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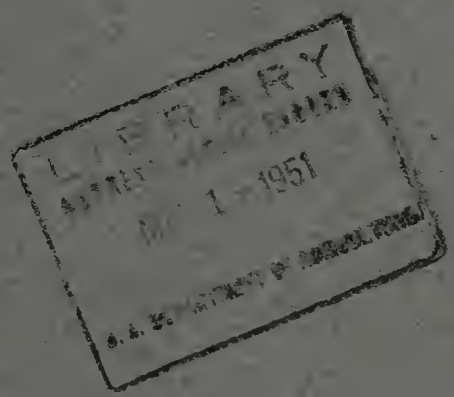

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AGRICULTURAL ECONOMICS RESEARCH

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Projections of the Regional Distribution of the Population of the United States to 1975

By Margaret Jarman Hagood and Jacob S. Siegel

There has been an increasing interest over the last several years among agricultural economists and statisticians in population projections, including regional trends and their probable effect upon geographic shifts or regional rates of increase in farm production. In this article, Jacob S. Siegel of the Bureau of the Census joins with Margaret Jarman Hagood of the Bureau of Agricultural Economics in developing population projections to 1975 for each of the major geographic regions of the United States, consistent with the Census Bureau's recent population projections to 1960 for the United States and unofficial extensions of these projections to 1975. This cooperative effort represents a further contribution by Dr. Hagood to a field to which she has contributed during recent years and a beginning of work on regional projections by the Bureau of the Census.—O. V. Wells

THE RAPID GROWTH of the population of the United States during the last decade, together with the wider use of statistics relating to the future, have brought about an increase of interest in population projections. Among agricultural economists, such interest stems primarily from their concern over future demands for products from farms. Size of population is only one of the factors affecting this demand; but it is of great importance, especially in appraising the increases in demand that are likely to take place in the next decade. Although no major area in the United States is self-contained with respect to production and consumption of agricultural products, nevertheless, the volume of production of certain types of agricultural commodities is affected by the size, growth, and composition of the population within the area. The purpose of this article is to review the background of regional population projections in the United States, to describe in some detail a relatively simple method of projecting the regional distribution of the population by age and sex, and to prepare by this method projections of the population of the nine major geographic divisions to the year 1975, and projections of the age-sex distribution of the population of the four major geographic regions to 1960.

Background of Projections

In spite of the increased interest in the future population, no official attempt has been made to publish periodically a systematic set of projections for the major geographic subdivisions of the United States. The difficulties in the way of developing a method having high reliability explain, in part, the reluctance of the Bureau of the Census to undertake the publication of such projections.

Official projections for the United States as a whole, however, have been published at frequent intervals for the last two decades, each later series being based on more current data and superseding the projections published earlier. At first, these series were published by the National Resources Planning Board; more recently the Bureau of the Census has sponsored the work. The many series published by the National Resources Planning

Board were prepared by Warren S. Thompson and P. K. Whelpton of the Scripps Foundation for Research in Population Problems, and Whelpton was the senior author of the recent Census Bureau monograph on *Forecasts of the Population of the United States, 1945-1975 (25)*. Since the appearance of this volume, two shorter reports on the future population of the United States, presenting projections to 1960, have been published by the Bureau of the Census *(19; 15)*. These several series of projections were developed by the "cohort-survival" method, which, essentially, involves carrying forward the population as enumerated at the last census or as estimated for a current date, by age and sex, to a future date by use of projected birth rates, death rates, and migration *(24; 15)*. Several series are usually computed to allow for the probable range. *Current Population Reports*, Series P-25, No. 43, the most recent report of the Census Bureau presenting projections, contains three series of projections to 1960—a low, medium, and high series, each based on a different set of assumptions as to the future course of fertility, mortality, and immigration.

The first systematic attempt to prepare projections of the population of all the major geographic subdivisions of the United States appears to have been made by Thompson and Whelpton in 1934, when the National Resources Board published their *Estimates of Future Population by States (17)*. This report presents projections to 1960 for States, by residence areas (urban, rural-nonfarm, and rural-farm), prepared by the cohort-survival method.

Although, so far as the present authors know, this is the only instance in which this method has been used in preparing a comprehensive set of projections for subdivisions of the country, there are several examples of projections for specific geographic subdivisions. Shryock and Siegel prepared projections by this method for the State of Texas; Moore and Staehle for Oregon; Schmid, Miller, and Mooney for Washington State; and Hawley for Michigan *(14; 12, pp. 21-37; 13, pp. 7-19; 9)*. Thompson's work on Cincinnati, Kuznets' work on Philadelphia, and the work of the Greensboro Department of Planning illustrate the application of the cohort-survival method to the projection of the population of a geographic area smaller than a State *(18; 10; 6)*.

In contrast to its relatively small importance in determining national changes in population at the present time, migration is an important component of change in the population of geographic subdivisions of the Nation. Careful consideration must be given to it, therefore, when regional projections are prepared, if the projections are to be realistic. The National Resources Board published two series of projections for each area, in its 1934 report—one with no allowance for migration and a second with a constant decennial allowance for migration equal to the volume of net migration that occurred in the period 1920 to 1930 *(17)*. Here the volume of migration in some recent period was used to allow for migration in future years. Shryock and Siegel prepared two series of projections to 1975 for the State of Texas by the cohort-survival method—one assuming no net migration and the other assuming net migration as in the period 1935-40 *(14)*. The use of a constant arbitrary amount in round numbers (for example, 10,000 per year), a constant arbitrary rate (for example, one percent per year), or changing amounts or rates representing extrapolations of the amounts or rates prevailing in past decades are possible alternative approaches to the allowance for migration in future years. Moore and Staehle assumed constant annual arbitrary rates of migration in preparing their three projections of the population of Oregon for 1960 by the cohort-survival method *(12)*. Schmid and his associates assumed constant annual amounts in round numbers, based on an analysis of past trends in migration, in preparing their three projections for 1960 for the State of Washington *(13)*.

Although the projection of birth and death rates presents difficult problems in the preparation of population projections for subdivisions of the United States, they are less difficult to handle than is the migration component. The problem of projecting them can be simplified by relating them to corresponding rates for the United States for past and future years. This procedure was used by Shryock and Siegel and by Schmid, Miller, and Mooney in the articles cited previously.

Projections have been made by use of components without working with age groups as the cohort-survival method requires. Stanbery and Spurr have each prepared projections for California for 1960, by making separate allowances for

total natural increase on the basis of past trends in the State and prospective national trends and for total migration on the basis of past trends, expected economic expansion in the State, and trends in national income *(2, pp. 39-55; 16)*.

Numerous agencies, both public and private, have prepared and published projections for certain subdivisions of the United States. For the most part, they have not attempted to work with components of population change such as births, deaths, and migration, but have simply extrapolated the total population (or the net change in the total population) directly. A wide variety of extrapolation techniques have been used, the most frequent being freehand graph, arithmetic, geometric, and logistic. The Consolidated Edison Company used logistic extrapolation, among other methods, in its work on New York City *(4)*. The article by Spurr *(16)* is of particular interest because it applies several such methods, as well as the component method mentioned earlier and the "ratio-to-United States" method described and illustrated below. The Federal Power Commission has made extensive use of a method based on assessment of future economic expansion and ratio of labor force to total population *(23, pp. 19-20)*.

We have already suggested the possibility of tying in local or regional projections with available projections for some broader area, such as the country as a whole, in connection with the projection of birth or death rates in the application of the component-factor method. Several estimators have used the approach of projecting the total population of an area as a proportion of the total for a larger area, usually the United States, and of applying the projected proportions to available totals for the broader area for future years. In November 1949 the Bureau of Agricultural Economics published a set of projections for the geographic divisions to 1975, developed by projecting each division's share of the national total and applying the projected proportions to the estimated future population of the United States (as projected by the Bureau of the Census and the Scripps Foundation in *Forecasts of the Population of the United States, 1945-1975 (7)*. In general, the proportion of the United States population in each geographic division was assumed to change in the next several years to come at roughly the same rate as in some specified recent span of years, but to approach constancy by some distant date. This method is described more extensively and illustrated later.

Just as for projections developed by extrapolation of the absolute total population of an area, so also in the application of the ratio-to-United States method a wide variety of extrapolation techniques may be used. In their projections of the urban population to the year 2000 by the ratio method, Hauser and Eldridge used the rate of change in the depression decade of the 1930's to represent slow growth, the rate of change in the prosperous 1920's to represent rapid growth, and the rate of change for the combined period to represent medium growth; and then assumed these rates of change to remain constant *(8, pp. 159-173)*. In their application of the ratio method to Texas, Shryock and Siegel fitted a logarithmic curve to the ratios for past years; Spurr projected California's percentage to 1960 "at a declining rate of growth" *(14; 16)*.

The preceding pages have been primarily concerned with projections of the total population of an area. Projections of the age-sex distribution of an area's population are also of considerable interest. Because projecting the population by age and sex is an essential part of the cohort-survival method, many of the studies mentioned above furnish illustrations of the estimation of the future age-sex composition of geographic and residence areas. Most of these studies had as their main objective the derivation of projections of the total population, and so projections for all age-sex groups were obtained. Occasionally a special age group is sought, as in the work of the Pacific Coast Committee of the American Council on Education in projecting to 1964 the college-age population in several Western States, or in the work of the California Teachers Association in projecting to 1960 the number of children of school age in California, by the cohort-survival method *(1; 3)*.

The application of this method requires lengthy computations and the availability of a considerable volume of data, so that several short-cut procedures have been used. For example, the percentage distribution by age and sex of an area's population as enumerated or as estimated for a recent date, or as extrapolated to a future date, can be applied to the future total for the area, if such a figure is available. Projections of the age-sex composition

TABLE 1.—*Trends in the percentage distribution of the population of the United States by geographic divisions, 1870 to 1950, with projections to 1975*

Year	United States	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific
Census										
1870	100.00	9.05	22.85	23.67	10.00	15.18	11.42	5.26	0.82	1.75
1880	100.00	8.00	20.93	22.34	12.28	15.15	11.13	6.65	1.30	2.22
1890	100.00	7.47	20.19	21.41	14.19	14.07	10.21	7.53	1.93	3.00
1900	100.00	7.36	20.34	21.03	13.62	13.74	9.93	8.60	2.20	3.18
1910	100.00	7.13	21.00	19.84	12.65	13.26	9.15	9.55	2.86	4.56
1920	100.00	7.00	21.06	20.31	11.87	13.23	8.41	9.69	3.16	5.27
1930	100.00	6.65	21.39	20.61	10.83	12.86	8.05	9.92	3.02	6.67
1940	100.00	6.41	20.91	20.22	10.27	13.54	8.19	9.92	3.15	7.39
1950	100.00	6.18	20.01	20.17	9.33	14.06	7.62	9.65	3.37	9.61
Projections										
1955	100.00	6.02	19.57	20.17	8.98	14.24	7.62	9.65	3.43	10.32
1960	100.00	5.89	19.22	20.17	8.70	14.38	7.62	9.65	3.47	10.90
1975	100.00	5.71	18.72	20.17	8.33	14.54	7.62	9.65	3.53	11.73

Source: Underlying population data through 1950 are from decennial censuses conducted by the Bureau of the Census. Census figures for 1870-1940 are shown in table 3, and census figures for 1950 appear in *1950 Census of Population, Advance Reports*, Series PC-9, No. 1 *(21)*. (See source note to table 3.) For assumptions and bases of projections, see text and table 2.

of the population of the Pacific and Mountain States for 1975 were prepared some years ago by one of the present writers by a variation of the ratio method. Here the ratio of the proportion of the total population of each geographic division in each age-sex group to the corresponding proportion for the whole country was projected to 1975, and was used in connection with available national projections by age and sex and projections of the total population of each division developed by the ratio method.[1] This method is described in further detail and illustrated later.

Method Used Here for Projecting Regional Totals

The general method used in this article to project regional totals is the ratio method already mentioned. The past trends in the share each major geographic division has of the total population of the United States are examined, the shares are projected into the future, and the projected percentages are applied to the low, medium, and high population projections for the United States as a whole that have been developed by the Bureau of the Census. Table 1 and figure 1 show the percentage share of the national population in each geographic division for each decennial year since 1870. Over this 80-year period, the Pacific Division is the only one of the nine divisions that has manifested an uninterrupted increase in its share, and the New England is the only one that has manifested an uninterrupted decrease. The other divisions present varying patterns that combine periods of increase, decrease, and approximate constancy in the proportions they have of the total population, although the general trend in each case is rather regular.

In the projection of the regional percentages beyond 1950, reliance was placed on the persistence of differential factors, both demographic and economic, that tend to make the population of a division grow more or less rapidly than the country as a whole. For each division the "trend" in its percentage was calculated by computing the annual average rate of change in the percentage over several decades—in most cases since 1920. Table 2 summarizes the periods on which the projected rates of change for each division were based and the resulting rates of change. These are the rates of change in the percentages for each division assumed to take place in the year following July 1, 1950.

The record of the past provides only a partial and imperfect guide for projecting future developments. In the present problem, the farther we go into the future, the less reliance we can place on the past as a guide. Therefore, an assumption was introduced to modify the assumption as to persistence of the operation of factors producing differ-

[1] This general procedure represents a variation and extension of a procedure suggested by Frank Lorimer *(11)*.

Figure 1.--PERCENT OF THE TOTAL POPULATION OF THE UNITED STATES IN EACH GEOGRAPHIC DIVISION, 1870-1950, AND PROJECTIONS TO 1975

SOURCE: TABLE 1.

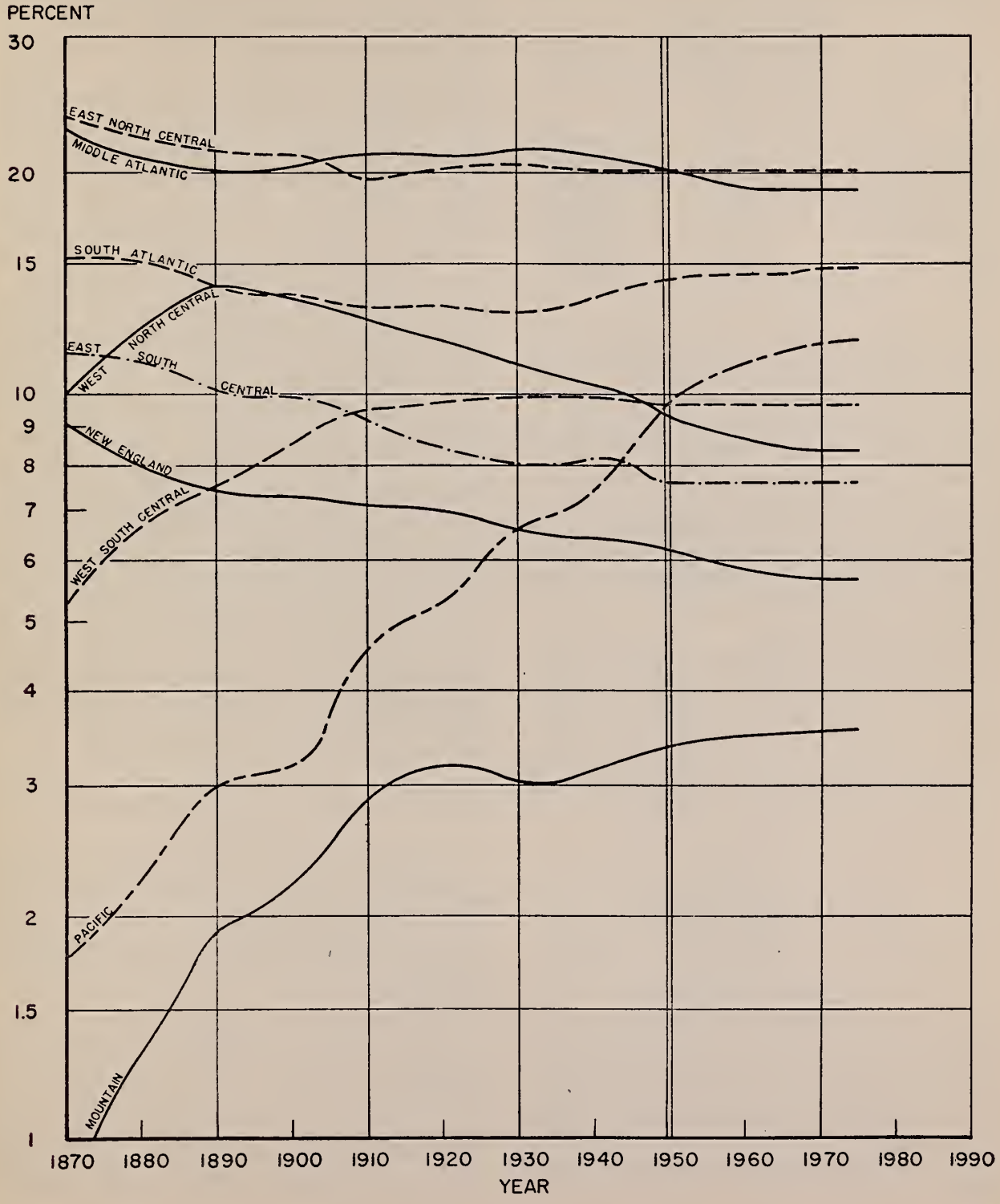


TABLE 2.—*Bases of projection of the distribution of the population of the United States by geographic divisions*

(See text for detailed explanation and method of application)

Division	Rate of change in division's proportion of U. S. population assumed for 1950-51 (Percent)	Period on which rate assumed was based
New England	—0.41	1920–1950
Middle Atlantic	—0.33	1930–1950
East North Central	None	1920–1950
West North Central	—0.69	1890–1950
South Atlantic	+0.45	1930–1950
East South Central	None	1920–1950
West South Central	None	1920–1950
Mountain	+0.54	1930–1950
Pacific	+1.71	1920–1940

ential growth among the geographic divisions. This assumption is that the factors operating before 1950 to produce differential rates of growth would gradually diminish and finally disappear. There is no basis for estimating from the population record of the past the direction of growth differentials that might arise from the emergence of new factors. In the absence of such knowledge, the assumption has been made that the rate of change in the share projected for each geographic division for the year after July 1, 1950, will be graduated to zero and will not change after 1975.

To illustrate the computations involved in projecting the percentage share of population, figures are given for the West North Central division. The period for computing the trend was taken as 1890 to 1950, because the decline has been steady during this 60-year period. If r is the annual average rate to be computed from the data in table 1,

$$(1 + r)^{60} = \frac{9.33}{14.19} = .6575$$

$$60 \log (1 + r) = \log .6575$$

$$\log (1 + r) = \frac{9.81790\text{-}10}{60} = -.003035$$

$$1 + r = .9931$$

$$r = -.0069 \text{ or } -0.69 \text{ percent}$$

If the annual rate of change in the West North Central's proportion for 1950-51 is —0.69 percent, and if this rate is to be graduated linearly to zero for years after 1975, the annual reduction will be $\frac{0.69}{25} = .028$, so that the rate of change in the proportion for 1951-52 will be $-0.690 + .028 = -0.662$ percent. As the West North Central's proportion for 1950 was 9.33 percent, a reduction of 0.69 percent in this would mean a 1951 percentage of 9.27, and a reduction of 0.662 percent in the latter would mean a 1952 percentage of 9.20. In this way the first approximations to the regional proportions were computed for each year, 1951 to 1975, although table 1 shows projected percentages for only 1955, 1960, and 1975. As the regional proportions must add to 100.00 percent for the United States, the first approximations were adjusted to fulfill this condition by a simple ratio correction (confined to the proportions which had been assumed to change after 1950).

The next step was to apply the percentage distributions by major geographic divisions to the current estimate of the total population of the United States (including armed forces overseas) for July 1, 1950 *(20)*, and to projections for 1955 and 1960 *(15)*, as published by the Census Bureau, and to unofficial projections for 1975 provided by the Census Bureau. The resulting high, medium, and low series of regional population projections are shown in the lower part of table 3. The projections distribute the total population of the United States among the major geographic divisions, with no corrections for armed forces that may be located overseas in 1955, 1960, or 1975 in excess of the number overseas before World War II. Implicit in the method used is the actual regional distribution of the armed forces in this country as of April 1950, but the extent to which this causes a distortion of the regional distribution is not significant.

Method Used Here for Projecting Regional Age-Sex Distribution

The general method and assumptions used here in projecting the age-sex distribution of the population of regions are similar to those used in projecting the regional distribution of the total population of the United States, although the computations differ.

The age and sex composition of the population of a region reflects its demographic history for the last several generations. Past regional differentials in birth rates, death rates, and migration rates leave their imprint on the age-sex structure. The general assumption was made that existing departures in the age-sex structure of the population of

TABLE 3.—*Population of geographic divisions of the United States, 1870 to 1950, with projections to 1975*

(Census figures exclude the small number of armed forces overseas. Current estimates and projections include armed forces overseas before World War II. Figures are shown in thousands)

Year	United States	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific
Census										
1870	38,558	3,488	8,811	9,124	3,857	5,854	4,404	2,030	315	675
1880	50,156	4,011	10,497	11,207	6,157	7,597	5,585	3,334	653	1,115
1890	62,948	4,701	12,706	13,478	8,932	8,858	6,429	4,741	1,214	1,889
1900	75,995	5,592	15,455	15,986	10,347	10,443	7,548	6,532	1,675	2,417
1910	91,972	6,553	19,316	18,251	11,638	12,195	8,410	8,784	2,633	4,192
1920	105,711	7,401	22,261	21,476	12,544	13,990	8,894	10,242	3,336	5,567
1930	122,775	8,166	26,261	25,297	13,297	15,794	9,887	12,177	3,702	8,194
1940	131,669	8,437	27,540	26,626	13,517	17,823	10,778	13,065	4,150	9,733
Current estimates										
1950	151,772	9,381	30,379	30,616	14,162	21,333	11,559	14,641	5,111	14,590
Projections										
Low Series										
1950	158,176	9,522	30,955	31,905	14,204	22,524	12,053	15,264	5,425	16,324
1960	161,679	9,523	31,075	32,611	14,066	23,249	12,320	15,602	5,610	17,623
1975	165,616	9,457	31,003	33,404	13,796	24,081	12,620	15,982	5,846	19,427
Medium Series										
1955	161,748	9,737	31,654	32,625	14,525	23,033	12,325	15,609	5,548	16,692
1960	169,371	9,976	32,553	34,163	14,735	24,356	12,906	16,344	5,877	18,461
1975	190,101	10,855	35,587	38,342	15,835	27,641	14,486	18,345	6,711	22,299
High Series										
1955	166,179	10,004	32,521	33,518	14,923	23,664	12,663	16,036	5,700	17,150
1960	180,276	10,618	34,649	36,361	15,684	25,924	13,737	17,397	6,256	19,650
1975	225,310	12,865	42,178	45,446	18,768	32,760	17,169	21,742	7,953	26,429

Source: Data for 1870-1940 from decennial censuses conducted by the Bureau of the Census. July 1950 estimate of total population of United States from Bureau of the Census, *Current Population Reports,* Series P-25, No. 45 *(20)*; for divisions this total has been distributed according to the distribution of the population shown by the 1950 Census of Population. Projections of the total population of the United States for 1955 and 1960 from Bureau of the Census, *Current Population Reports,* Series P-25, No. 43, p. 7 *(15)*. Projections of total population of United States for 1975 are unofficial projections furnished by the Bureau of the Census, representing extensions of the projections for 1955 and 1960 on the basis of roughly similar assumptions. Distribution by divisions for future dates derived by use of projected percentages shown in Table 1.

a region from that of the Nation would gradually diminish. The projections of age-sex structure are limited to four major regions that are combinations of the nine major geographic divisions,[2] and to the medium series. The computational methods will be illustrated for the projection of the age-sex distribution of the population of the South.

The departure from 1.000 of the ratios shown in column 3 of table 5 indicates the deviation of the South from the United States in age-sex structure, as of April 1950. The assumption was made that the direction of this departure would be maintained for 50 years, but that regional differentials would gradually diminish and would disappear by the year 2000. For example, the ratio in column 3 for males under 15 years of age, for April 1950, is 1.135. If this ratio is to be 1.000 by the year 2000, the reduction to take place by July 1955 is

$$\frac{.135}{50} \times 5.25 = .014$$

and the ratio is $1.135 - .014 = 1.121$.

This ratio and the results of similar computations for the other age-sex groups, entered in column 4 of table 5, were applied to the United States percentages by age derived from the 1955 medium projections of the Census Bureau (shown in column 5) to obtain the first approximations to the percentages for the South, shown in column 6. The entries in column 6 do not sum exactly to 100; therefore, an adjustment ratio (100.00 divided by the total of column 6) was applied to these items to obtain the second approximations, shown in column 7. If the South had been the only region for which projections of the population by age and sex were being prepared, the entries in column 7 could have been considered the final projections of the percentage distribution by age and sex for 1955. How-

[2] The limitation is due to the lack of data for geographic divisions for a current date at the time of writing. The data on the age-sex composition of the population of regions are based on preliminary sample tabulations of the 1950 Census.

ever, when these results and the results of similar computations for the other three regions were applied to the medium projections of the total population of the regions, the resulting figures for each age-sex group did not sum to the United States medium total for that group. The final figures for the population of each region in each age-sex group were obtained by an iterative adjustment process *(5, pp. 115-121)*.

The process as used here consisted essentially of first adjusting the four regional figures for each age-sex group to sum to the United States age-sex totals, then adjusting the resulting ten figures for each region to sum to the regional totals, and repeating the process until all the rows and columns summed to their pre-established totals. The final percentages for the South, shown in column 8 of table 5, were computed from the adjusted population figures. It may be noted that the final percentages differ only slightly from the second approximations in column 7. Percentages for the other regions and for 1950 and 1960 were also obtained by the procedure described above and are shown in table 6.

TABLE 4.—*Percent increase, 1950 to 1960, projected for the total population of the United States and geographic divisions*

(A minus (—) sign denotes decrease)

Area	Low series	Medium series	High series
United States	6.5	11.6	18.8
New England	1.5	6.3	13.2
Middle Atlantic	2.3	7.2	14.1
East North Central	6.5	11.6	18.8
West North Central	—0.7	4.1	10.7
South Atlantic	9.0	14.2	21.5
East South Central	6.6	11.7	18.8
West South Central	6.6	11.6	18.8
Mountain	9.8	15.0	22.4
Pacific	20.8	26.5	34.7

Source: Data in table 3.

Prospective Changes in Regional Population

Under the medium and high projections, each of the nine major geographic divisions is expected to have a population increase in the decades immediately following (table 4). All except the West North Central would gain even under the low projections. However, the rate of population increase is not expected to be equal among the divisions.

TABLE 5.—*Basis for projection of medium age-sex distribution of the population of the South in 1955*

Sex and Age	Percentage distribution, 1950[1]		Ratio, South to U. S.		Percentage distribution, 1955			
						South		
	United States (1)	South (2)	1950 (2)÷(1)= (3)	1955[2] (4)	United States[3] (5)	First approximation (4)×(5)= (6)	Second approximation[4] (7)	Final[5] (8)
Total, all ages	100.00	100.00	———	———	100.00	100.01	100.00	100.00
Males under 15 years	13.81	15.68	1.135	1.121	14.63	16.40	16.39	16.38
Males 15 to 24 years	7.14	7.60	1.064	1.058	6.90	7.30	7.30	7.29
Males 25 to 44 years	14.71	14.51	.986	.988	14.07	13.90	13.90	13.89
Males 45 to 64 years	10.08	8.73	.866	.880	10.06	8.85	8.85	8.86
Males 65 and over	3.79	3.17	.836	.854	3.86	3.29	3.29	3.29
Females under 15 years	13.35	15.10	1.131	1.117	14.01	15.65	15.65	15.64
Females 15 to 24 years	7.50	8.22	1.096	1.086	6.75	7.33	7.33	7.33
Females 25 to 44 years	15.12	14.53	.961	.965	14.61	14.10	14.10	14.11
Females 45 to 64 years	10.12	8.87	.876	.890	10.61	9.44	9.44	9.45
Females 65 and over	4.39	3.59	.818	.837	4.48	3.75	3.75	3.76

[1] Based on data in: Bureau of the Census, *1950 Census of Population, Preliminary Reports*, Series PC-7, No. 3 *(22)*.

[2] Computed on assumption that ratio shown in col. (3) will be graduated to 1.000 by the year 2000.

[3] Based on medium projections of U. S. population, by age and sex, published in Bureau of the Census, *Current Population Reports*, Series P-25, No. 43 *(15)*. An allowance for armed forces overseas in excess of the number overseas before World War II has been included.

[4] Col. (6) adjusted to 100.00.

[5] Adjusted to tie in with regional totals and U. S. distribution by age and sex.

TABLE 6.—*Percentage distribution by age and sex of the population of the United States and geographic regions: Current estimates, July 1, 1950, and medium projections, July 1, 1955 and 1960*

(Percents based on figures which include United States armed forces overseas in excess of the number overseas before World War II. Underlying population data not shown in this article but may be obtained approximately by applying the percentages shown in this table to the current estimates for 1950 and to the medium projections for 1955 and 1960 shown in table 3. Totals may differ slightly from the sum of their parts because of rounding.)

Age and area	1950			1955			1960		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
United States[1]	100.0	49.7	50.3	100.0	49.6	50.5	100.0	49.4	50.6
Under 15 years	27.6	14.1	13.5	28.6	14.6	14.0	27.4	14.0	13.4
15 to 24 years	14.7	7.4	7.3	13.7	6.9	6.8	15.0	7.6	7.4
25 to 44 years	29.5	14.4	15.1	28.7	14.1	14.6	27.3	13.5	13.8
45 to 64 years	20.6	10.2	10.4	20.7	10.1	10.6	21.2	10.2	11.0
65 years and over	7.6	3.6	4.0	8.4	3.9	4.5	9.1	4.1	5.0
Northeast[2]	100.0	49.3	50.8	100.0	49.0	50.9	100.0	48.8	51.1
Under 15 years	24.4	12.5	11.9	25.6	13.1	12.5	24.6	12.6	12.0
15 to 24 years	14.2	7.2	7.0	13.1	6.7	6.4	14.5	7.4	7.1
25 to 44 years	30.7	14.8	15.9	29.8	14.4	15.3	28.1	13.7	14.4
45 to 64 years	22.5	11.1	11.4	22.5	10.9	11.6	22.9	10.9	12.0
65 years and over	8.2	3.7	4.6	8.9	3.9	5.0	9.8	4.2	5.6
North Central[2]	100.0	49.6	50.3	100.0	49.6	50.6	100.0	49.2	50.8
Under 15 years	26.8	13.6	13.2	27.9	14.2	13.7	26.6	13.5	13.1
15 to 24 years	14.3	7.2	7.1	13.3	6.7	6.6	14.6	7.4	7.2
25 to 44 years	28.8	14.0	14.8	28.0	13.7	14.4	26.8	13.1	13.7
45 to 64 years	21.5	10.7	10.8	21.6	10.6	11.0	22.0	10.6	11.4
65 years and over	8.5	4.1	4.4	9.3	4.4	4.9	10.0	4.6	5.4
The South[2]	100.0	49.8	50.1	100.0	49.8	50.2	100.0	49.5	50.4
Under 15 years	31.1	15.9	15.2	32.0	16.4	15.6	30.2	15.5	14.7
15 to 24 years	15.9	7.9	8.0	14.6	7.3	7.3	16.0	8.0	8.0
25 to 44 years	28.7	14.2	14.5	28.0	13.9	14.1	26.7	13.3	13.4
45 to 64 years	17.9	8.8	9.1	18.3	8.9	9.4	19.1	9.1	10.0
65 years and over	6.3	3.0	3.3	7.1	3.3	3.8	7.9	3.6	4.3
The West[2]	100.0	50.2	49.8	100.0	50.0	50.0	100.0	49.8	50.3
Under 15 years	27.1	13.8	13.3	28.2	14.4	13.8	27.0	13.8	13.2
15 to 25 years	14.1	7.2	6.9	13.1	6.7	6.4	14.4	7.4	7.0
25 to 44 years	30.5	15.2	15.3	29.6	14.8	14.8	28.2	14.1	14.1
45 to 64 years	20.7	10.3	10.4	20.9	10.2	10.7	21.4	10.3	11.1
65 years and over	7.6	3.7	3.9	8.2	3.9	4.3	9.1	4.2	4.9

[1] Percents for July 1, 1950, based on unpublished estimates provided by the Bureau of the Census. Percents for 1955 and 1960 based on data in Bureau of the Census, *Current Population Reports*, Series P-25, No. 43 *(15)*. Figures given in that report have been adjusted to include armed forces overseas in excess of the number overseas before World War II.

[2] Method of derivation illustrated in table 5 and explained in the text.

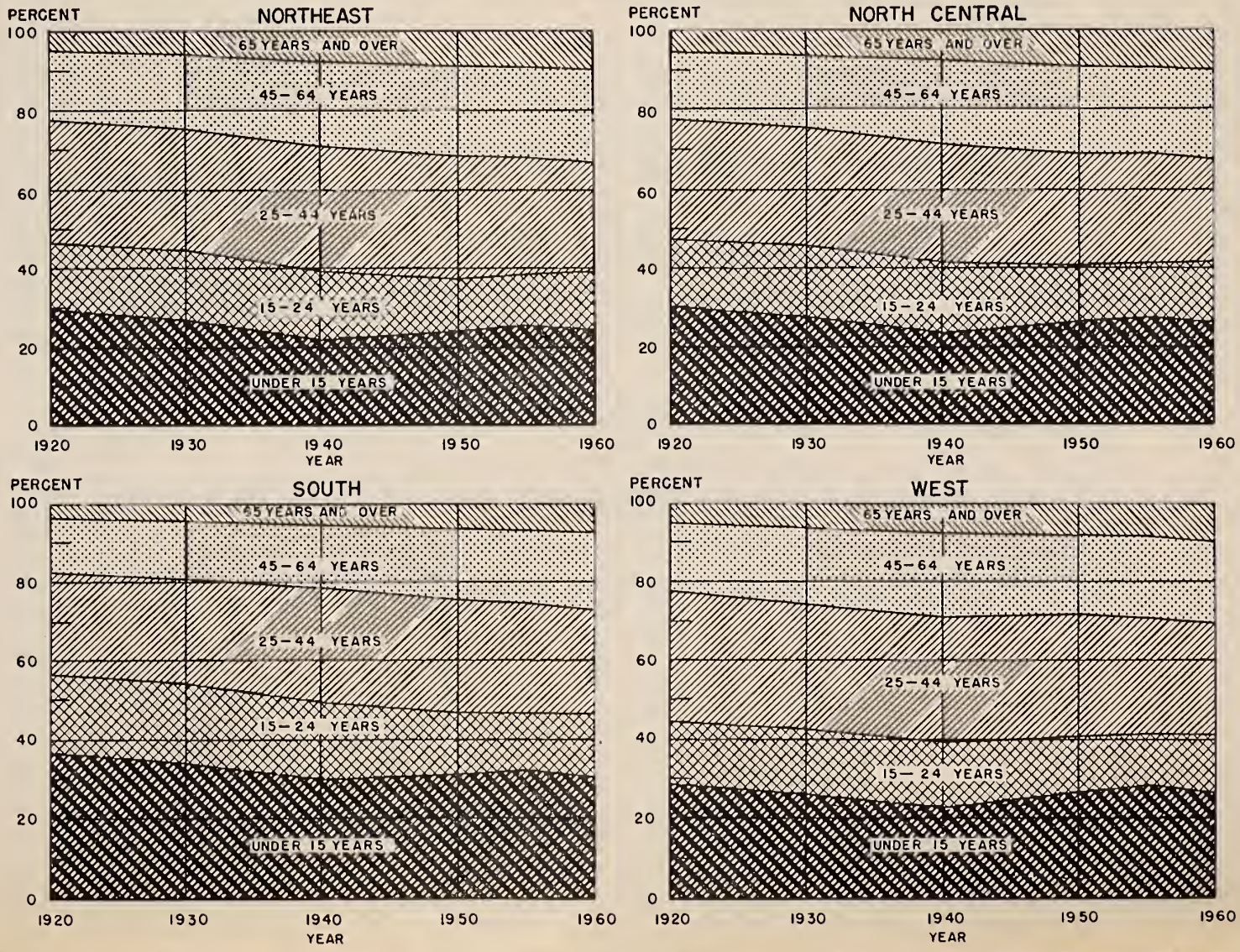
The Pacific division will exceed all others in rate of population growth unless new factors affecting the distribution of the population within the United States should become so important as to break the continuity with the past.

For several decades, the five geographic divisions on the eastern seaboard and in the east central part of the country have experienced somewhat similar rates of change in their populations. When their percentage shares of the total population are plotted on a logarithmic scale, the courses for these five divisions are roughly parallel, showing a gradual downward trend since 1870 (fig. 1). The four more recently settled divisions in the western half of the United States all show a very rapid initial increase in the decades immediately following 1870, but their later courses differ. The general regularity in past patterns of the curves shown in figure 1—in spite of certain inflection points—underlies the assumptions chosen for projecting the regional shares of total population into the future.

If the expectation of population gain in each major region of the country is granted, the next question of interest to many who are trying to look to the future is, What changes will there be in the age-sex composition of the population of the major

Figure 2.--PERCENT DISTRIBUTION OF THE POPULATION BY AGE, 1920 TO 1950, AND PROJECTIONS TO 1960, FOR GEOGRAPHIC REGIONS

SOURCE: TABLE 6.



regions? In the main, the regions are expected to follow the general pattern of the Nation's population in the alterations of their age-sex structures between 1950 and 1960. Every region is expected to have a sex balance numerically in favor of females by 1960. This was not true of the West in 1950.

Every region is expected to have significant increases in the number and proportion of older persons during the next decade (fig. 2). The rate of increase in the proportion of persons 65 years of age and over is expected to be highest in the South, the region that had the lowest proportion of older people in 1950. The North Central region, however, is expected to retain its first place among regions in the proportion of older persons in its population, followed in order by the Northeast, the West, and the South.

At the other end of the age range, the proportion of children under 15 years of age is expected to rise between 1950 and 1955 and then to drop in the next 5 years, so that the 1960 proportion will not differ greatly from that for 1950. This pattern of change is expected to be manifested in each of the major regions. In contrast, the next older group—youths between the ages of 15 and 24 years—is expected to decline, relative to total population, from 1950 to 1955, and then to rise by 1960 to approximately the same percentage as in 1950. For the two younger age groups combined, the South is expected to have the highest proportion in 1960, as it did in 1950. Under the medium projections computed, about 46 percent of the population in the South will be under 25 years of age in 1960, contrasted with 39 percent in the Northeast and 41 percent in the North Central region and the West.

Limitations and Applications of Method Used

The method described here for projecting the geographic distribution of the population of a country is relatively simple and is applicable to many other problems. Whether it represents the best approach to such problems is by no means clear.

In projecting the total population of a country that is not undergoing a period of extensive foreign immigration or emigration, the two crucial components of change to be estimated for the future are births and deaths. As suggested earlier, in projecting the population of a subdivision of a nation that has few impediments to internal migration and that has a very mobile population, the component of internal migration also has to be projected either implicitly or explicitly. The projection of fertility and mortality presents difficult problems, and the record of accuracy in making such projections has been exposed to both justified and unjustified criticism; nevertheless, fertility and mortality occur with more statistical regularity than does migration, and to the extent that they do they are more predictable. Because of this, it seems reasonable to conclude that projections of the total population of the United States can be made with more accuracy than projections for geographic subdivisions of the country.

When faced with the problem of projecting the population of some geographic area within the United States, one has, generally speaking, two alternatives (and intermixtures thereof) in choosing from methods already used. The first is to project the components of population change for the area through use of available data on current population, fertility, mortality, and migration. The other is to project the total population rather than components. The second alternative is illustrated by the method used in this article. This alternative assumes that the total effect of all the components of population change in the area is predictable from the record of the past and from more elaborately developed projections for the United States as a whole.

The authors wish to point out that they are not suggesting preferability of the method used over the more elaborate methods. Its chief advantage lies in its simplicity and in the fact that it can be applied in cases in which the detailed data are not available for the other methods. It is our hope that projects can be developed or expanded in governmental and other agencies to appraise, from data now available, the degree of success that would have been achieved by alternative approaches in projecting the regional or State distribution of the present population of the United States.

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Making Changes Feasible on Small Farms

By D. B. Ibach

There is growing interest in the problem of low-income farmers on under-productive farms. This interest has been heightened by the need for full production in connection with the defense effort. This paper presents a research analysis of the problem that this poses as exemplified by the situation of small farmers in the Southern Piedmont of North Carolina. It describes a representative small farm in such terms as capital investment and organization; outlines what such a farm would require to make it as efficient as possible under the limits defined; and outlines a programmatic approach that would make it feasible to bring about the needed changes.

SMALL FARMS GENERALLY have not been reached adequately by soil conservation and other programs directed toward improvement in farming systems. Relatively few of their operators participate. Those who do can obtain some benefit in the form of increased yields of cash crops. But lack of necessary capital resources would prevent many of them from making desirable changes in farming even if they took advantage of assistance offered in the way of soil-improvement programs that result in increased production of forage crops and pasture.

Many operators of small farms also lack experience with livestock so that a balanced program involving planning and management counsel and credit for adequate livestock, buildings and fencing, is often needed if they are to make desired changes in farming systems based on soil improvements. Many of these operators do not have alternative opportunities for productive employment. If the other necessary resources can be developed through a well-adapted credit arrangement, a good case can be made for grants or other forms of aid to provide the necessary soil improvement, provided such assistance is not used for lands that are unsuited to farming. If the task is approached through development of a complete farm plan, this situation can be avoided.

An example of the problem and an illustration of how it may be met, may be developed through examination of a study of farming opportunities in the Southern Piedmont area of North Carolina.[1]

A sample of 217 farms in 11 intensive cotton-producing communities was studied in order to learn the characteristics of the farms, and to develop suggestions for improved farming systems. Cotton is the principal source of income, furnishing more than half of the total value of all products sold in 1944. In 1945, 36 percent of the total cotton acreage of the State was located within the 13 counties represented by the sample used in the study. Local conditions make the competitive position of cotton strong even at price relationships that are much less favorable to cotton than those of the present time.

The problem is not to replace cotton, but to obtain more profitable utilization of all farm resources. The combination of enterprises should provide a market for the feed and pasture that can be grown, and for farm labor throughout the year. Present farming systems promote a rapid rate of soil depletion and erosion. This, together with a high degree of dependence on one crop, is conducive to extreme risks.

Data showing the complete farm organization, production, yields, and important crop and livestock practices, were obtained from 22 farms in each of 11 communities. In that study 11 producing neighborhoods were selected within 6 soil associations in 13 counties. Complete neighborhoods were selected as sampling units, with the number of sampling units in each soil association in about the same proportion as the acreage in that association bears to the total acreage in all soil groups. Records from 217 farms (in 11 neighborhoods) were used to find out the more common systems of farming and modal levels of farm resources. These farms were classified by sizes and types within soil associations. Purposive sampling was again used

[1] OPPORTUNITIES FOR ADJUSTMENTS IN FARMING SYSTEMS, SOUTHERN PIEDMONT AREA OF NORTH CAROLINA, by W. W. MCPHERSON, W. H. PIERCE, and R. E. L. GREENE, published as Technical Bulletin, No. 87, of the North Carolina Agricultural Experiment Station, Raleigh, N. C.

TABLE 1.—*Capital investment of the representative small farm by classes and items, 1945*

Real estate		Machinery and equipment		Livestock	
Item	Value	Item	Value	Kind and number	Value
Land	$3,700	Wagon	$ 48	Milk cows (2)	$ 150
		Mowing machine	45	Heifer calf (1)	25
Barn	75	Rake	25	Hens (40)	34
Corn crib	30	Plow	8	Work stock (2)	330
Poultry house	16	Harrow	11		
Smoke house	15	Planter	12	Total	$ 539
Fencing	18	Cultivator	10		
		Fertilizer distributor	12		
Total service buildings	$ 154	Auto	200		
Dwelling	600				
		Total	$ 371		
All buildings	$ 754				

TABLE 2.—*Present and improved organization, income, and expenses—representative small farm*

Farm organization			Financial summary [1]				
Item	Present organization	Improved organization	Sales	Present organization		Improved organization	
	Acres	*Acres*		*Quantity*	*Dollars*	*Quantity*	*Dollars*
Land use			Cotton (cwt.)	42	521	45	558
Cotton	8.5	8.5	Cotton seed (ton)	3.35	129	3.5	134
Corn	7.9	5.0	Wheat (bu.)	40	46	72	82
Wheat	6.1	7.4	Lespedeza seed (cwt.)	—	—	60	402
Oats	4.1	2.8	Milk (cwt.)	20	58	56	162
Barley	—	2.0	Cow or heifer (no.)	—	—	1	80
1st yr. lespedeza	(10.2)	(12.2)	Veal (cwt.)	.75	9	1	12
2nd yr. lespedeza	3.5	7.0	Chickens (cwt.)	.55	13	3.34	80
Alfalfa	—	3.1	Cull hens (cwt.)	—	—	2	42
Garden	1.7	1.0	Eggs (doz.)	180	50	2,400	672
Idle	5.0	0.0	Total sales	XX	826	XX	2,224
Total crop land	36.8	36.8	Expenses				
Per open pasture	6.1	7.0	Ginning (bales)	8.5	42	8.9	44
Other	13.1	12.2	Combining (acres)	6.1	21	12.2	43
Total land	56.0	56.0	Comb. & Cl. lesp. seed	—	—	—	219
Livestock	Number	Number	Seeds and plants	—	51	—	80
Milk cows	2	2	Fertilizer 4-10-6 (ton)	5.6	157	—	—
Heifers, 2 yrs. old	0	1	6-8-6 (ton)	—	—	5.1	143
Heifers, 1 yr. old	0	1	16-0-0 (ton)	1.4	55	2.52	98
Heifers, calf	1	1	Lime and phosphate	—	—	—	50
Hens	40	200	Feed	—	74	—	204
Work stock	2	2	Livestock purchases	—	16	—	46
			Other livestock exp.	—	15	—	20
			Hired labor	—	22	—	—
			Machy. exp.	—	84	—	84
			Bldg. and fence repair	—	51	—	59
			Ins. and taxes	—	34	—	61
			Total expenses		622		1,151
			Net cash income		204		1,073

[1] The prices used in developing this analysis are not forecasts. They represent lower levels than would probably be estimated by many informed price specialists. But for purposes of farm budgets as a basis for credit, it seemed preferable to stay on the conservative side. The prices used recognize that the general agricultural and business economy could be moderately prosperous if balance were achieved with lower prices. No controls are assumed.

North Carolina State Report to Improve Farming Opportunities in the South, June 30, 1946, supplied the prices used which are: Cotton $0.124 per lb.; cottonseed $38.38 per ton; lespedeza seed $6.70 per cwt.; eggs $0.28 per doz.; and milk $2.90 per cwt. Unit costs used for principal items are combining $3.50 per acre; ginning $4.90 per bale; fertilizer $31 to $39 per ton depending on grade; dairy and poultry feeds $2.50 and $3.25 per cwt., respectively.

for the selection of one farm from each group for special study.

This paper deals with the small farms for which the problem is most difficult. These comprise 47 percent of the number included in the sample.

In terms of efficient farming, the first step should consist of farm enlargement. But the owners of many small farms would not find it possible, or feasible, to make this change even though general assistance were available. Some may not be located near other suitable crop land, or land that can be improved. Others may prefer their small farms. The typical small farm now carries 2 cows, whereas 10 cows are suggested for farms of medium size. Such a herd would demand a marked change in the work habits of the farm family. Many will want to continue part-time farming along with other employment; about two-fifths of the small farmers had off-farm work in 1945. If farm prices became less favorable, more would probably supplement their farm income through other work.

A Representative Small Farm

Table 1 shows details of the capital investment for a representative small farm. Both the present and the improved organization, and a summary of income and expenses for this representative small farm are given in table 2. The combination of enterprises may vary with differences in land resources, operator's preference, and the local market situation. For example, a few hogs or a larger dairy enterprise might be substituted for the poultry enterprise.

The principal changes suggested in land use are a reduction in intertilled crops and an increase in the acreage of legumes that occupy the land during the entire season. Acreages of cropland and cotton would remain unchanged. There would be a reduction in cropland used for intertilled crops, and an increase in acreage of legumes grown alone. The slight increase in permanent pasture would be drawn from land now in woods. These minor changes, accompanied by use of more fertilizer and lime, particularly for hay and pasture, would result in more feed grain, better quality of roughage and pasture, and more months of good pasture during the year. The quantity of grain in terms of corn equivalent would be increased from about 300 to a little less than 600 bushels. Animal-unit months of pasture would be increased from 14 to 37.

TABLE 3.—*Estimated cost and value of new investments needed on representative small farm*

Type of investment and item	Cost	
Soil improvement	*Dollars*	
Establish 3.1 acres of alfalfa		
Lime	25	
Fertilizer; 2-12-12	43	
Seed	30	
Establish 7.0 acres permanent pasture		
Lime	28	
Fertilizer; 0-14-7	41	
Seed	35	
Lime other cropland	54	
Terrace half of cropland	116	
		372
Buildings and fences		
Brooder house	50	
Laying house	224	
Granary	65	
Poultry fence	100	
		439
Livestock		
2 heifer calves	70	70
Total cash cost		881
Value of farm-produced materials and farm labor included in buildings		610
Estimated total value of new investments		1,491

New investments would include those for soil improvements, a poultry house for 200 hens, a brooder house, a granary, some additional fencing, and two dairy heifer calves of high-production ancestry (table 3). The soil improvements consist of liming all, and of terracing half, of the cropland; establishing a stand of alfalfa; and developing 7 acres of pasture through use of lime, fertilizer, and seeding. The initial investment for soil improvements is calculated to be $372.

Total cash outlay for new investments is estimated at $372 for the soil improvements, $70 for livestock, and $439 for buildings and fences. The value of the buildings when completed would be $1,049, the difference being accounted for by the contribution of farm-produced lumber and unpaid labor. The two cows now on the farm would be replaced by the two heifer calves when they come into production.

Problems in Making the Change

Even the conservatively estimated cash outlay of $881 for new investments presents a difficult problem. The net cash income of $204 (table 2) estimated under the present organization will not permit this undertaking, even assuming there is no present indebtedness. Furthermore, this $204

TABLE 4.—*Calculated repayments on principal of new investment loans, other than for soil improvement, small farms*

Item	Cash farm income, expenses and calculated repayment schedule by years					
	0	1	2	3	4	5
Cash receipts:	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Crops	696	1,078	1,122	1,112	1,171	1,176
Livestock and produce	130	299	526	787	935	1,048
Total sales	826	1,377	1,648	1,899	2,106	2,224
Cash farm expenses	622	969	1,089	1,119	1,135	1,151
Net cash farm income	204	408	559	780	971	1,073
Available for repayment[1]	0	0	0	180	371	473
Increase over base year	0	0	0	180	371	473
Cumulative increase	0	0	0	180	551	1,024
Percent (5th year = 100)[2]	0	0	0	18	54	100
Cumulative repayments[3]	0	0	0	134	401	[4]742
Annual repayments	0	0	0	134	267	341
Available for other purposes[5]	0	0	0	46	104	132

[1] After deducting $600 for family living expenses from net cash farm income. This would be —$192 and —$41 for the first and second years respectively, but for purposes of this table these deficits are not recorded as they are covered in the original loan of $742.

[2] Percent cumulative increase each year is of cumulative increase the fifth year.

[3] Percentage on preceding line multiplied by the total loan advance.

[4] Total loan advance if all of soil-improvement investment were handled as a grant.

[5] Amounts available for repayment, minus annual repayments.

must be applied on family living expenses. With only this net cash farm income, it must be assumed that there are off-farm wages to make up at least a reasonable minimum for family living. This minimum is, of course, a variable sum. Within the framework of prices used in this analysis, and for purposes of illustration here, it is assumed to be $600. Thus the net cash farm income of $204 falls $396 short of reaching this minimum.

If the investment of $372 for soil-improvement and conservation practices were handled as a grant, contingent upon carrying out a sound farm plan, this would leave a balance of $509 for the other investments for which a loan would be needed. But if there were no off-farm work, or income from other sources, and if $600 were a necessary minimum for family living, there would be operating deficits of $192 and $41 for the first and second years, respectively (table 4). Therefore the total loan advance is assumed to be $742. It is commonly recognized that some minimum requirement for family living has the first claim on net farm income. A prudent lender will want to be assured that at least this reasonable minimum is taken into account. In this illustration it is assumed that the loan fund is the only source.

Table 4 shows how the principal sum may be retired during the last 3 years of a 5-year period. The repayments are based on the cumulative increases in available net income, after allowing for $600 estimated family living expenses. As the net cash income is below this minimum for the first 2 years, no cash is available for interest payments during that time. The last line of table 4 shows the amounts available for interest on unpaid balances, and for other purposes during the 5-year period.

Table 5 shows the farmer's estimated final cash position after paying his interest. Because no interest could be paid the first 2 years, a small unpaid balance is left to be met in the sixth year. In actual practice, this may be met earlier, as table 4 indicates small balances after the principal payments are made during each of the 3 years in which payments are made. But these balances, in reality, are too small to allow an adequate cushion for contingencies. This illustrates the severity of the problem on many small farms.

A Desirable Approach

In this kind of situation there is opportunity for joint efforts on the part of public agencies that offer programs to assist farmers in making needed changes. On many small farms other desirable changes cannot be made except as they are based on soil improvements. At the same time, soil im-

TABLE 5.—*Loan advances, other than for soil improvement, repayments of principal, and interest payments as related to net cash available, small farms*

Year	Loans for new investments[1] (1)	Net cash income available[2] (2)	Total loan advances (3)	Principal payments (4)	Unpaid balance [3] (5)	Interest paid at 5 Percent (6)	Total principal & interest payments (7)	Available for other purposes (8)
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1	509	−192	701	0	701	0	0	0
2	0	− 41	41	0	[4]777	0	0	0
3	0	180	0	134	[4]816	41	175	5
4	0	371	0	267	682	34	301	70
5	0	473	0	341	415	21	362	111
6	0	473	0	74	74	4	78	395
7	0	473	0	0	0	0	0	473

[1] $439 for poultry house, brooder house, granary and fencing, and $70 for two heifer calves.
[2] After deducting $600 for family living. Minus signs the first 2 years indicate loans for this purpose.
[3] Beginning of year.
[4] Includes $35 and $39 unpaid interest from first and second years, respectively.

provements are likely to be wasted if they are not accompanied by the other investments. A combined program, in which careful planning and management counsel are provided, and conservation and soil-improvement measures are supported by credit for other needed capital investments, offers a desirable approach.

Many Farms Involved

Table 6 provides some indication of the number of farms in the southern Piedmont area of North Carolina which have adjustment problems similar to those presented here. The small farms in the sample had from 10 to 44 acres of cropland so the first two groups in table 6 consist of farms that were not represented. Group 1 represents rural residences of occupants who have full-time nonfarm employment, or are retired or otherwise unemployed. A large proportion of the occupants of units in group 2 probably have similar tenure status. But all of the farms in groups 3 and 4, and possibly three-fourths of those in group 5, would be classed as "small," as defined in the study. This would make approximately 18,000 small farms, out of the 33,401 farms in the area. On many of these, the problem would be more difficult than on the representative small farm here used as an illustration.

The Southern Piedmont area of North Carolina appears to offer good possibilities for demonstrating what can be done under difficulties through a joint approach involving the ACP and FHA programs, backed up by closely coordinated educational and technical assistance from other sources such as the Agricultural Extension and the Soil Conservation Services.

TABLE 6.—*Number of farms by size groups, Southern Piedmont area, North Carolina, 1945*[1]

Group	Acres harvested	Number of farms
1	none	1,078
2	1 to 9	6,206
3	10 to 19	6,582
4	20 to 29	6,207
5	30 to 49	7,485
6	50 to 99	4,308
7	100 to 199	1,255
8	200 and over	280
	Total	33,401

[1] U. S. CENSUS OF AGRICULTURE, 1945, SPECIAL REPORT OF MULTIPLE-UNIT OPERATIONS IN SELECTED AREAS OF SOUTHERN STATES.

Book Reviews

Statistical Inference in Dynamic Economic Models. By Cowles Commission Research Staff Members and Guests. Edited by Tjalling C. Koopmans, with introduction by Jacob Marschak. John Wiley & Sons, Inc., New York. 438 pages. 1950. (Cowles Commission Monograph No. 10)

AS EARLY AS 1945, writers in this new field systematically omitted important statements of fundamentals, theorems, derivations, and proofs, with a passing reference to Monograph No. 10, as "soon to appear." Probably not since the 20-year gestation of Schumpeter's treatise on business cycles has a work been so conspicuous by its absence. As this field is comparatively unfamiliar to many economists and statisticians, it is desirable to review some of the background leading to the extensive research which has produced the contributions to the volume.

Economists have recognized and accepted the representation of all economic variables of an economy or major segment in terms of a mutually interdependent set defined by a system of simultaneous equations—following the concepts of Walras and Pareto. Most economists and statisticians would be surprised to learn that their procedures in separately fitting individual economic equations to observational data are frequently inconsistent with the postulate of mutual economic interdependence.

Trygve Haavelmo first called attention to the inconsistency of this procedure in, *The Statistical Implications of a System of Simultaneous Equations* (Econometrica, January 1943). He pointed out that the simultaneous character of a system of economic equations and the mutual and simultaneous determination of a set of interdependent economic variables imposed logical restrictions upon the estimating procedure used to calculate statistical constants for these equations. To Ragnar Frisch is credited the first suggestions leading to development of this new line of analysis.

Intensive study in the field has been sponsored by the Cowles Commission for Research in Economics and the University of Chicago, culminating in the present volume—a product of pooled research and exploration by an outstanding group of econometricians. Contributing members here represented include T. C. Koopmans, R. L. Anderson, T. W. Anderson, T. Haavelmo, H. Hotelling, L. Hurwicz, R. B. Leipnik, H. E. Mann, J. Marschak, H. Rubin, and A. Wald. Meyer Girshick was a major contributor to development of the basic theory and its application.

Monograph No. 10 is a basic reference work, source book, and treatise, on the theory relating to the new methodology. Its language is essentially statistical and mathematical. Much statistical theory, particularly that part dealing with multivariate analysis, is presumed to constitute part of the preliminary equipment of the reader. As the discussion and development proceeds in terms of vectors and matrices and matrix operations, the prospective reader will want to brush up on at least the elementary operations of matrix algebra. Numerical illustrations and examples are exceedingly rare.

There is need for a volume on the order of Ezekiel's, *Methods of Correlation Analysis,* to bridge the gap between the elaborate and abstract theory of Monograph 10 and the numerical applications. Until a work of that character is published the applied research worker, who lacks sufficient mathematical training to proceed directly from the basic theory, will be obliged to imitate procedures demonstrated in the few articles in which these methods have been applied. Outstanding among them is the article by M. A. Girshick and Trygve Haavelmo, *Statistical Analysis of the Demand for Food—Examples of Simultaneous Estimation of Structural Equations* (Econometrica, April 1947).

This reviewer would advise the student to read the 1943 article of Haavelmo, then the article by Koopmans, *Statistical Estimation of Simultaneous Economic Relations* (Journal of the American Statistical Association, December 1945), and then the above article by Girshick and Haavelmo by way of introduction to the Monograph.

The analysis by Girshick and Haavelmo utilizes the "limited-information maximum-likelihood" method of estimation to determine values of the

structural coefficients—also known as the "reduced form" method—involving sacrifice of certain *a priori* information. This method is touched on at points in the Monograph and is discussed in the chapter by T. W. Anderson. The reduced-form method has been used in most applied analyses where a single equation is to be determined or a few out of a larger set of equations. It yields consistent estimates of parameters, which approach population values in the probability sense as sample size increases. But these estimates are less efficient, with larger sampling variance of the estimated constants, than those obtained by the more detailed "information-preserving maximum-likelihood" method. Principal emphasis of Monograph No. 10 is directed toward development of the latter method—particularly Section II, Measuring the Equation Systems of Dynamic Economics, by Koopmans, Rubin, and Leipnik. The working out of these theories is not complete, and unsolved problems and approximate solutions are indicated at certain points.

This method is often called structural analysis. An economic model of the total economy or a particular self-contained segment is set up as a system of simultaneous equations of prescribed form. Decisions as to form of equations and choice of variables appearing in each, utilize part of the *a priori* information of the model. Variables are divided into an "endogenous" group whose current values constitute the jointly dependent variables and an "exogenous" group whose current values are not influenced by any other variable in the system. The exogenous group together with lagged values of all variables constitute the "predetermined" variables which resolve the simultaneous determination of the jointly dependent variables. The statistical stochastic device which is adopted is the so-called shock model in which random disturbances are assumed to affect entire equations of the system, but variables are assumed to be measured free of error.

A major contribution of the new theory is the concept and technique of "identification" of particular equations and of the entire model—a logical problem that precedes estimation. A collection of observed data simply specifies a probability distribution and the statistical method is required to estimate the most probable consistent values of the structural coefficients for those equations which are identifiable. If certain equations are not identified, a number of alternative structures would yield the identical set of observed values of the variables and hence would be indistinguishable on the basis of the observed data. This situation is met frequently in observed scatters of price-quantity data which could be generated by any pair of a double infinity of alternative pairs of demand and supply functions. In such a situation additional information must be injected into the system in order to stabilize or identify the supply function, or the demand function, or both.

The estimation problem is treated systematically by applying the criterion of maximum likelihood, but this application becomes involved because of the presence of *a priori* information in the form of various linear and bilinear side conditions or restrictions upon the structural coefficients and the distribution function of the disturbances.

Dynamic character is achieved by use of lagged variables and by possibility of arbitrarily altering certain structural coefficients to fit changed present or future situations.

This reviewer believes that it is only a question of time before these concepts and methods for statistical analysis of economic data will become generally accepted and utilized. Therefore scientific economists would seem to have an obligation to study this newest analytical tool.

Richard O. Been

A Reconstruction of Economics. By KENNETH E. BOULDING. John Wiley & Sons, Inc., New York. 311 pages. 1950.

THERE ARE THREE CATEGORIES of economic studies: (1) Economic expediency, (2) economic ethics, and (3) economic description. Some economic descriptions are in the nature of photographs or journalistic reports; others are concerned with the development and presentation of a consistent body of generally applicable and useful hypotheses. Boulding's new book is of the latter type.

Boulding's "Reconstruction" of economic theory will not come as a complete surprise to those already familiar with his earlier work. However, the basic concepts are here developed and extended in their complex interrelatedness through symbolic logic to their ultimate structure. This is a ready-made, modern, and refreshingly new synthesis of the theory of the market, the theory of the firm, the theory of the consumer, and the macro-economic theories of production (output), employment, interest, and money. Unfortunately the book contains a great deal of filler that does little either to elucidate or further the argument. Combined with the absence of summaries, this characteristic makes it difficult to discover and to follow the essential framework.

The Boulding theories are grounded on the concept of preferred asset ratios. For those who need to use the theories in guiding research projects, the problem will immediately arise of how to discover or measure such ratios. But use of the preferred asset ratios does allow Boulding to tie the concept of liquidity preference into both price analysis and production economics theory. Having taken this step, he can bring firm analysis one step nearer reality by making a meaningful distinction between (1) production and (2) sales. Consumer analysis is also given a more realistic treatment by a similar distinction between (1) consumption and (2) purchases. Incorporation of these obvious truths into the body of economic theory is a real contribution.

Before one could be relatively sure that Boulding's micro-economic hypotheses of exchange and production would be useful in marketing research projects or farm-management studies, one would have to try them out on specific problems. The haunting fear that the central concept of preferred asset ratios would prove difficult, if not impossible, remains until it is downed by successful application of the concept in research activity.

Boulding also tries to fill a gap that has always existed in economic theory—the need for a macro-economic theory of distribution. Micro-economic analysis as applied to the firm or the industry simply cannot correctly be blown up to an explanation of the distribution of income to the various factors of production.

This discovery has a significant relationship to the analysis of problems involved in public policy. For example, Boulding's theoretical structure may prove more useful in developing a more meaningful analysis of farm price-support problems than was possible with the hypotheses heretofore available. The new look gives some novel and startling conclusions that differ markedly from the maxims drawn from less incisive theoretical constructs in the fields of taxation, regulation of labor relations, and stabilization programs in general, as well as in private firm and family economic operations.

This reviewer doubts that Boulding has yet done his most mature work. The author of *"A Reconstruction"* is still searching for a more useful vision. He is worried by the thought that a general nonprice equilibrium rather than a general price equilibrium may actually house the strongest forces involved in real problems. General *price* equilibrium may be more misleading than helpful in understanding the nature of economic problems.

Chapters One and Two also make me think that ultimately he will give us something even more useful than this book. These chapters are naive almost to the point of being nonsensical; I doubt that Boulding has nailed up even the first scantlin' for the structure upon which a final synthesis of all the social sciences will be built. But he does have that aim, and, although he has missed the real reason why economics, as well as the other social sciences, is abstract, he'll probably keep trying to attain his high aim.

John A. Baker

Water, Land, and People. By Bernard Frank and Anthony Netboy. Alfred A. Knopf, New York. 331 pages. 1950.

THIS VOLUME is a valuable addition to the growing list of non-technical books written to acquaint citizens with their stake in the wise use of natural resources. It is timely, published when national attention is focused on water by the President's Water Resources Policy Commission. It is provocative, too. Among technicians, administrators, and policy makers, the authors' bold statements, firmly expressed convictions, and forthright criticisms, will evoke both commendation and controversy.

There are three parts: The Problems, The Cost, and The Solutions. In the first third of the text, the authors portray the impacts, with examples, of too much and too little water. They contend that, in the search for remedial action, too little attention has been given to the watershed, too much to dams and levees on the river. What a watershed is and how it functions as receiver, storer, and regulator of water are described in a chapter of particular interest. The dominant note is: "The watershed should be protected and used in such a manner as to maintain the stability and health of the soil, and therefore its ability to absorb water. This is the key to nearly all our water problems."

A chapter on Water Economics forms Part II. Its 19 pages give a brief discussion of the heavy costs of public water supplies, flood control works, irrigation and other water development, water purification, and flood damage. The recent plight of New York City and estimated costs of remedial action are outlined.

Two-thirds of the text is devoted to The Solutions. Engineering answers are regarded as inadequate. Although the "economic value of well-conceived multi-purpose projects has been proved beyond dispute," they have serious disadvantages. "The public interest . . . would best be served by holding in abeyance many of the dams now proposed until thoroughgoing plans for the restoration of the watersheds above them have been presented to the public."

Watershed treatment, the authors state, is slowly coming to be recognized as essential. The Department of Agriculture has made a start under the Flood Control Act of 1936 and in other ways, but needs for corrective action are still tremendous. There are many impediments. They think perhaps "the land use solutions to our watershed problems may be regarded as too little, and perhaps too late," adding that "in the light of a traditional tendency to use land wastefully and not to face squarely the social consequences, we must not be too critical of the failings of the engineering approach. . ."

Projects dealing with solutions to water problems exhibit many weaknesses, the authors maintain: Insufficient planning, piecemeal planning and lack of coordination. The TVA is both praised and sharply criticized. The Pick-Sloan Plan is called "a patchwork of conflicting . . . projects;" the Department of Agriculture's proposed comprehensive Missouri Basin agricultural program is lauded as filling one of the most serious shortcomings of that plan. Implied approval is given the proposed Columbia Valley Administration. The Federal Inter-Agency River Basin Committee and field committees, although conceded as doing some good work, are declared to fall short of what is needed.

Despite somber appraisal on the whole, the authors conclude that much conservation still can be done, and must be done faster, if America is to survive. More research and education are needed. Public financial and technical assistance is good but "to stop the misuse of our watersheds will require such controls on rural private property as have not yet been undertaken anywhere in the United States." Landlord-tenant relations, a formidable obstacle to soil conservation, demand special attention. Critical watershed areas should be in public ownership. The scope of our land problems calls for such large-scale undertakings as only the Federal Government can carry out, with help from States and local governments. But, they maintain, "protection of the public welfare demands a new and centralized agency that will guide the activities of Federal bureaus. This agency should be vested with the planning and coordinating functions of the defunct National Resources Planning Board, plus authority to approve or veto programs submitted by the bureaus . . . It should have the power to pass on the merits of all river-basin projects, and provide ample opportunities

for open hearings before programs receive White House blessing and are sent to the Congress."

The ultimate test, they conclude, is whether we as a Nation can alter our traditional attitudes toward private property so that land will be used in the public interest, by the imposition of social sanctions, if necessary. On this the outlook "while dim, does not warrant pessimism."

E. H. Wiecking

Vertical Farm Diversification. By D. Howard Doane. University of Oklahoma Press, Norman. 184 pages. 1950.

MUCH HAS BEEN WRITTEN about and many programs have been aimed at stabilizing the incomes of farmers and attempting to assure for them an equitable share of the national income. Here is a comparatively new approach to the problem. The author of this book concludes that the greatest opportunity for the American farmer is to perform some of the services now handled by the "middleman," and thus retain for himself a part of the margin between the price paid for raw farm products and the price paid by the consumer. In the opening words "Vertical farm diversification is the handling of farm products by the producer for one or more steps beyond raw production. It may consist of transportation, packaging, processing, storing, or retailing by the individual farmer or by cooperating groups of farmers. It starts with the completion of production and may follow through to the final consumer."

That it is not a new idea is evidenced by the many individuals and farmer cooperatives that have successfully taken advantage of some of these opportunities. What Howard Doane does is to dramatize these opportunities and to place them in a new setting. He presents many of his own ideas on how farmers might profitably expand into new lines of effort stemming directly from the production of the most profitable crop they can produce on their farms. In passing, he takes some verbal side-swipes at horizontal diversification—the handling of a variety of farm enterprises for the sake of spreading the risks of prices and weather.

The author has a long-standing reputation for imaginative thinking and development of new ideas for improvements in management and operation of farms. He here brings together many of these ideas, including ways of adapting industrial processes and techniques to the farm and the farm home. Suggestive of his originality in treatment are titles to two chapters: "The Kitchshop" and "The Farmfac."

Many will argue that the proposals, in effect, deny the economies of specialization and division of labor. Others will maintain that most of the advantages of vertical diversification—because of volume of product or investment requirements—are beyond the abilities of individual farmers and must be handled on a cooperative basis. Advantages to the individual farmer then depend entirely upon how effective and efficient the cooperative is in competition with private processors or distributors. The farmer may or may not improve his income. Despite all such questions, this book suggests many interesting possibilities and contains many worth-while ideas for the enterprising farmer. It no doubt will receive widespread attention and consideration.

Carl P. Heisig

Agricultural Progress in the Cotton Belt Since 1920. By JOHN LEONARD FULMER. The University of North Carolina Press, Chapel Hill. 236 pages. c 1950.

MOST ECONOMISTS would probably agree that the essence, or at any rate a primary element, of economic progress is the orderly and continuous adaptation of the use of productive resources to changing conditions of production and demand.

Conceptually, therefore, an economist investigating agricultural progress would have three general objectives: (1) To discern the significant developments, past and prospective, which have altered or may alter the conditions of production and demand; (2) to analyze relationships between these realized and emergent developments, and (3) to portray and evaluate the response of resource utilization to these changed and changing conditions of production and demand.

Although the book under consideration does not explicitly proclaim these objectives, its general tenor suggests that the author would not disagree with this over-all conception of the problems with which he is dealing. In this work the Cotton Belt is considered to be the States of North Carolina, South Carolina, Georgia, Alabama, Tennessee, Mississippi, Louisiana, Arkansas, Oklahoma, and Texas.

Dr. Fulmer does discuss the more important developments which have affected and are affecting conditions of agricultural production and demand. The principal ones that he considers are mechanization of production, the extent and rates of urban growth, farm and nonfarm rates of population change, and Government agricultural programs.

A commendable array of data concerning mechanization, urbanization, and population changes is assembled, and the general way in which these developments have affected conditions of production and demand is indicated. It is this reviewer's opinion that the author has somewhat neglected both the delineation, and the nature, of the effects of governmental programs upon the conditions of production and demand.

A thorough analysis of each one of the developments could easily be the subject of a longer work than that now under consideration. There is, then, no occasion for surprise or criticism in the fact that analysis of the relationships between these developments is not very extensive.

In two chapters—*Regional Trends* and *Farm Organizational Changes*—the author marshalls an impressive amount of information concerning the response of agricultural resource utilization to the changed conditions of production and demand. It is regrettable that the nature of the available data, and probably the limitations imposed by restricted time and resources, have resulted in the presentation of these data largely in the form of State and State-group regional averages. Such averages are capable of concealing as much as they reveal. As was the case with analysis of the relationships between developments affecting conditions of production and demand, evaluation of the indicated changes in resource utilization is not extensive. A valuable chapter on income shifts does present income data which are useful in an over-all evaluation of the changes that have been made in resource utilization. This chapter probably could have been made more valuable analytically if the author had taken more explicit recognition of the fact that, in order to effect a gradual transfer of some of its human resources to other segments of the economy, the labor returns from southern agriculture as a whole must be below those prevailing in the economic sectors to which the transfer is expected. Of course, this does not mean that returns in agriculture must be absolutely low.

The evaluation of changes in resource utilization has also suffered, this reviewer believes, from the author's efforts to buttress an apparent predilection to the belief that diminution of cotton production and of numbers of cotton-growing farms is synonymous with agricultural progress in the Cotton Belt.

Robert B. Glasgow

Selected Recent Research Publications in Agricultural Economics Issued by the Bureau of Agricultural Economics and Cooperatively by the State Colleges[1]

ALMACK, RONALD B., and HEPPLE, LAWRENCE M. RURAL SOCIAL ORGANIZATION IN DENT COUNTY, MISSOURI. Mo. Agr. Expt. Sta. Research Bul. 458, August 1950. (BAE cooperating.)

In 3 years, Dent County people have adopted much mechanization, and increased livestock and dairy farming. They use more information from public agencies. The county has more organizations and participation in organized groups than ever before.

BACHMAN, KENNETH L., and JONES, RONALD W. SIZES OF FARMS IN THE UNITED STATES. U. S. Dept. Agr. Tech. Bul. 1019, 79 pp., illus. July 1950. (Bur. Census cooperating.)

About 1,590,000, or slightly more than a fourth of all the farms, were classified by 1945 Census as part-time and nominal units, leaving 4,270,000 farming units, covering a wide range of economic conditions and scale of operations.

BOWLES, GLADYS K., DUCOFF, LOUIS J., and HAGOOD, MARGARET JARMAN. THE HIRED FARM WORKING FORCE—1948 AND 1949. WITH SPECIAL REFERENCE TO COVERAGE OF HIRED FARM WORKERS UNDER OLD-AGE AND SURVIVORS INSURANCE. Bur. Agr. Econ. 45 pp. November 1950. (Processed.)

Total number who worked on farms for wages in 1949 reached almost 5.1 million. Approximately 600,000 of these would have been covered by the new law extending old-age and survivors insurance had it been in effect in 1949.

BURNS, D. J., and BEAL, G. M. FACTORS AFFECTING SEASONAL MILK PRODUCTION IN THE BALTIMORE MILKSHED. Md. Agr. Expt. Sta. Bul. A-58, 16 pp., illus. October 1950. (RMA; BAE cooperating.)

"Summer" dairy farms in Baltimore milkshed can be converted from highly seasonal to a relatively uniform production by a series of steps that will increase annual output.

CABLE, C. CURTIS, JR. MARKETING PRACTICES OF NORTHWEST ARKANSAS BROILER PRODUCERS. Ark. Agr. Expt. Sta. Bul. 503, 37 pp., illus. November 1950. (RMA; BAE cooperating.)

A study showing changes in marketing practices of broiler producers in northwest Arkansas, analysis of factors affecting marketing practices, and present marketing relationships between producers and buyers of broilers.

COOK, HUGH L., and HALVORSON, HARLOW. INDUSTRIAL USES AND PREFERENCES FOR NONFAT DRY MILK SOLIDS. Wis. Agr. Expt. Sta. Research Bul. 169, 47 pp., illus. August 1950. (RMA; BAE cooperating.)

Recommendations include expanding the bakery outlook; tailoring the product to the needs of specific users; improving distribution and information.

FOOTE, RICHARD J. THE STATISTICAL ANALYSIS OF CYCLES OR OSCILLATIONS IN TIME SERIES. 19 pp. Bur. Agr. Econ. November 1950. (RMA) (Processed.)

Intended to stimulate interest in autoregression analysis, which appears to be applicable in many fields.

GILCREAST, ROY M. SUGAR BEET PRODUCTION IN THE RED RIVER VALLEY. N. Dak. Agr. Expt. Sta. Bul. 363, 48 pp., illus. December 1950. (RMA; BAE cooperating.)

In this, a major sugar-beet region, the chief opportunities for further mechanization are in pre-harvest operations, especially thinning and blocking.

HECHT, REUBEN W., and BARTON, GLEN T. GAINS IN PRODUCTIVITY OF FARM LABOR. U. S. Dept. Agr. Tech. Bul. 1020, 121 pp., illus. December 1950.

Compared with 40 years ago, a man-hour of farm labor now produces 200 percent more food grains, 100 percent more feed grains, 75 percent more fruits and tree nuts, 50 percent more truck crops and cotton, about 50 percent more milk and poultry products—in short, twice as much farm output for human use.

KOFFSKY, NATHAN M., and LEAR, JEANNE. THE SIZE DISTRIBUTION OF FARM OPERATORS' INCOME IN 1946. 32 pp., illus. Bur. Agr. Econ. September 1950. (RMA) (Processed)

In 1946, off-farm income of farm operators totaled $5.5 billion. Net farm income reported in enumerative surveys is generally understated because of biases in reporting.

NORTH CENTRAL LIVESTOCK MARKETING RESEARCH COMMITTEE. FROZEN FOOD LOCKERS AND HOME FREEZERS IN MEAT DISTRIBUTION. Wis. Agr. Expt. Sta. Bul. 490. (Regional bul. 21) September 1950. (RMA; Agr. Expt. Stas. of Ill., Ind., Iowa, Kans., Ky., Mich., Minn., Mo., Nebr., N. Dak., Ohio, S. Dak., Wis. and BAE cooperating.)

Appraises the position of frozen-food locker plants and home freezers in the over-all pattern of livestock and meat marketing, livestock slaughter, and meat distribution.

PURCELL, MARGARET R. INTERSTATE BARRIERS TO TRUCK TRANSPORTATION. HISTORY AND CURRENT STATUS OF REGULATIONS REGARDING SIZE AND WEIGHT, TAXES, AND OTHER SELECTED PHASES THAT AFFECT TRUCKING. 117 pp., illus. December 1950. (RMA) (Processed.)

Discusses some aspects of highway trade-barrier problems; evolution of problem; increase in trade barriers between World Wars; easing of interstate trucking regulations during World War II; State regulation of commercial motor vehicles.

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[1] *Processed* reports are indicated as such. All others are *printed*. State publications may be obtained from the issuing agencies of the respective States.

STIPPLER, H. H., and PETERSON, A. W. ELECTRICITY ON FARMS IN NORTHWESTERN WASHINGTON. Bur. Agr. Econ. and State Col., Wash. Inst. Agr. Sci., Agr. Expt. Stas. F.M. 77, 105 pp., illus. June 1950. (RMA; BAE cooperating.) (Processed.)

In 1947, most of the farms had been connected to power lines for 20 years. Study shows that household uses accounted for more electricity consumed than did farm uses; and length of time service had been available had little influence on the amount now consumed on individual farms.

THAIR, PHILIP J. STABILIZING FARM INCOME AGAINST CROP YIELD FLUCTUATIONS. N. Dak. Agr. Expt. Sta. Bul. 362, 31 pp., illus. September 1950.

Apparently no one of the stabilizing techniques studied can alone protect the farm business and provide a minimum living each year from current income. A combination of two or more could achieve this objective.

UNITED STATES BUREAU OF AGRICULTURAL ECONOMICS. CONSUMER PREFERENCES REGARDING APPLES AND WINTER PEARS. U. S. Dept. Agr. Agr. Inform. Bul. 19, 69 pp. 1950. (RMA, PMA, FCA, BHNHE, and representatives from the technical committees who represented the experiment stations cooperating.)

Apples are used more than other fruits by a third of the 80 percent of homemakers who preferred one fruit above others. Taste, usefulness, and health were the major reasons given.

UNITED STATES BUREAU OF AGRICULTURAL ECONOMICS. FIBER CONSUMPTION IN TEXTILES USED FOR PASSENGER AUTOMOBILE INTERIORS. PRELIMINARY SUMMARY REPORT. 5 pp. Washington, D. C. December 1950. (RMA, BHNHE, and PMA cooperating.) (Processed.)

Wool was the leading fiber used in upholstery and sidewall material; cotton led in headlining, seat padding, and sheeting. For all five items, cotton accounted for more than three-fifths of the consumption of all fibers and materials reported.

UNITED STATES BUREAU OF AGRICULTURAL ECONOMICS. MEN'S PREFERENCES AMONG WOOL SUITS, COATS, AND JACKETS. PRELIMINARY SUMMARY REPORT. 21 pp. Bur. Agr. Econ. November 1950. (RMA) (Processed)

Supplements previous survey on men's clothing preferences.

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