PROCEEDINGS

OF THE

SIXTH INTERNATIONAL CONFERENCE

OF

AGRICULTURAL ECONOMISTS

HELD AT

DARTINGTON HALL

ENGLAND

28 AUGUST TO 6 SEPTEMBER 1947

GEOFFREY CUMBERLEGE

OXFORD UNIVERSITY PRESS

LONDON NEW YORK TORONTO

1948

RECENT AND PROSPECTIVE CHANGES IN FARMING IN THE UNITED STATES

SHERMAN E. JOHNSON

Bureau of Agricultural Economics, Washington, D.C., U.S.A.

PRODUCTION CHANGES

THE changes in farming under consideration in this paper are those that have developed and that seem to be in prospect in the United States. It seems desirable to interpret the term 'recent' somewhat liberally in order to consider developments in the inter-war period because the foundation for the large production increases of the war and early post-war years was laid in the period between the two wars. In considering the broad sweep of changes since the First World War, most of the comparisons are from statistics contained in the agricultural censuses of 1920–45 and from the annual estimates of the Bureau of Agricultural Economics.[1]

There was a small increase in gross farm production in the United States during the 1920s (Fig. 1).[2] This was partly accounted for by a net increase in cropland. Several million acres of virgin sod were broken up in the Great Plains and planted to wheat during the 1920s. But the effect of the additional arable land in the west was partly offset by land abandonment in the eastern part of the country. The output of farm products available for human use increased more rapidly than gross farm production because of the shift from animal to mechanical power during that period. This shift released land for marketable products that formerly produced horse and mule feed (Fig. 1).

The small increase in production during the 1920s was halted by severe depression and the beginning of the drought years in the early 1930s. The unprecedented drought of 1934 reduced gross farm production about 20 per cent. below the average of the years 1928–32

[1] Much of the material in this paper is described in more detail in recent publications of the Bureau of Agricultural Economics, especially in the series of reports summarized under the title *Changes in Farming in War and Peace*, F.M. 58, Bureau of Agricultural Economics.

[2] The measures of production used in Fig. 1 are explained in the processed B.A.E. report entitled *Farm Production in War and Peace* by Glen T. Barton and Martin R. Cooper. Briefly, *gross production* includes all crop production, pasture consumed by livestock, and the production of all livestock and livestock products, including farm-produced power. The measure called *farm output* does not include farm-produced power. It is a measure of the volume of farm production available for human use.

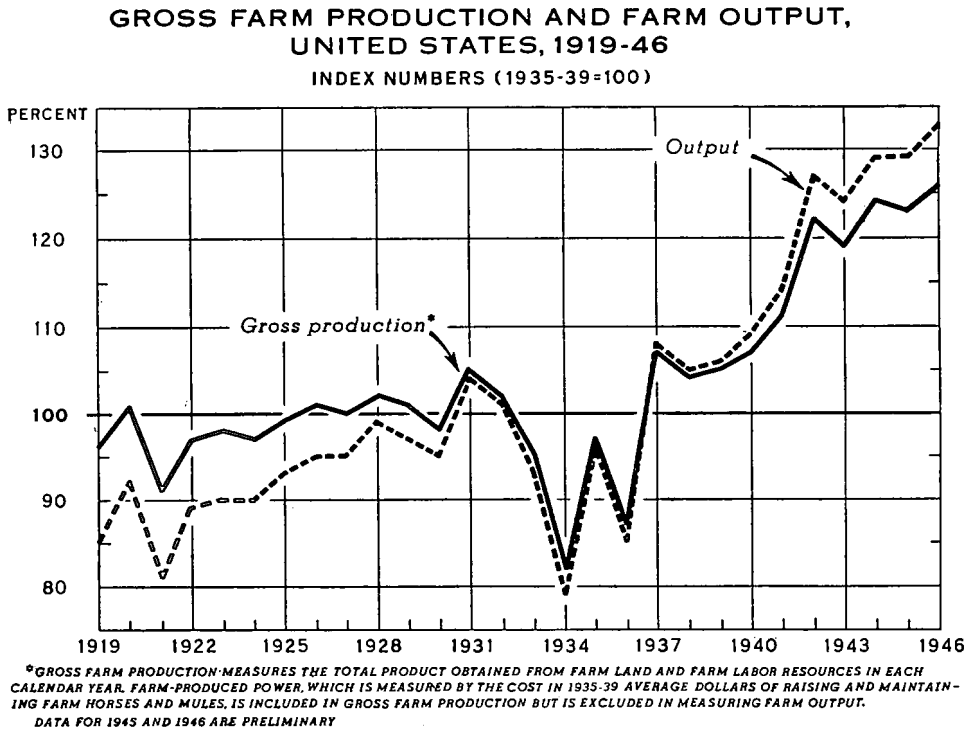

FIG. 1. Gross farm production increased 22 per cent. during the war period 1942–4 over the pre-war period 1935–9. The higher increase in farm output was the result of transfer of production resources from horse and mule production and maintenance to production of other livestock and crops for sale. Exceptionally large corn and wheat crops in 1946 partly account for the record output.

The drought in 1936 was somewhat less severe, but its influence on production was almost as great because it was preceded by several drought years with only slight let-up in 1935. The volume of farm production reached a new peak in 1937, and although it receded slightly in 1938 and 1939 it remained above the pre-drought level up to the beginning of the war.

The increase in farm output during the Second World War and the early post-war years is unprecedented. In the war years 1942–4 it averaged 27 per cent. above the pre-war years 1935–9, and in 1946 it reached an all-time record with an output 33 per cent. larger than during the pre-war period. At the same time that this increase in total output took place, farmers also made large shifts towards products that were more needed in the war effort. In the early war years this meant expanded production of pork, eggs, and milk; and a tremendous increase in soy-beans, peanuts, flax seed, dry beans, and peas. In later years more emphasis has been given to wheat production.

These changes in the component parts of the output made it more difficult to expand the total volume because production per acre is usually lowered when a product is grown on land that is less suited for its production or by growers who have insufficient experience. It would have been much easier to increase the total volume of production by maintaining the same relationship among the different farm enterprises as prevailed in the pre-war years.

The expansion in farm output that took place during the First World War furnished no basis for expecting a large increase in the recent war period. With financial and patriotic incentives similar to those of the Second World War, and with the need for food just as urgent, the volume of output for human use increased less than 10 per cent. from the pre-war years 1910–14 to 1918–19. Production at that time was limited by lack of mechanical power, shortage of fertilizer, damage by plant and animal pests and diseases, and somewhat unfavourable weather. In the early years of the Second World War many people felt that exceptionally favourable weather conditions were largely responsible for the increased output. But when the phenomenal production record continued year after year despite adverse weather in many areas, especially in 1943 and 1945, favourable weather seemed an inadequate explanation.

The Bureau of Agricultural Economics undertook a study in the fall of 1944 with the objectives of analysing the changes in farming during the inter-war and war years and appraising the forces back of the large increases in production. From that study it appears that about one-fourth of the total increase in farm output during the war

years 1942–4 can be accounted for by weather conditions that were more favourable than in the pre-war years 1935–9. This means that 75 per cent. of the war-time increase must be explained in terms of other forces. The forces that made this part of the increase physically possible are largely the product of research and invention that took place in the inter-war years.

Considering the inter-war as well as the war years, the most effective production-increasing forces were: (1) mechanization of agriculture, (2) use of lime and commercial fertilizer, (3) improvements in strains and varieties of crops, (4) greater use of conservation practices, (5) better breeding, feeding, and care of livestock, (6) insect and disease control. These forces represent technological changes in farming that will have permanent production-increasing effects.

In addition to these more permanent forces there were some of a more transitory nature that operated during all or part of the war period. For example, in 1944 about 3 per cent. more land was planted to crops than in the pre-war years. We also planted about 4 per cent. more intertilled crops (Table I). There was a steady decrease in the acreage of intertilled crops in the southern states during the war years, chiefly because of reduced acreage in cotton.

TABLE I. *Changes in the Principal Uses of Cropland in the United States, 1928–32, 1935–9, 1944, and 1945*

Use of cropland	*Average 1928–32*[1,2]	*Average 1935–9*	*1944*[2]	*1945*[2]	*Percentage 1944 is of*		
					1928–32	*1935–9*	*1945*
	Mil. acres	*Mil. acres*	*Mil. acres*	*Mil. acres*	%	%	%
Intertilled crops[3]	176·6	163·0	168·8	157·6	96	104	107
Close-growing crops[3] . .	132·6	133·0	129·8	132·4	98	98	98
Sod crops[3, 4] .	77·3	73·5	80·2	82·5	104	109	97
Total cropland used for crops .	386·5	369·5	378·8	372·5	98	103	102
Summer fallow and idle cropland . .	41·3	56·9	47·3	54·4	115	83	87
Total cropland[5] .	427·8	426·4	426·1	426·9	100	100	100

[1] The data on which the 1928–32 estimates are based are less complete than for later periods.

[2] Planted acres in so far as available; all others harvested acres.

[3] Adjustments made for multiple use of land by considering first use in the crop year as the primary use.

[4] Including acres in tame hay, hay, and cover-crop seeds, and in rotation pasture.

[5] Includes rotation pasture, but does not include wild hay, orchards, vineyards, and farm gardens.

But until 1945 that decrease was more than offset by the large increases in corn, soy-beans, and other intertilled crops planted in the Corn Belt and Lake states. The wheat acreage planted for 1947 harvest was over 8 million acres higher than for 1945.

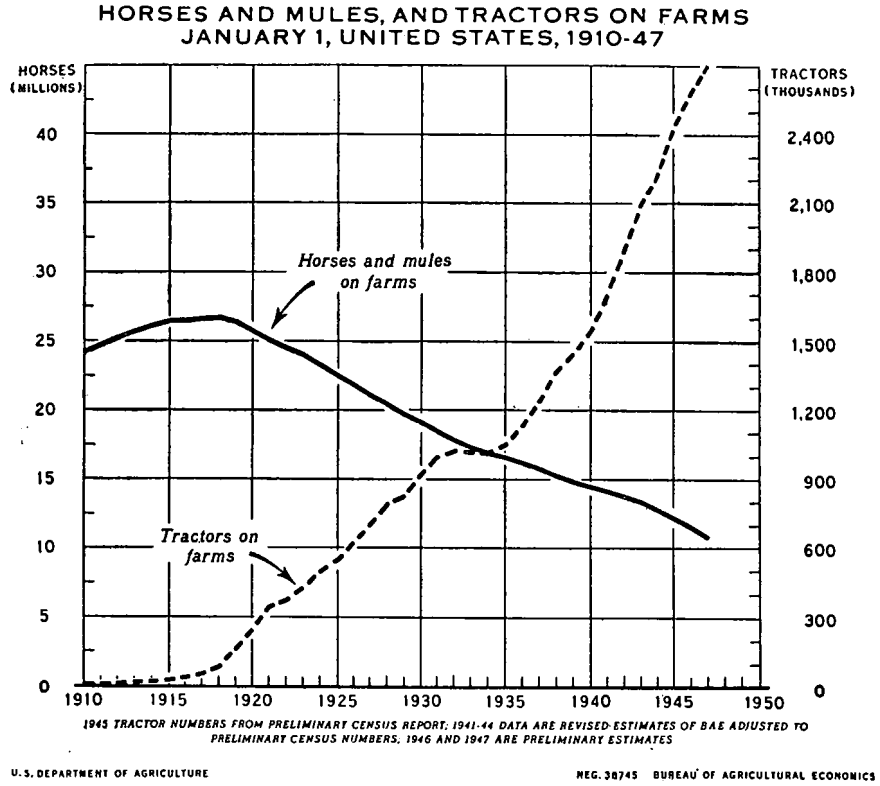

FIG. 2. Displacement of horses and mules by mechanical power has been rapid during recent years. Production of smaller type tractors is resulting in further displacement of horses and mules, especially in the south. The number of colts raised in recent years has been small, and the rate of decline in horse and mule numbers has been increasing.

Whenever emergency food needs subside somewhat it will be necessary in the interest of soil maintenance and permanent agriculture to shift between 8 and 9 million acres of intertilled crops in the Corn Belt and Lake states into hay and rotation pasture. It will also be desirable to return at least 10 million acres of the less adapted cropland of the Great Plains and some other areas to permanent pasture and other less intensive uses.

Of the production-increasing forces in operation since the First

World War, mechanization has had the greatest effect on output for the market. The shift from animal to mechanical power since 1920 has made available for the production of marketable products about 55 million acres of cropland that was formerly used for horse and mule feed. The drastic nature of this change in type of power is portrayed in Fig. 2. There were nearly 26 million horses and mules on farms in January 1920, whereas in January 1947 the number had shrunk to 10 million. Our colt crops are only large enough to maintain 5 million horses and mules, which means that over a period of years there will be a gradual displacement of animal power and the release of 15 to 20 million more acres of cropland for production for the market. In January 1947 we had 2,700,000 tractors on farms as compared with 246,000 in 1920. By 1950 there will be over 3,000,000 tractors on farms in the country. Tractor power not only releases land for the production of marketable products. It also adds timeliness and thoroughness to farm operations with definite yield-increasing results.

Use of lime more than tripled during the war years (Fig. 3). And in 1946 it was nearly four times the pre-war average. In terms of plant nutrients, application of commercial fertilizer nearly doubled during the war, and by 1946 we were using more than twice as much as before the war (Fig. 4). These changes probably were next in importance to mechanization in their production-increasing effects. Farmers in our Corn Belt states, as well as in many other areas that formerly used no commercial fertilizer, have learned to use it during the war years, and once having learned what it can do to step up yields, even on relatively productive soil, they are likely to continue its use.

Of the improvements in strains and varieties of crops, hybrid seed corn is by far the most important (Fig. 5). About 71 per cent. of our more than 86 million acres of corn was planted with hybrid seed in 1947; and in the north central states, which contain the most important corn areas, 93 per cent. of the acreage was planted with hybrid seed. It is estimated that the use of hybrid seed alone added nearly 400 million bushels to the 1946 corn crop. Improved varieties of oats, soy-beans, wheat, cotton, and many others have also had pronounced yield-increasing results. Effects of conservation practices are difficult to measure, but there is little doubt that their adoption has influenced production. For example, the acreage of winter cover crops in our southern states was 4 times larger in 1944 than in pre-war years. Other practices such as contour cultivation and strip cropping also have been adopted on large areas. Disease

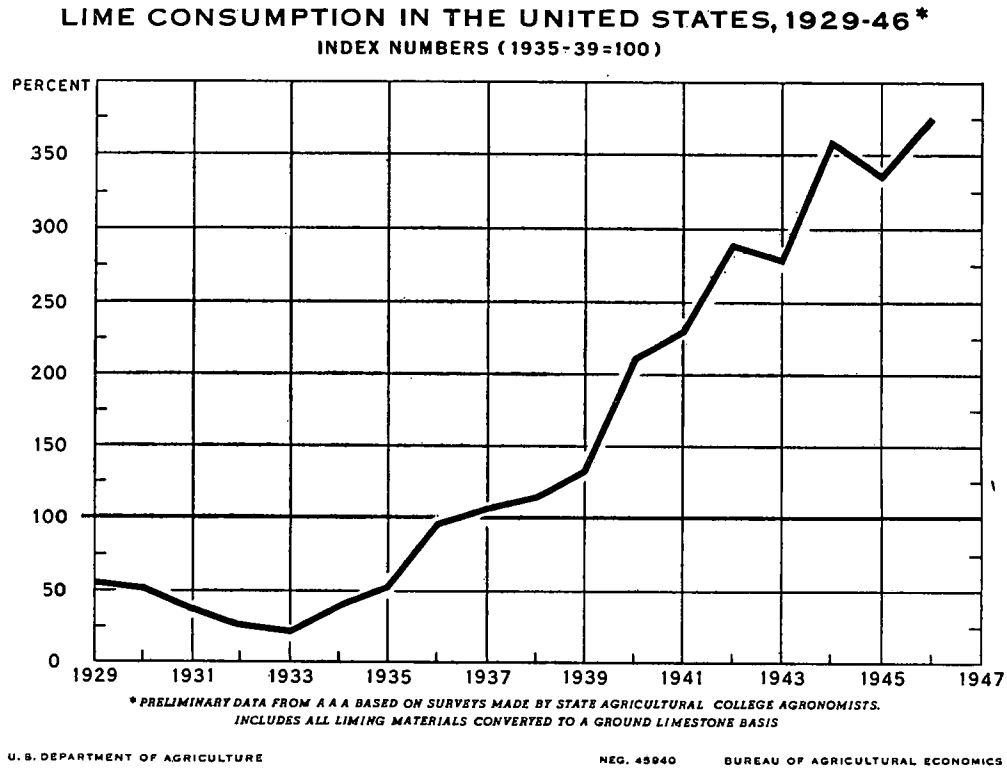

FIG. 3. Application of liming materials rose to pre-depression levels by 1935. Most of the increase in the use of lime since 1936 can be attributed to the stimulation provided by its inclusion as a conservation material in the Agricultural Conservation Programme.

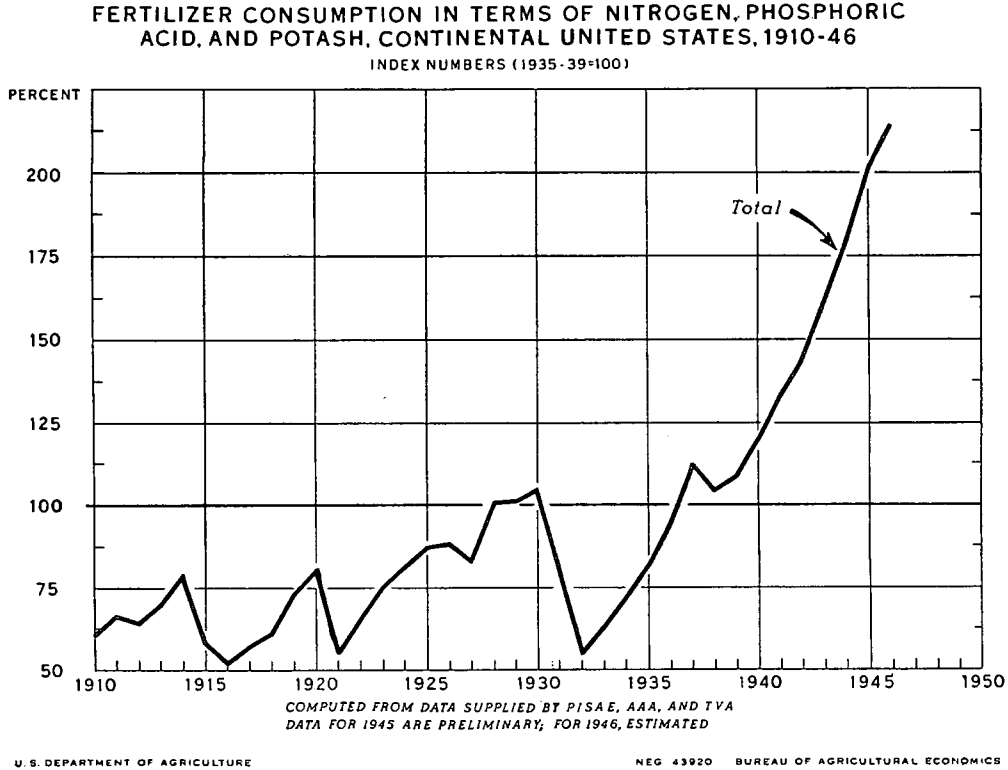

FIG. 4. Use of nitrogen, phosphoric acid, and potash as fertilizer during the Second World War reached a level nearly double that of the 1935–9 average. Consumption in 1945 and 1946 was more than twice the pre-war average. The highest consumption before 1937 occurred in 1930, when the level reached was 5 per cent. above the average of the years 1935–9.

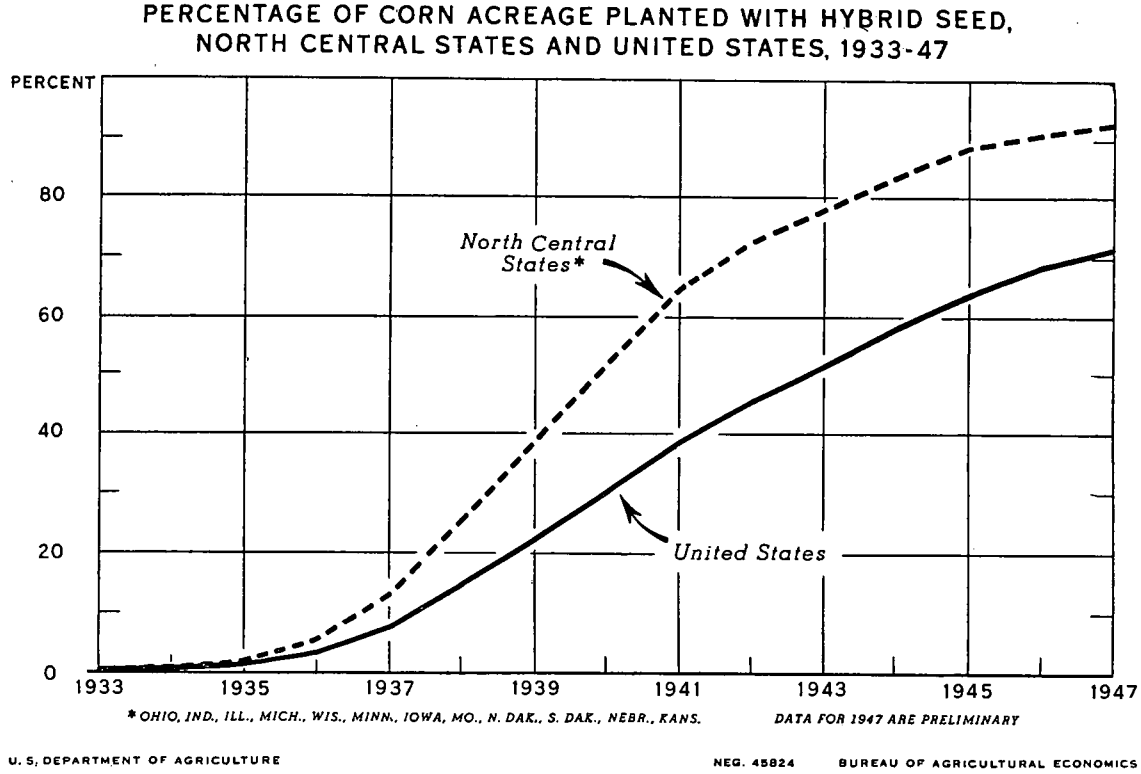

FIG. 5. From the merest beginnings in 1933, hybrid seed had replaced open-pollinated varieties on about 64 per cent. of the total acreage planted in 1945 and on 71 per cent. of the acreage in 1947. The increase has been most rapid in the north central states, where it was used for planting 88 per cent. of the acreage in 1945 and 93 per cent. in 1947.

control has been important especially on some crops. The new insecticides were not sufficiently plentiful to influence yields materially during the war years, but the use of D.D.T. on potatoes was a significant factor in the high potato yields of 1946.

The combined influence of improved practices on crop production is indicated in Fig. 6. This chart shows the relatively small additions to the cropland base, and the contrasting large increase in production per acre.

The effects of better breeding, feeding, and care of livestock are evidenced by the considerable rise in production per unit of breeding livestock, shown in Fig. 7. In large part the higher production per unit is the result of more feed per animal but also of better balance of feed nutrients. One of the more significant changes in the feeding of livestock has been a constant improvement in the quality of hay. The substitution of higher protein legume hays has added nearly 40 per cent. more digestible protein to the hay supply since 1920. The remarkable freedom from major outbreaks of insect pests and animal diseases during the war years is partly good fortune, but also in large part due to development of more effective control methods.

The combined effects of all the production-increasing forces that have just been described are indicated in Fig. 8. This chart also shows how farm employment decreased steadily from 1935 to 1945, which meant that the war-time increases in production were achieved with a constantly shrinking labour supply. In 1945 farmers had 10 per cent. fewer workers than in 1935–9, and many of the hired workers that were available did not have the strength and skill that are usually considered necessary for farm work. Total farm population dropped from 30 millions in 1940 to 25 millions in 1945. Fewer workers and a large expansion in farm production obviously meant more gross production per worker—37 per cent. higher in 1945 than in 1935–9.

Despite the large production increases of recent years the conclusion should not be drawn that there are no limits to further immediate expansion. Unfortunately, from the standpoint of the present food emergency the limits are now fairly rigid over a period as short as from one to three years. Present production levels have been achieved partly by the sacrifice of soil-maintaining rotations in the Midwest. And the record wheat crop of 1947 was grown partly at the expense of summer fallow and other yield-maintaining practices. It must also be realized that once in a while we are likely to experience weather disasters, such as the droughts of 1934 and 1936. In any one year these might cause as much as a 20 per cent. drop in output. On

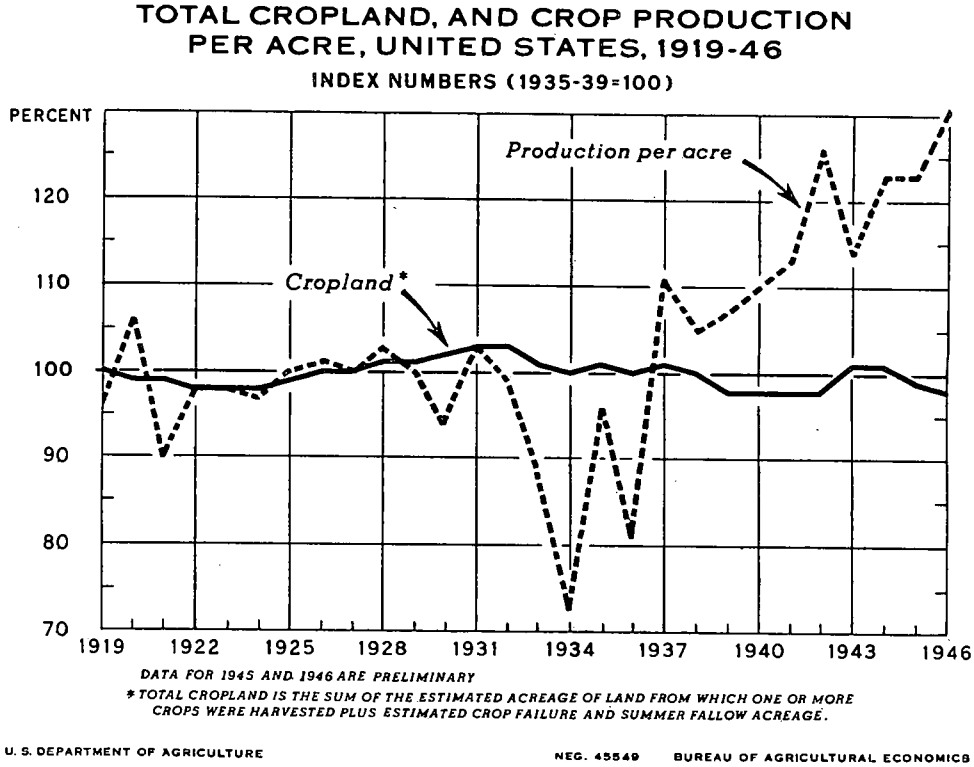

FIG. 6. Increased crop production per acre was by far the most important single factor responsible for record war-time farm production. The total cropland acreage has been fairly stable throughout the entire period.

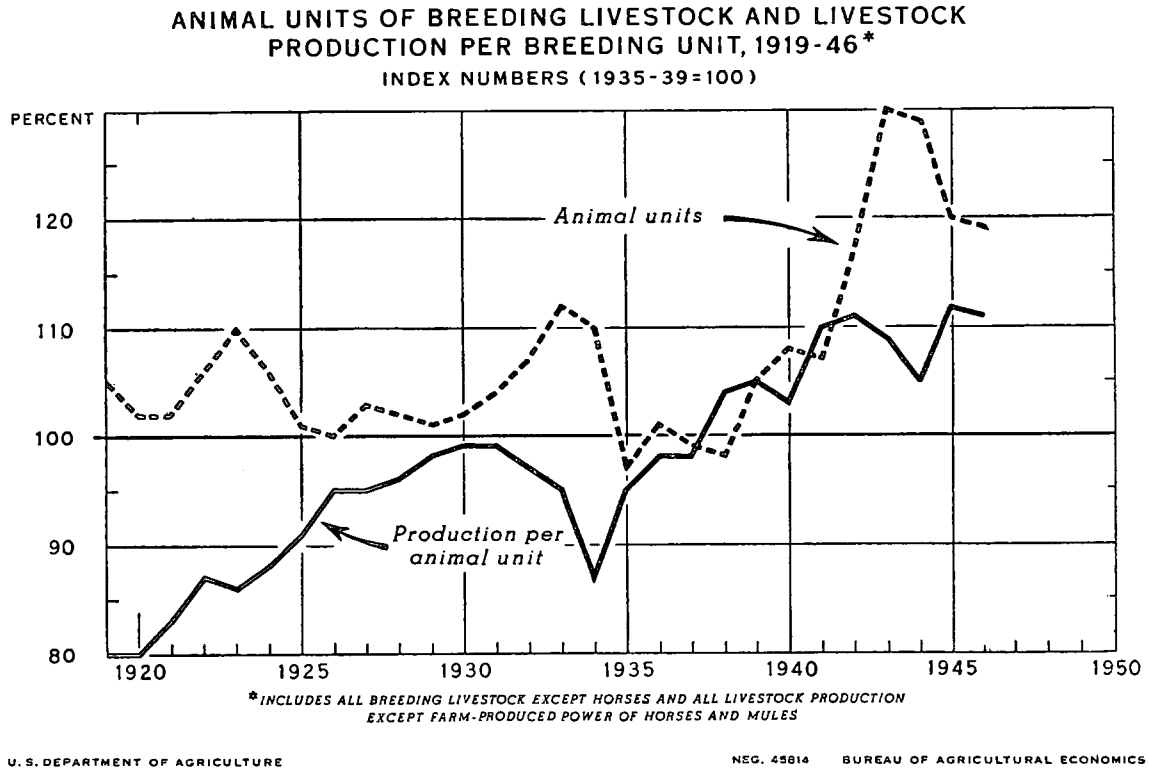

FIG. 7. Livestock production per animal unit of breeding stock has shown an upward trend since 1920. And the animal units of breeding livestock increased sharply in the early war years. The war-time increases in livestock production therefore resulted both from increases in numbers of breeding animal units and in production per unit.

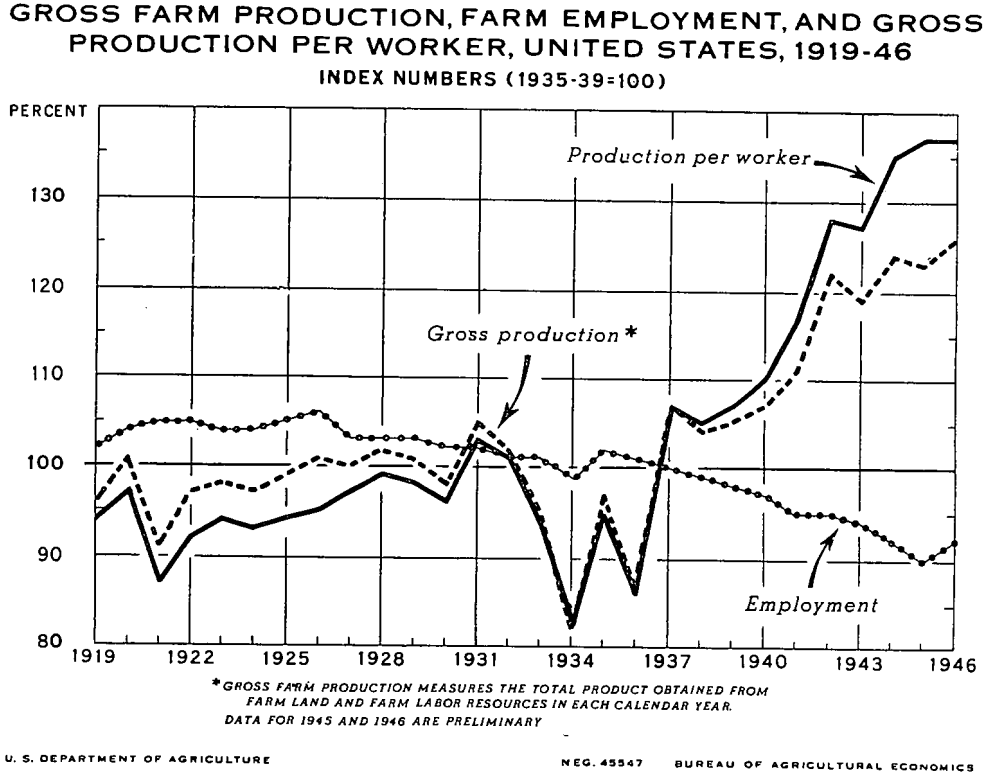

FIG. 8. Acceleration during the war of the long-time downward trend in farm employment, coupled with marked increases in farm production, resulted in record levels of production per farm worker.

the other hand, the production-increasing forces will have only minor effects over a period as short as from one to three years.

Considering the production outlook over a period of five to ten years, however, it appears that, with average weather, we can look forward to an upward trend in the volume of output for human use. Further displacement of animal power will release more cropland. Mechanization will promote further progress in timeliness and thoroughness of farm operations. Use of more lime and fertilizer and other improved practices also will tend towards increased output. On the other hand our cropland base is fairly stable. The new land that might become available from clearing, irrigation, and drainage might be more than offset by land abandonment and by shifting to other uses the land that is not permanently suited for arable farming.

Over a still longer period of time it is evident that one of the main production-increasing forces, the shift to mechanical power, will slow down. Its effect on total output will diminish progressively as horse and mule numbers decline towards minimum levels. Expansion in output will then come chiefly from increased production per acre and per animal; which in turn is dependent upon new advances in technology, and their adoption by farmers.

CHANGES IN NUMBERS AND SIZES OF FARMS

The technological factors responsible for a large part of the production increases also have had considerable influence on changes in the number and sizes of farms (Table II). A part of the change in sizes of farms since 1920 results from factors related to development of new arable land in the west, abandonment of land in the east, and the very considerable growth in part-time farming. But technological forces have influenced those changes. And they have also directly affected both the changes in number of farms and their size distribution.

The total number of farms counted in the census of agriculture decreased 9 per cent. from 1920 to 1945. On the other hand, the 'land in farms' increased 19 per cent. The latter change occurred largely in the seventeen western states. In fact, the land in farms decreased in some of the eastern states during this period.

Changes in sizes of farms are difficult to measure. There are several reasons for this. The first is that the counting of farms in different farm size groups has varied in the different census enumerations; second, we do not have a good measure of farm size; third, we need a better classification of farms than we now have in order to appraise the changes that have occurred; and fourth, in order really

TABLE II. *Number of Farms and Changes in Number of Farms by Size of Farm in the United States, 1920, 1940, and 1945*[1]

Size group (acres in farm)	*Number of farms*			*Percentage change*		*Percentage of farms in farm size groups, 1945*
	January 1, 1920	*April 1, 1940*	*January 1, 1945*	*1920–45*	*1940–45*	
	Number	*Number*	*Number*	%	%	%
Under 10	288,772	506,402	594,561	106	17	10
10–99	3,486,240	3,071,308	2,811,724	−19	−8	48
100–259	1,980,430	1,796,077	1,693,024	−15	−6	29
260–499	475,677	458,787	473,184	−1	3	8
500–999	149,819	163,694	173,777	16	6	3
1,000 and over	67,405	100,531	112,899	67	12	2
All farms	6,448,343	6,096,799	5,859,169	−9	−4	100
Average size of farm (acres)	148	174	195	32	12	..

[1] From United States census reports.

to understand the size of farm changes we should analyse them by type of farming areas and by types of farms. But our information is not adequate for that type of analysis. It is possible only to consider the acre changes in size on the assumption that the census reports reflect the broad changes that have taken place.

In the quarter-century from 1920 to 1945 there was a 106 per cent. increase in the number of extremely small units that are counted as farms by the census, those under 10 acres in size (Table II and Fig. 9). In the United States farms of that size are mostly part-time farms, rural homes, and retirement units. Very few of them are considered as actual farms in the areas where they are found. But they are counted by the census as farms because they are 3 acres or over in size, or have value of products of $250 or more. Fig. 10 shows the areas where a large number of farm operators worked 100 days or more off the farm. These same areas also had a large number of farms under 10 acres in size.

In contrast to the large increase in the extremely small farms, there was a 19 per cent. decrease in what might actually be called 'small farms', those from 10 to 99 acres in size. There were 675,000 fewer farms in this group in 1945 than in 1920. There were also 15 per cent. fewer farms in the size group 100–259 acres. This was our traditional 'homestead' size. But the size group from 260 to 499 acres nearly held its own. It showed only a 1 per cent. decrease in number of farms from 1920 to 1945.

At the upper end of the size of farm scale there was an increase in the number of farms during this period. The group from 500 to 999 acres showed an increase of 16 per cent., and those of 1,000 acres and over increased 67 per cent. Although the group of farms of 1,000 acres and over in size was two-thirds larger than in 1920, that group still contained less than 2 per cent. of the total number of farms in 1945. But operators of farms of that size controlled about 40 per cent. of the total land in farms. This seems like a rapid trend towards concentration of land holdings until we analyse the data more closely. About 87 per cent. of the number of farms of 1,000 acres or over in size were found in the 17 western states. This means that the increase took place mostly in the ranching and dry land wheat areas where 1,000 acres is not a large-scale farm.

But there has actually been some increase in farms of 1,000 acres or over in size outside of the grain and ranching areas of the western states. In other words, we have had some growth in large-scale farming. More important, however, was the shift to larger farms within the size groups included between 100 and 999 acres. That

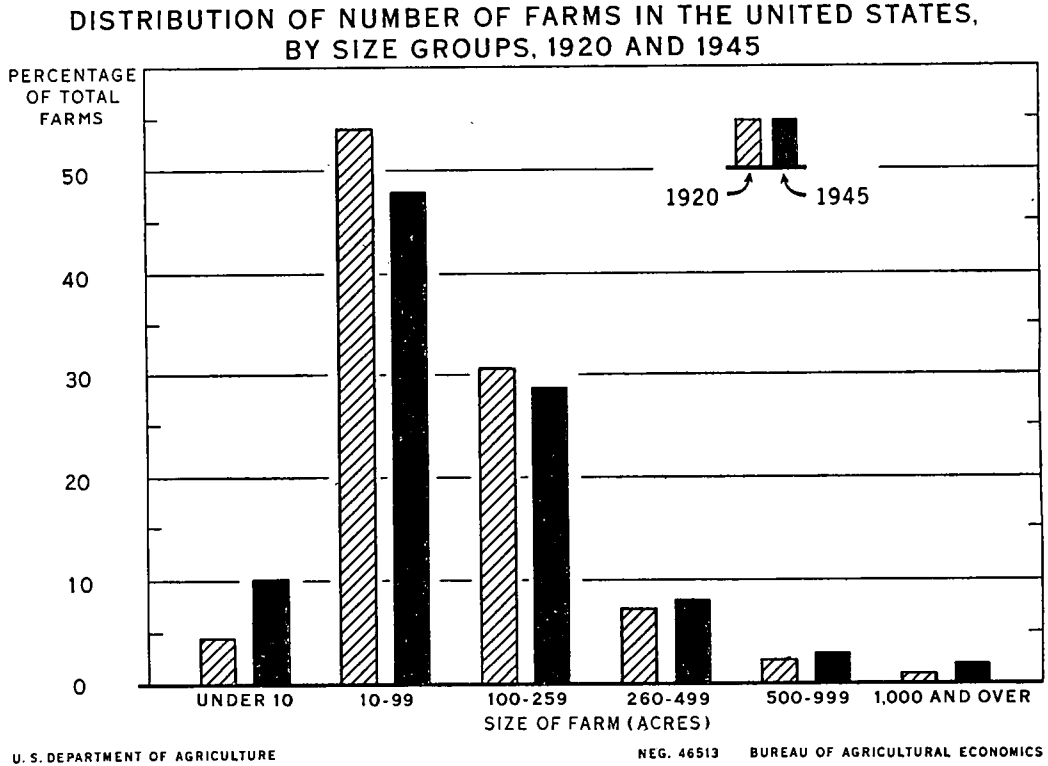

FIG. 9. From 1920 to 1945 the number of farms under 10 acres in size more than doubled. There were fewer farms of 10 to 99 acres in 1945, but they still constituted 48 per cent. of the total number. Farms in the size groups above 259 acres were relatively more important in 1945 than in 1920.

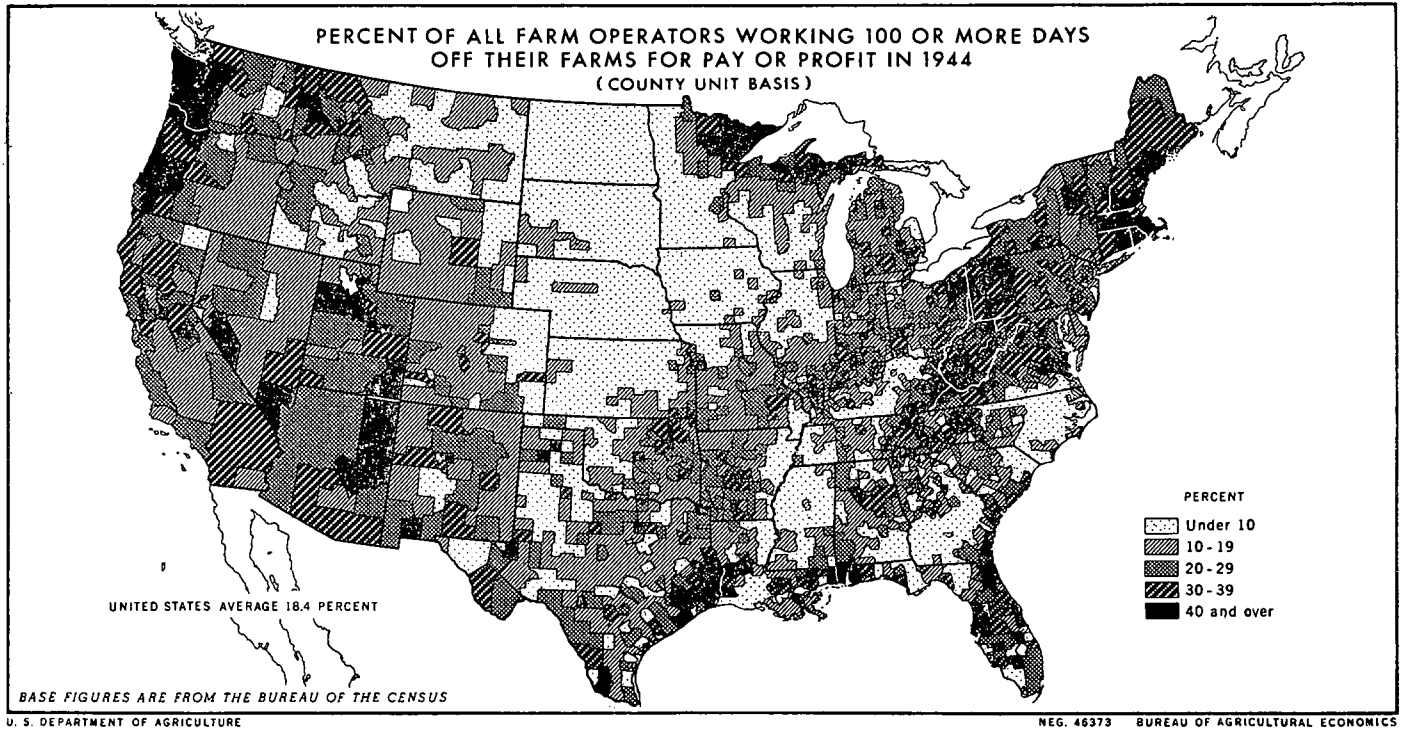

FIG. 10. Part-time farming as indicated by operators working 100 or more days off the farm is concentrated near metropolitan centres, or in areas where mining or lumbering is carried on.

change can be characterized as a trend towards larger, more commercial family farms rather than towards large-scale farming. It was made possible and has been accelerated by technological changes, especially by adoption of mechanical power and associated equipment.

Farmers in the size groups from 100 to 999 acres controlled nearly half of the land in farms in 1945. They constituted 40 per cent. of the total number of farms counted by the census in that year. About 48 per cent. of the total number of farms were in the small farm size groups (10–99 acres), but farmers in that group controlled only about 11 per cent. of the land in farms. The extremely small farms, those under 10 acres, had less than 1 per cent. of the land in farms. And even though this group more than doubled, they constituted only about 10 per cent. of the total number of farms counted by the census in 1945.

In summary, the census changes in sizes of farms from 1920 to 1945 show a doubling of the extremely small or 'nominal' farms, an increase of two-thirds in farms of 1,000 acres and over, some increase in the number of farms of 500 to 999 acres, and much more than offsetting decreases in the small and middle-scale size groups. These changes resulted in a 9 per cent. decrease in the total number of farms; also a 32 per cent. increase in the average acreage of all farms, which increased from 148 acres in 1920 to 195 acres in 1945.

Looking forward over the next decade, some of the same forces are likely to continue to influence changes in the number and sizes of farms as have operated over the last quarter-century. We might expect a further large increase in the number of part-time farms. The full-time family-operated farms are likely to be fewer and larger. And there might be some further increase in the number of large-scale farms, but they will still constitute a relatively small segment of the agricultural industry.

CHANGES IN TENURE

There have also been important changes in farm tenure during the last quarter-century. Census returns for 1945 indicate that about 32 per cent. of all the farms counted by the census were operated by tenants, as contrasted with 38 per cent. in 1920. Tenancy increased in the decade following 1920, and 42 per cent. of the farms were operated by tenants in 1930. But by 1940 the percentage of tenancy was about back to 1920 levels. And a very considerable decrease between 1940 and 1945 resulted in the lowest level of tenancy since before 1900 (Table III).

TABLE III. *Number of Farms by Tenure of Operator, United States, 1900–45*[1]

Census year	All operators	Full owners		Part-owners		Managers		All tenants	
	Number	Number	Per cent. of all farms	Number	Per cent. of all farms	Number	Per cent. of all farms	Number	Per cent. of all farms
	thousands	thousands		thousands		thousands		thousands	
1900 . .	5,737	3,202	55·8	451	7·9	59	1·0	2,025	35·3
1910 . .	6,362	3,355	52·7	594	9·3	58	0·9	2,355	37·0
1920 . .	6,448	3,366	52·2	559	8·7	68	1·1	2,455	38·1
1925 . .	6,372	3,313	52·0	555	8·7	41	0·6	2,463	38·6
1930 . .	6,289	2,912	46·3	657	10·4	56	0·9	2,664	42·4
1935 . .	6,812	3,210	47·1	689	10·1	48	0·7	2,865	42·1
1940 . .	6,097	3,084	50·6	615	10·1	36	0·6	2,362	38·7
1945 . .	5,859	3,301	56·3	661	11·3	39	0·7	1,858	31·7

[1] From United States census reports.

The number of full owners actually increased 7 per cent. from 1940 to 1945, at a time when the total number of farm operators decreased 4 per cent. A part of the increase in farm ownership is accounted for by the larger number of farms under 10 acres in size, about 75 per cent. of which are owner-operated.

The number of part-owner farms increased about 18 per cent. from 1920 to 1945, and the acres of land they operated by 112 per cent. More than twice as large an acreage of land was operated by farmers who owned part of the land and rented part as in 1920. In this group of part-owner farms a little over half of the land (52 per cent.) was owned by the operator in 1945; the acreage of land rented more than doubled from 1920 to 1945. The greater number of part-owner farms is one explanation of how many farms have become larger in size. Farmers who owned some land have rented adjoining farms or separate tracts of land that could be combined with their own land for operation as a more efficient unit.

Fig. 11 shows the geographic concentration of the land in farms operated under lease in 1945. About 38 per cent. of all land in farms was rented land. The area operated by *full* tenants was less in 1945 than in 1920, but the increase in part-owner farms resulted in a somewhat larger total area of rented land.

Owner-operatorship of family farms is considered one of the goals of agricultural policy in the United States. The tenure figures for 1945 indicate considerable recent progress towards that goal. The overall mortgage debt situation also indicates that farmers have greatly increased their equity in the land they own. Total mortgage debt is only about half as large as in 1920. But 1947 figures indicate an upward turn in mortgage debts. And one of the blind spots in the picture is whether there are large numbers of new owners who have bought farms on credit at inflated values, and therefore will find themselves vulnerable in periods of lower farm-incomes.

CHANGES IN COSTS AND RETURNS

The changes in farming that have been described so far have had significant effects on costs per unit of output of farm products. A recent study indicates that costs in terms of physical inputs per unit of product for labour, power, and machinery were reduced about 30 per cent. from the years 1920–2 to 1942–4.[1] Total costs per unit of farm output, also measured in physical terms, decreased about

[1] The basis for these computations is described in detail in the forthcoming U.S.D.A. Miscellaneous Publication 630, *Progress of Farm Mechanization*, by M. R. Cooper, Glen T. Barton, and A. P. Brodell.

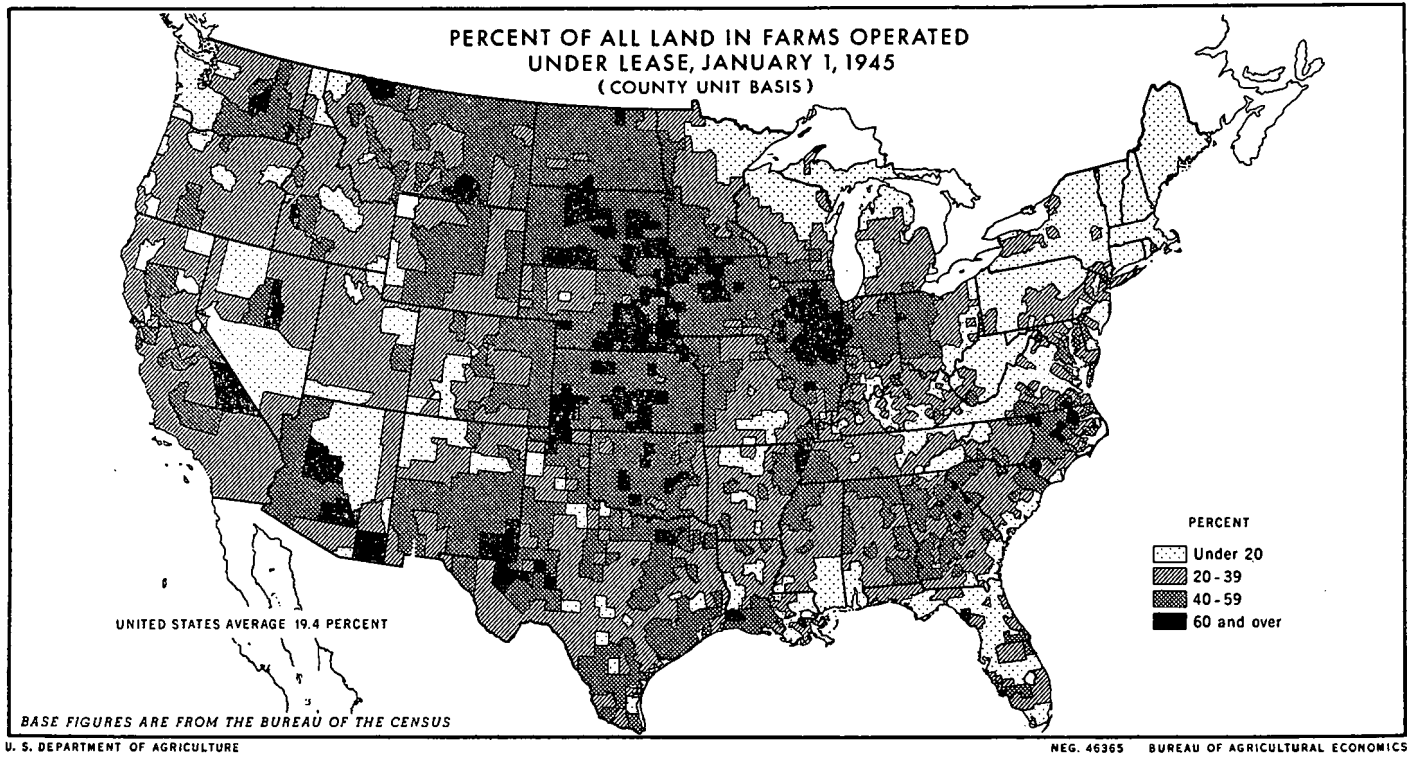

FIG. 11. The land operated under lease in 1945 was mostly heavily concentrated in the corn, wheat, and cotton areas; and also in some western counties, where grazing-lands are leased.

26 per cent. during the same period. If war-time farm output in the years 1942–4 had required the same costs per unit as prevailed in 1920–2, farm-operating expenses would have been about 3 billion dollars higher in the latter period. Or, stated the other way round, if cost reductions per unit of product had not taken place in the intervening years, farm-product prices would have needed to be 14 per cent. higher than they were to provide farm operators with the same net income as they received in 1942–4. Or, assuming the same gross farm income, the net farm income would have been 26 per cent. lower if there had been no cost reductions.

Labour requirements per unit of farm output were reduced about 36 per cent. from 1920–2 to 1942–4. It is estimated that about the same total hours of labour were required on farms in this country in 1945 as in 1939 despite a 22 per cent. increase in farm output.

So far the labour savings have come largely in the production of some of the staple crops. Small grains and corn and even the hay crops are now well mechanized. But labour savings in caring for livestock have not been nearly as significant as in field operations. In consequence, on typical Midwestern livestock farms about 75 per cent. of the total labour used on the farm is expended in direct work on livestock. The rapid progress of rural electrification in recent years should facilitate reduction of labour requirements in livestock production. Research directed towards potential cost reductions in livestock production, especially in the dairy enterprise, might point the way towards very significant savings in labour and other costs.

Cotton and tobacco are still produced largely with hand labour. Production of these crops is centred in our southern states, where technological advances have not been nearly as rapid as in other regions. Partly as a result of this lag in technology, production per worker is low; and a little over half of the total number of farm workers are employed in the thirteen southern states. Table IV shows gross production per worker by geographic divisions in 1944. It indicates that production per worker in 1944 was 61 per cent. of the national average in the three southern divisions, that workers in the south had only a little more than half as much cropland per worker, and that the investment in land and buildings, livestock, and equipment was about half as large as the average for the country, including the south.

If we make these comparisons for the southern states with the rest of the country, exclusive of the south, we find that production per worker in the southern states was only 43 per cent. of the average for

TABLE IV. *Gross Production per Worker, and Value of Land and Buildings, Livestock, and Equipment per Worker, by Census Geographic Divisions, 1944 and 1945*[1]

Census Geographic Division	*Production per worker, 1944 (U.S. average = 100)*	*Land and buildings per worker, 1945*[2]	*Livestock per worker, 1945*[2]	*Equipment per worker, 1945*[2]	*Total cropland per worker, 1944*
	%	*Dollars*	*Dollars*	*Dollars*	*Acres*
West north-central	168	7,668	1,592	926	88·1
Pacific	152	8,748	826	623	33·8
Mountain	143	6,470	1,820	719	66·5
East north-central	131	7,175	1,184	863	43·3
Middle Atlantic	108	3,942	1,018	838	23·9
New England	96	3,960	745	529	15·6
Northern and western states	142	6,899	1,288	823	55·1
West south-central	71	3,433	616	320	33·4
South Atlantic	61	2,212	343	187	14·6
East south-central	51	1,923	351	177	16·1
Southern states	61	2,519	434	227	21·2
United States	100	4,622	844	513	37·4

[1] Production per worker in 1944 is used because that is the production year reported in the 1945 census.
[2] From the 1945 census of agriculture.

the other regions, and that cropland and capital investment per worker were only about one-third as large as for the rest of the country.

These figures indicate that if it were possible by mechanization and other technological advances to increase production per worker in the south to the level of the rest of the country, the average production per worker would be stepped up tremendously. And fewer workers would be needed on farms in the United States. The significance of such a change can be illustrated by indicating that if production per worker in the south had averaged as high as for the rest of the country it would have required only about 70 per cent. as many workers to produce the total output of that year as were actually employed, and the gross production per worker would have been 42 per cent. higher.

It is fully recognized that there are many obstacles to achieving as high a production per worker in the south as the present average for the rest of the country. Such a change could not come rapidly, and a quick transition might not even be desirable because of certain social problems that would be involved. But there is no doubt that progress in that direction is highly desirable. Some of the changes that will bring it about are already under way. The percentage increase in the number of tractors on farms from 1940 to 1945 in the three southern regions was about double the average for the entire country. The mechanical cotton-picker, the mechanical chopper, the flame cultivator, and other labour-saving machines also are being adapted for southern farms.

These advances are likely to result in larger farms and fewer workers, but much greater output per worker, which should also bring larger real returns to the remaining farm-workers. Mechanization in the south would have progressed much more rapidly in the war years if an adequate supply of suitable farm machinery had been available. Additional labour would then have been released for war work, and the transition to higher farm production per worker would have been much further forward.

If mechanization of the south can take place in a period of industrial prosperity when other employment opportunities are available for workers no longer needed in farming, the transition will be relatively easy. But if part of the change is made in a period of unemployment, the stress and strain of labour displacement will be much greater. And farm-labourers who have been displaced by labour-saving machines or other technological advances will find their situation worsened—at least temporarily.

Our next consideration is the effect of technological advances on the incomes of farm-operators who own the land they operate. The farmers who first adopt cost-reducing improvements are in a position to retain all of the gain until or unless the improvement results in marketing a larger volume of product and this in turn reduces market prices. In periods such as the present food emergency there is a ready market for all the food that can be produced. In this situation farmers tend to hold all the gains from cost reduction. But in the inter-war years food-supplies were pressing heavily on market outlets. And under those conditions part of the gains are shifted to other groups. Not all improvements result in increased output. For example, a more efficient method of harvesting hay may save labour in haying without resulting in the production of more hay. The entire gain from such an improvement is likely to be held by farmers who adopt the practice. If some producers cannot adopt it they will operate at a disadvantage in comparison with those who benefit by adoption, but the actual level of their incomes will not be affected.

Most improvements, however, do have a tendency to increase output. For example, use of more commercial fertilizer results in higher yields per acre. Such an improvement can be said to be *land-saving* in its effect. Substitution of tractor power for animal power releases land formerly used for producing feed for work stock and is also land-saving but in a somewhat different sense. Land-saving improvements also tend to be labour-saving because less labour is required per unit of product as more is produced per acre. Some improvements, however, are *labour-saving* without also resulting in larger output. The hay-harvesting example is one of these. But even though such labour-saving improvements do not increase output directly they do release time that can be spent on other enterprises and this might indirectly result in larger output. On family farms it may mean pressure to increase the size of the farm in acres or to build up more labour-intensive enterprises such as dairy or poultry.

Improvements can be said to be *capital-saving* in their effects when they actually result in less use of capital for a given volume of production. If a new and more efficient corn-picker can be bought at a lower first cost than the machine it replaces, capital is saved on the first investment in the machine. If the outlay for operating expenses also is lower it is capital-saving in current operation as well as in the original outlay. Most improvements in farming have had a tendency to require both a larger total capital investment and larger current outlays on family farms, but this does not necessarily mean more capital for the same operation. It can mean less capital per unit of

product, provided the new machine or technique is adopted on a scale that constitutes a good fit on the farm on which it is used. Frequently, however, purchase of a tractor and associated equipment has resulted in a high overhead investment in machinery for the size of farm; and since use of power machinery enables each worker to do more work the effect is pressure to increase the size of the farm either in acres or by shifting to more intensive enterprises.

Thus, although only the land-saving improvements have direct production-increasing effects, both the labour-saving and the capital-saving improvements have indirect tendencies to increase output. The larger volume of product going to market will have a price-depressing effect unless the demand for that particular product is increasing, as it has during the war emergency.

If farmers could count on gradually increasing market outlets for the products in which cost reductions are effected they would tend to hold the gains resulting from lower costs. Otherwise part of the gain will be shifted by lower prices. But even if the entire cost reduction is shifted in this way farmers might still benefit indirectly because more purchasing power would be available for other things —including other farm products.

The farmer who adopts improved practices, however, is protected against price repercussions both by lower costs per unit and by having a larger volume for sale. It is the farmers who cannot adopt improved practices and who still continue to produce the products affected who will find themselves seriously disadvantaged by the change. If such disadvantage prevails over a farming area and persists over a period of time it will tend to be reflected in lower land values in that area.

In areas where a cost-reducing improvement is adopted, the pressure to increase the size of farm will tend to push land values upward. The higher physical production per acre also means a higher land income expectancy unless the larger production is entirely offset by lower prices. The higher income can be used for the purchase of land and to service a loan based on higher land values. This, of course, means that part of the gain from technological advances will be translated into higher land costs to new purchasers. And this will tend to offset the reduction in other costs. Farmers again will have a high cost structure because of a larger investment in land. Thus, by bidding up the price of land, farmers as a group tend to lose what they otherwise would gain from improved practices. Farmers could retain this part of the gain from cost-reducing improvements if as a group they were willing to use their first income advantage to slacken the pace of farm work, to make

more leisure time available for the entire family, and to invest their increased earnings in education, health, farm, and home conveniences, and in maintenance of soil resources.

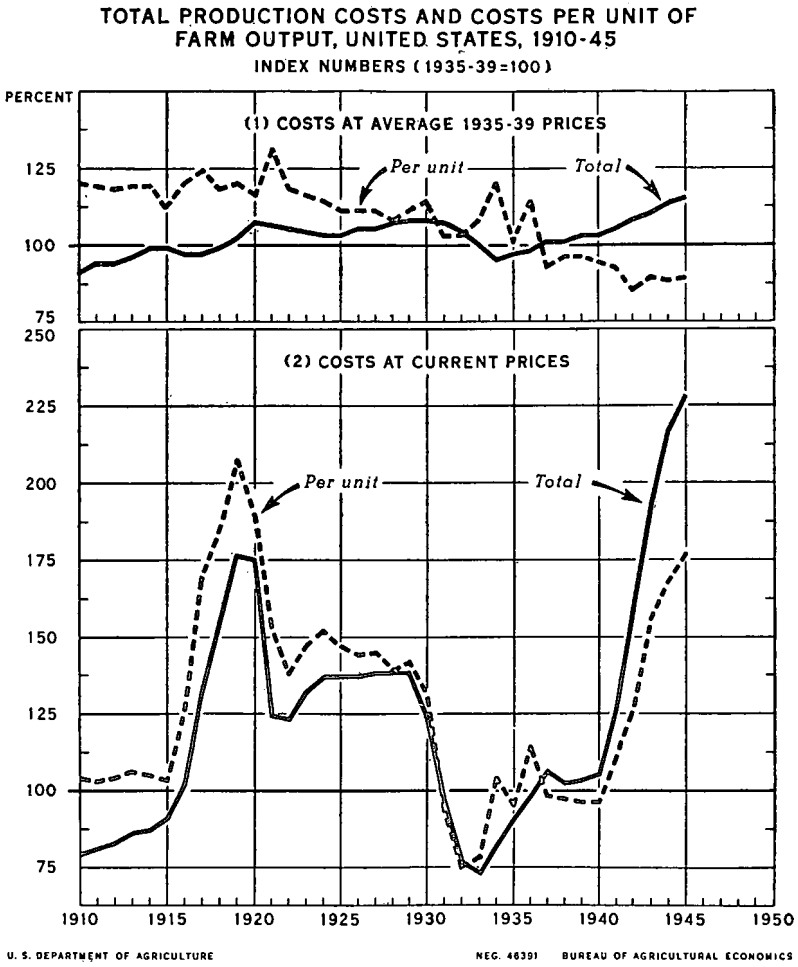

FIG. 12. The trend of costs per unit of farm output is downward when measured in terms of average 1935–9 prices; but in terms of current prices costs per unit have risen a great deal since the beginning of the Second World War.

Cost-reducing improvements not only tend towards larger scale of operations on family farms; they also tend to make the business of farming more complex. These improvements, therefore, are *management-consuming* in their effects. This does not necessarily mean that

more management is needed per unit of product; but more is required per farm, and it takes a higher grade of managerial ability for successful operation of the size of farm that can be handled by a farm family.

The farmer who possesses managerial ability of a high order will be able to combine improved practices in a larger business to obtain a much higher income for himself and his family. On the other hand, the farmer who possesses only limited managerial ability may have to continue operating a smaller farm on which he cannot take full advantage of the new improvements. This tends towards greater disparity in incomes between farmers of high and low managerial ability.

Technological changes also have another management-consuming effect. They increase the proportion of costs that are cash outlays—for power, machinery maintenance, fertilizers, hybrid seed, &c. Farmers therefore become more vulnerable to price changes or to crop failure. More management is required to cope successfully with these problems. Some technological advances, such as drought-resistant varieties of seed, tend to reduce this vulnerability by reducing the physical hazards. But on balance, as farming has become more commercialized, the risks from low prices or production losses have increased.

The higher capital investment needed to operate a family farm efficiently tends to restrict the opportunity for owner-operatorship. The war-time increase in land values will accentuate this tendency if we experience a period of lower farm-prices. The total investment required for land, equipment, and livestock on Corn Belt farms to-day is about twice as large as before the war.

If we consider the management-consuming effects of improvements along with the higher capital investment that is needed for the operation of the larger farms equipped with mechanical power, we can readily see that commercial farming in the United States has become a business that cannot be readily entered by all the young men growing up on farms; and that only those who possess better-than-average managerial ability are likely to make a financial success of the undertaking. Young men without special aptitude and training for the job will tend to have a harder time getting a foothold as farm-operators. Many will have to seek other occupations or become farm-labourers.

SUMMARY OF PROSPECTIVE CHANGES

The following is a short summary of the changes and the problems that seem to be in prospect for the years ahead.

1. *Technological advances will continue.* In fact, mechanization is likely to be accelerated during the next several years. But as mechanical power supplants more and more of the animal power now on farms the effect on output of the release of land for marketable products will slow down and eventually tend to disappear. Other technological advances can be expected to continue, although their effect on production may not be as great as during the war years because that change represented adoption of developments over several years which had been dammed up by the forces of drought and depression.

2. *The total volume of production is likely to increase over a period of years.* With allowance for average weather conditions we can expect a higher total volume of production at least under conditions of relative prosperity, but the increase will come at a much slower rate than during the war years. And it should be recognized that at present production levels there is not a great deal of elasticity in the total volume of output over a period as short as from one to three years.

3. *Use of improved techniques will result in more efficient lower-cost farming.* This will mean a much higher output per worker engaged in full-time farming. If larger markets are available over a period of years it will also mean larger net incomes per worker and per farm family, although part of the gains is likely to be shifted to other groups in the form of lower prices. Farmers can retain a large part of the benefits from cost-reducing improvements by refraining from capitalizing these gains into higher land values.

4. *Fewer workers will be needed in full-time farming.* This points to the need for non-farm-work opportunities for those who will no longer find employment in farming; also the need for training part of our farm youth for non-agricultural employment.

5. *The trend towards more part-time farms and rural homes is likely to continue.* This desirable trend can be accelerated by development of sound lending policies for these units. There is also the possibility of extending farm-management assistance to those without farming experience who desire to establish homes in the country.

6. *Although the number of small full-time farms is likely to decrease, they will still constitute an important group in American agriculture.* Nearly half of the total number of farms counted by the census are now in that group. Many small farms furnish a comfortable living for the farm family. And some operators of small farms can adopt a sufficient number of improved practices to maintain their income position. But the gap is likely to widen between the efficiently-operated fairly large farm and the small farm that cannot readily adopt cost-reducing

methods. Small farms located in poor land areas will experience the greatest disadvantage unless these areas are given special attention by public agencies. The fact that low-income farming in these areas has persisted over a period of years through agricultural prosperity as well as in depression is evidence of the need for special attention if existing maladjustments are to be corrected.

7. *Family farms of middle-scale and larger size are likely to become larger and somewhat fewer in number.* As they become more mechanized and as many of them shift towards more livestock there will be need for investment of more capital in relation to land and labour.

8. *There is likely to be some increase in the number of large-scale commercial farms.* They are not likely, however, to constitute more than a small percentage of the total number of farms. The family farm seems likely to remain as the prevailing business unit in the agriculture of the United States. There is no convincing evidence of economy of scale that will tend to push agriculture rapidly in the direction of large-scale farming, but we need some basic studies of the competitive position of family farms in the different farming areas.

9. *Changes in farm tenure will be subject to opposing forces.* There is likely to be a further increase in owner-operatorship under conditions of prosperity, but the high land-values that now prevail will act as a deterrent to this trend. And young men who go heavily into debt to purchase farms will be burdened with high fixed charges if less favourable economic conditions are encountered.

10. *Commercial farming in the United States will become a more complex business as farms become larger and as more and more technological improvements are adopted.* This means that adequate training and managerial ability of a high order will be needed for successful operation of efficient family farms. But there are likely to be many people with rather limited resources and capacity who will still find their best income opportunities in full-time farming. They will need special types of assistance if they are to earn a comfortable living on farms. Serious study will need to be given to the desirability of maintaining a continuous array of all sizes and types of farms to provide farm living and work opportunities for people with different backgrounds, abilities, and interests.

In reply to questions:

In reply to Mr. Shenoy: There are some statistics on the extent of subsistence farming in America available for 1940 from the censuses of agriculture. They have not been completed yet for 1945. There is a census monograph from 1940 that gives indication of the percentage

of the gross value of production that is consumed in the home. We do have some fairly concentrated areas of subsistence farming. The area between the Cotton Belt and the Corn Belt and dairy areas of the north has quite a concentration of subsistence farming, and all through the Appalachian highlands. There are also some areas in New Mexico and some in the 'cut-over' areas of the Lake states.

Dr. Lee has asked what are we going to do with the farmers that are displaced by technical improvements? In times like these, of course, we do not need to worry very much. When industrial production is high, employment is high, and there are employment opportunities in non-farm work, we do not have to worry a great deal. But still some of the workers that will be displaced will not have adequate training and skill for non-farm work. Historically we have had periods of unemployment and periods of fairly full employment. But displacement has not been much of a problem over a period of years because our economy has been expanding. Some workers have been temporarily disadvantaged, but actually I think to a large extent mechanization has come in periods when farmers thought there was a labour shortage, because workers had already found other employment. There is one exception to that, the period of the middle 1930s. Tractors came in, and workers were displaced who could not find work elsewhere. That situation became especially acute in some of our southern states.

Dr. Klatt asked: What will be the effect of the Marshall Plan, and what is the attitude of the American farmers towards the Marshall Plan? My feeling is that they are not yet well informed about the Marshall Plan. I think to the extent that they know and realize the world situation they are for the objectives of the Marshall Plan. And I should say this, that knowledge with respect to the world situation is very much better than it was after the last war. There has been a tremendous improvement in the realization of world conditions and that we are living in a world from which we cannot isolate ourselves. I do not know that I can go any farther than that. Farmers are impressed with the need for markets for some of our export crops and the fact that recovery of the rest of the world is an important factor in that.

Mr. Dinsdale's question was: What is the relationship between the decrease in the horse and mule population and the increase in the human population? Of course, our human population has increased. We have had quite an upward spurt in the war period, as some other countries have had. The downward trend in horse and mule numbers has released crop-lands for the production of food and fibre for the market, and it has enabled us to feed a larger population

and maintain exports. It has not been the only factor, as I have tried to bring out, but it has been the most important one.

Mr. Dinsdale also asked me if I could confirm the statement that the cropland released by the reduction of horses and mules is just about twice the rate of increase in the United States population. I think I can state that there has been about a 25–30 per cent. increase in population since 1920. The release of cropland has been about 55 million acres, and we have about 370 million acres of cropland. The amount released is about 15 per cent. Our population has increased proportionately more than that.

Dr. Coke's question was: Does the increase in the number of part-time farmers include those who are producing fruit and vegetables? Yes, they are included. Farms of all types are included in the different size groups. Sometimes our census is a little incomplete, but they are all supposed to be included. Now there has been an increase in fruit and vegetable production—a tremendous increase—that is one of our enterprises that has been going up, and going up very rapidly, because there has been a tremendous increase in *per capita* consumption of fruit and vegetables. I think it is correct to say that the increases have been greater in the *commercial* vegetable- and fruit-producing areas, where they are produced on larger acreages than under 10 acres. But there are some truck farms included among the farms under 10 acres. The point that I tried to make was that the increase in small farms was mostly accounted for by the growth in part-time farming. I was in our north Ohio area recently, and travelling over about a 50-mile area between Cleveland and Akron it seemed to me that the whole area had been taken over by part-time farming.

Dr. Baptist asked if a decrease in markets for cereals would oblige us to shift towards animal products. Well, of course, our farmers have shifted towards more and more animal products, because they were more profitable, and part of that came during the inter-war years; the farmers who were producing cash grain and fibre crops were the worst off financially. The depression after the last war hit them the hardest. That is quite true. Now during the war years our upward spurt was first in animal products and in oil crops. There was a tremendous increase in oil crops, and in beans and peas, but also in the animal products. Then later, as the post-war emergency demand for food developed, we have given much more attention to wheat production. Our wheat production is tremendously expanded at the present time compared with immediate pre-war years.