Regional Distribution of Former Vocational Agricultural Students in College, Unknown or Deceased (1946-1960)

Region	Number of studies	Number of students	Students by states within region	Number in college, unknown or deceased when studied	Percent in college, unknown or deceased when studied
North-east	3	9,211	N. Y. 8464, Me. 747	622	6.8
North Central	6	7,716	Ind. 1635, Kan. 836 Mo. 130, Ohio 3107 Wis. 2008	1,138	14.7
South	4	591	Ga. 162, N. C. 429	73	12.4
West	1	93	Colo. 93	19	20.4
U. S.	14	17,611		1,852	10.5

Table D-9. Regional Distribution of Former Students Who Completed Three or More Years of Vocational Agriculture and Are Engaged in Farming (1918-1960)

Region	Number of studies	Number of students	Students by states within region	Number farming when studied	Percent farming when studied
North-east	1	180	N. Y. 180	77	42.8
North Central	2	335	Il1. 205, Mo. 130	76	22.7
South	5	1,361	Ga. 30, Md. 1132 N. C. 199	430	31.6
West	1	121	Mont. 121	44	36.4
U. S.	9	1,997		627	31.4

Table D-10. Regional Distribution of Former Students Who Completed Three or More Years of Vocational Agriculture and Are Engaged in Farm Related and Nonfarm Occupations (1918-1960)

Region	Number of studies	Number of students	Students by states within region	Number in farm related occupations studied	Percent in farm related occupations studied	Number in non-farm occupations studied	Percent in non-farm occupations studied
North-east	1	180	N. Y. 180	29	16.1	72	40.0
North Central	1	130	Mo. 130	27	20.8	35	26.9
South	2	1,216	Md. 1132, N. C. 84	83	6.8	610	50.2
West	0						
U. S.	4	1,526		139	9.1	717	47.0*

*Includes students in military service. Two studies involving 214 students reported 21.0 percent of the students in military service when studied.

Table D-11. Regional Distribution of Former Students Who Completed Three or More Years of Vocational Agriculture and Were in College, Unknown or Deceased When Studied (1918-1960)

Region	Number of studies	Number of students	Students by states within region	Number in college, unknown or deceased when studied	Percent in college, unknown or deceased when studied
North-east	0				
North Central	1	130	Mo. 130	44	33.8
South	1	1,132	Md. 1132	113	10.0
West	1	121	Mont. 121	10	8.3
U. S.	3	1,383		167	12.1

Table D-12. Change in Occupational Distribution of Former Vocational Agricultural Students Engaged in Farming

Year of study	Period of study	Number of students	First occupation		Occupation when studied		Change	
			Number farming	Percent farming	Number farming	Percent farming	number farming	Percent farming
1952	Unknown	99	54	54.5	45	45.4	- 9	-16.7
1956	1946-55	271	130	48.0	122	45.0	- 8	- 6.2
1953	1938-52	149	34	22.8	16	10.7	-18	-52.9
1956	1947-55	100	17	17.0	13	13.0	- 4	-23.5
1958	1950-55	111	46	41.4	26	23.4	-20	-43.5
1954	1936-52	105	58	55.2	47	44.8	-11	-19.0
1953	1938-51	94	63	67.0	62	66.0	- 1	- 1.6
1952	Unknown	136	73	53.7	41	30.0	-32	-43.8
Totals		1,065	475	44.6	372	34.9	-103	-21.7

Table D-13. Change in Occupational Distribution of Former Vocational Agricultural Students Engaged in Farm Related Occupations

Year of study	Period of study	Number of students	First occupation		Occupation when studied		Change number farm related	Change Percent farm related
			Number farm related	Percent farm related	Number farm related	Percent farm related		
1952	Unknown	99	8	8.1	11	11.1	+3	+37.5
1956	1946-55	271	11	4.1	11	4.1	0	0
1953	1938-52	149	1	.7	3	2.0	+2	+200.0
1956	1947-55	100	3	3.0	3	3.0	0	0
Totals		619	23	3.7	28	4.5	+5	+21.7

Table D-14. Change in Occupational Distribution of Former Vocational Agricultural Students Engaged in Nonfarm Occupations

Year of study	Period of study	Number of students	First occupation		Occupation when studied		Change number nonfarm	Change percent nonfarm
			Number nonfarm	Percent nonfarm	Number nonfarm	Percent nonfarm		
1952	Unknown	99	37	37.4	44	44.4	+ 7	+18.9
1956	1946-55	271	130	48.0	138	50.9	+ 8	+ 6.2
1953	1938-52	149	88	59.1	119	79.9	+31	+35.2
1956	1947-55	100	69	69.0	80	80.0	+11	+15.9
1958	1950-55	111	57	51.4	77	69.4	+20	+35.1
1954	1936-52	105	47	44.8	54	51.4	+ 7	+14.9
Totals		835	428	51.3	512	61.3	+84	+19.6

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