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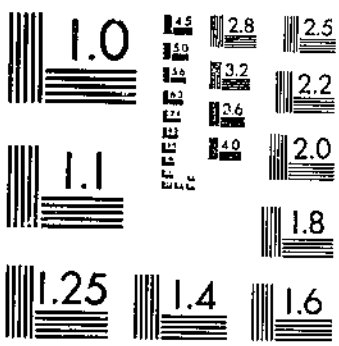

MICROCOPY RESOLUTION TEST CHART
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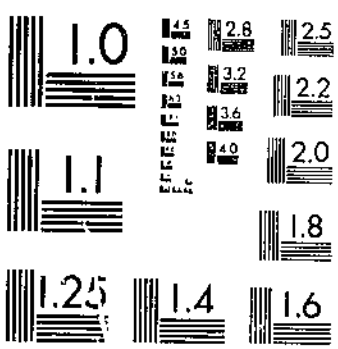

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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Oil Crops in American Farming[1]

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CONTENTS

INTRODUCTION

Events of recent years have shown the significance of the oil crops for food, feed, and industrial uses. Several special studies have been made on soybeans, flaxseed, cotton, and peanuts, to throw light on the production possibilities for each crop. The full meaning of these separate studies cannot be appraised until their

[1] Received for publication June 23, 1947. The work represented by this publication was supported by the Bankhead-Jones special research fund.

findings are brought together and related to a general summary of the potential supplies and market outlets for all fats and oils and their related products (*12, 18*), [2], [3], [4].

The purpose of the present report is to make a brief general appraisal of the position of oil crops for the period ahead. Market-outlet possibilities, domestic-production prospects, and world production and trade are considered. Against this background the outlook for the oil crops will be seen in better perspective.

Great interest now centers on the oil crops in the United States because of the phenomenal wartime increases in the output of soybeans, flaxseed, and peanuts. Growers of these crops want to know about the long-time outlook. Will the high wartime demand be followed by low peacetime demand for fats and oils? Will interregional or international competition adversely affect prices of the oil crops? Will market outlets expand?

Among the important issues that will affect the answers to such questions are the probable course of production of tropical oil and marine oil, the future level of cotton production in the United States, the speed at which European reconstruction takes place, and the success attained in restoring international trade on a sound basis.

On the consumption side of the problem much depends on the maintenance of a reasonable degree of prosperity. The use of oils in paints and varnishes and for other industrial purposes is especially related to an active economy. With so many variables involved any conclusions will include elements of judgment and conjecture, but increased understanding will grow as judgment is exercised.

Before venturing an appraisal of coming events it is desirable to indicate the time in the future which is to be kept in mind and to suggest a general framework which a reasonably prudent individual might use in forming judgments.

Our reference point in time is a year about 1955. This is far enough ahead of most of the transition from war to peace to avoid certain immediate problems but near enough to give a firm foundation to projections of trends in population, technology, and consumption habits.

With the year 1955 we can associate a United States population estimate of 150 million people or about 16 percent more than in 1935–39.[5]

Estimates of European population, important in relation to world demand for fats and oils, rest on a less definite basis be-

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[2] Italic numbers in parentheses refer to Literature Cited, page 53.

[3] "Adjustments Toward an Efficient Agriculture in the South." Nine Southern Experiment Stations and the United States Department of Agriculture cooperating. 71 pp. 1947. (Processed.)

[4] United States Department of Agriculture. "Peanuts in Southern Agriculture." 112 pp. 1947. (Processed.)

[5] See "Forecasts of the Population of the United States, by Age and Sex: 1945–2000." United States Department of Commerce, Population—Special Reports Series P–46, No. 7, Sept. 15, 1946. (Processed.)

cause of the war. We shall assume, however, that the population in Europe, excluding Russia, will have increased only moderately over 1935–39 figures. The populations of the Soviet Union, India, and other continental areas, on the other hand, will have increased at somewhat greater rates than in the United States (*14*).

For the domestic economy it is assumed that 1955 will represent a period of relative business prosperity with a sustained level of employment. A comparable international situation will be understood to prevail, with world trade making definite progress and with the European situation growing better although not fully recovered. Good working relationships are anticipated among countries.

These guiding landmarks for time, population, and prosperity may be sufficient to provide a favorable economic climate for the continued development of agricultural technology and the extension of market outlets for both oil and competing products. Other assumptions may be noted later but these are the major ones within which the general appraisal will be made.

WORLD SITUATION [1]

In this section the broad world trends for the major oil crops are reviewed briefly and some tentative estimates for 1955 are presented as general landmarks to go with the other background materials. Obviously, forecasts in the international field are subject to a large degree of uncertainty. However, it is essential to consider the probable quantities of fats and oils that may enter international trade under specified conditions.

The world's total supply of fats and oils is obtained from animal, marine, and vegetable sources. This supply consists of two parts. The part with which we are mainly concerned here is made up of the fats and oils consumed in "visible" form for food and industrial purposes. Another and perhaps increasing part is consumed in "invisible" form in milk, pork, cereals, nuts, and in other ways. The increasing proportion of the animal fats used in this fashion has contributed to the growing importance of the vegetable oils in the visible group.

Another problem is incompleteness of international data on the production of fats and oils. Much of the production of fats and oils for local use is only imperfectly accounted for in the available estimates. This imperfect accounting is probably most significant for animal fats but it also affects such oil crops as coconuts, palm oil, and palm kernels. Consequently, estimates of the world production of fats and oils are somewhat more generalized than are the estimates of world trade.

World production and net export of vegetable oils have been moving sharply upward since before the first world war (table 1). Although the data for earlier years may not be complete, it ap-

[1] The analysis in this section is taken mainly from Peter L. Hansen, "World Trends in Major Oil Crops." Bur. Agr. Econ., 62 pp., 1946. (Processed.)

pears that the net export of major vegetable oils by all primary producing countries almost doubled from 1909–13 to 1934–38, and production increased more than 50 percent. In a large measure this expansion has been the result of improved transportation, advances in technology, and the use of new practices in production. The rapid growth of population, particularly in industrialized countries and rising levels of living, have been compelling reasons for the increased import of vegetable oils by these consuming areas.

The world production of animal fats may have increased fully as much as vegetable oils during the same period if account is taken of "invisible" production and of the unreported production for local consumption. The total quantity of animal fats in world trade is much less, however. The three principal animal fats (butter, lard, and tallow) which entered world-trade channels in 1934–38 averaged less than a million metric tons as compared with more than 4 million metric tons of vegetable oils and oil seeds in terms of oil.

TABLE 1.—*Average annual world production and net export of major vegetable oil crops, in terms of oil, selected 5-year periods*

Period	Production	Net export [1]	Period	Production	Net export [1]
	Million metric tons	*Million metric tons*		*Million metric tons*	*Million metric tons*
1909–13	10.4	2.3	1929–33	14.3	3.8
1924–28	12.9	3.4	1934–38	15.0	4.2

[1] Net export is obtained by adding net exports of the individual oils from each country.

Estimates based on data published by International Institute of Agriculture, Rome.

Marine oils entering world trade annually in 1934–38 came to an average of 650 thousand metric tons. This average was about four times that of 1909–13. The increase was mainly due to the larger production of whale oil which, with the coming of hydrogenation, became an important food oil. Production of whale oil is expected to remain well below the 1934–38 average for the next decade as a result of international agreements to protect the whales. Because the greater part of the world trade is in the vegetable oils and because this part appears still to be expanding our main interest centers on the oil crops.

World's Major Oil Crops

The thirteen oil crops shown in table 2 accounted for approximately 90 percent of all of the vegetable-oil crops produced in the world during the 5-year period 1934–38. Production and net export are shown in terms of oil equivalent in this table. The first seven oil crops make up more than nine-tenths of the exports listed. Three of the seven are definitely tropical; two more—cottonseed and peanuts—are warm-climate crops and only soybeans and flaxseed are crops of the cool temperate zone.

TABLE 2.—*Average annual production and net export of the major oil crops, in terms of oil, during 1934–38*

Oil crop	Production	Net export
	1,000 metric tons	*1,000 metric tons*
Coconuts	[1] 2,675	1,060
Peanuts	2,370	681
Flaxseed	1,166	644
Palm	[1] 745	445
Soybeans	1,791	404
Palm kernel	[1] 365	310
Cottonseed	2,009	163
Olive	869	121
Tung	[1] 120	78
Sesame	693	68
Rapeseed and mustard seed	1,345	41
Sunflower	589	29
Babassu	[1] 25	12

[1] Estimate built up from partial information.

Estimates based on data published by International Institute of Agriculture, Rome.

Coconuts and peanuts contribute heavily to both the total volume of world production and the net export of vegetable oil crops. The oil equivalent of the coconut and peanut products that entered the world market annually during 1934–38 exceeded the total quantity of animal fats and marine oils that entered world trade. Cottonseed, soybeans, and rapeseed have a large volume of production but contribute relatively less to world trade because they are consumed principally in the countries where they are produced. Drying oils, such as flaxseed and tung, which in some countries are produced mostly for export, are examples of oil crops with a relatively large proportion of total production entering world trade.

Trends in World Production

As we have seen, the total world production of the vegetable oil crops increased rapidly during the 30 years before World War II. The increase has been most spectacular for the tropical oil crops, the most important of which are coconuts, palm oil, and palm kernels (fig. 1). The upward trend in world production is likely to continue except perhaps for soybeans and sunflower seed. Both of these two crops expanded tremendously during the war and are not likely to return to the prewar level of production. Export may remain higher than prewar.

The introduction of the plantation system of production in the Netherlands Indies together with the use of an improved variety of the oil palm more than anything else were responsible for the large increase in production of tropical oils. After the system had proved successful in producing palm oil in Sumatra it was used in Malaya, and later coconut plantations were established in the Philippines. Only a small part of the world's production of coconuts originates in the plantations but the plantation system has proved itself, so far as production is concerned, for the yields

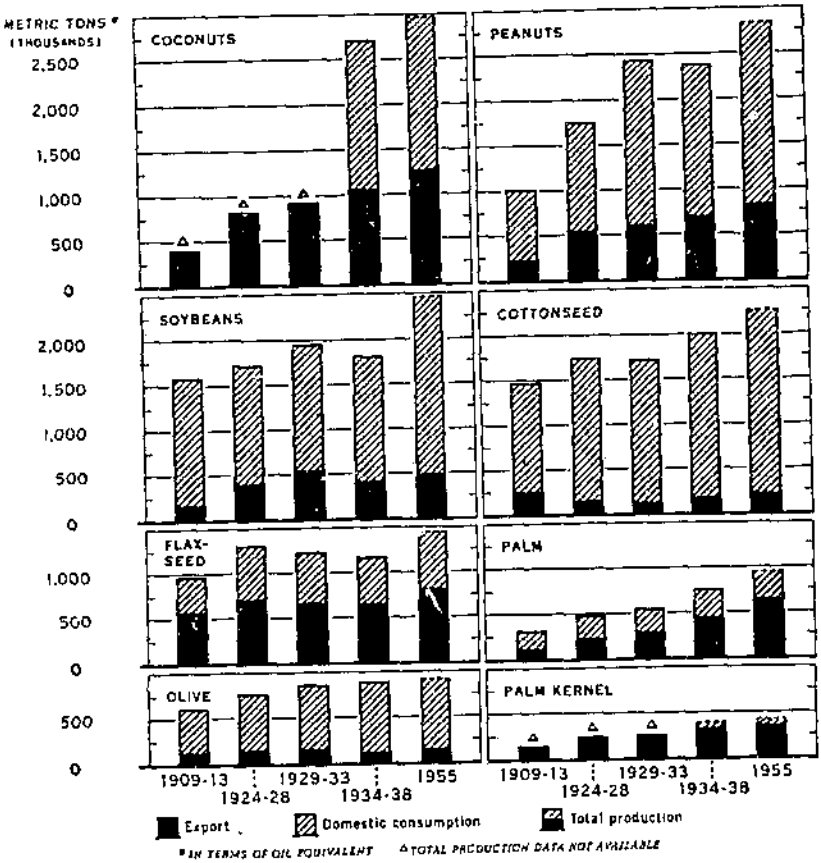

FIGURE 1.—Average production and net export of eight major oil crops from leading producing countries for selected periods and an estimate for a year about 1955 (this is not a forecast).

are reported to be about twice as high as those obtained in small groves.

In the production of palm oil and palm kernels in Sumatra a high degree of efficiency has been reached. Before the war plantations averaged about 3,000 acres and each had its own oil-pressing plant and small-gage railroad for transportation within the plantation.

An idea of the production possibilities of palm oil may be had from the data on yields reported from Sumatra by agricultural authorities in the Netherlands Indies (*8*). The average yields of palm oil per hectare from 1931 to 1936 were as follows:

Year:	*Kilograms per hectare*[1]
1931	1,780
1932	2,060
1933	2,232
1934	2,393
1935	2,369
1936	2,581

[1] 1 hectare = 2.471 acres. 1 kilogram = 2.2046 pounds.

A later report shows that the production in 1940 had increased to 3,233 kilograms per hectare, or 2,880 pounds per acre. This compares with less than 200 pounds of soybean oil per acre in the United States. If the most modern methods and increased quantities of fertilizer are used even higher yields may possibly be obtained in the future.

Table 3 shows the percentage of the total estimated production that was exported from the producing countries during the periods indicated. The data on production have been estimated on the basis of partial information for these three oil crops and it appears from the percentages of net exports that these estimates are reasonable. During the entire 30 years most of the additional production of palm oil and palm kernels coming both from Congo and the Netherlands Indies went into the export market.

In addition, there have been large increases in the production of some of the temperate-zone oil crops. Peanuts, cottonseed, and—during the war—soybeans, sunflower seed, and castor beans have greatly increased in volume produced. These field crops differ from tree crops as, for example, the oil palm and the coconut palm, in that they produce in the same year they are planted, while tree crops do not begin to yield until they are from 5 to 10 years old. However, some of the field crops have other characteristics. Cottonseed is a byproduct of cotton fiber production and the quantity produced depends on the output of cotton rather than upon the price of vegetable oils. Peanuts in the United States are not produced for oil but are used as roasted peanuts, peanut butter, in candy, and for other purposes. Usually only low-grade peanuts or peanuts that are diverted under Government programs are crushed for oil. The soybean, formerly grown mainly in China and Manchuria, is now one of the major crops in the Corn Belt. Production was expanded during the war mainly because of the shortage of fats and oils among the United Nations. Soybeans have proved so successful that they will continue to be produced on a large scale partly because of the high value of the protein meal obtained.

TABLE 3.—*Average annual world production and net export of coconuts, palm kernels, and palm oil in terms of oil, selected 5-year periods and 1955* [1]

Period or year	Production	Net export	Exports as a percentage of production
	1,000 metric tons	*1,000 metric tons*	*Percent*
1909–13	2,250	654	29
1924–28	2,975	1,258	42
1929–33	3,289	1,442	44
1934–38	3,785	1,815	48
1955	4,330	2,251	52

[1] Estimates based on data published by the International Institute of Agriculture, Rome.

Protein meal obtained from most oil crops when they are crushed for oil is highly esteemed for feeding purposes in the production of several animal food products. The most impor

tant of these is milk. Curiously enough the use of protein meals makes for greater intensity in the production of butter and other animal fats which are directly competitive with vegetable oils. Even more significant in many countries that have intensive agricultural production is the fact that the rich manure resulting from the use of these protein meals adds to the fertility of the soil and thus, because of the heavier crops, contributes to an even greater output of dairy and other animal products.

The proportion of oil meal for each pound of oil obtained from several of the major oil crops and the value of the oil meal obtained with each dollar of oil value are shown in table 4, under certain assumed values. The actual values for both oils and oil meals will of course vary from one another as well as from the assumed relationships. Economically, there is considerable difference in the flexibility of production of the individual oil crops as the relative prices vary. Those that are byproducts such as cottonseed oil have little flexibility. Other oil crops like flaxseed are very much more affected by price relationships and the production is much more elastic.

TABLE 4.—*Average yields of oil and oil meal per hundred pounds of oil-bearing material, ratio of oil meal to oil, and value of oil meal per dollar of oil, United States*

Oil-bearing material	Yield per hundred pounds		Oil meal per pound of oil	Value of oil meal per dollar of oil[1]
	Oil	Oil meal		
	Pounds	*Pounds*	*Pounds*	*Dollars*
Cottonseed	15.5	45.0	2.90	0.58
Flaxseed	34.0	64.0	1.88	.38
Peanuts	29.0	43.6	1.50	.30
Soybeans	15.0	80.0	5.33	1.07
Sesame seed	47.0	48.0	1.02	.20
Copra	63.0	35.0	.56	.11
Palm kernels	45.0	53.0	1.18	.24
Babassu kernels	63.0	35.0	.56	.11
Sunflower seed	25.0	73.0	2.92	.58

[1] Based on an assumed value of oil per pound five times that of oil meal.

The tree oil crops which require heavy investments and several years before any production can be expected, are relatively less affected by prices over the short run. Over a long period oil production from the tree crops would be affected by price changes, because new plantings would be influenced. Usually there is no alternative crop which can be expanded if the oil palm or the cocoanut palm becomes temporarily unprofitable. In contrast with the annual oil crops the tree oil crops have an advantage during periods of low prices because of lower operating costs. Reduction in acreage and production may be almost immediate for the annual crops. In the case of the tree crops, production is also reduced but that is usually because not all the nuts are collected when prices are low.

Production of the temperate-zone oil crops may still be expanded very considerably during the coming years. Much of this increase is likely to come about as a result of improved practices,

particularly the use of more commercial fertilizer, and of improved varieties rather than as a result of increases in the total acreage grown. On the other hand, acreages of tropical oil crops can be expanded very materially. Large areas are said to be available for such expansion in the outer islands of the Netherlands Indies and in certain parts of the Philippine Republic. Promising areas for expansion are also reported to be available in New Guinea and several of the more-or-less undeveloped island groups in Oceania, as the Solomons and the Bismarck Archipelago. Among the factors preventing the development of these areas has been the lack of an adequate and dependable labor force.

Lack of labor has included managers and other supervisory and scientifically trained personnel in many cases. Few were willing to undergo the isolated life in these areas. Today, with modern transportation by airplanes and by fast diesel-driven motor ships, it seems probable that such personnel will be easier to find. With recently discovered methods of eliminating mosquitoes and other insects with DDT and similar materials, malaria and yellow fever can be controlled in many areas hitherto considered virtually unfit for human beings. It is too early to attempt to estimate what this will mean from the standpoint of new production of vegetable oils and new areas for settlement of people from densely populated countries. In any event, little of this is likely to develop before 1955.

In considering the chances for expanded production of the tropical vegetable-oil crops it must not be forgotten that it is still possible to increase production greatly in the old producing areas. Although modern methods of production often are available and may be easily put into use, it is extremely difficult to get small-scale native growers to adopt them. Education is the great need in many of the world's most backward countries. Any advance in the adoption of modern techniques is likely to be slow and difficult until acceptable systems of elementary education have been established.

There seems little doubt that the world production of vegetable-oil crops will follow an upward trend as in the past. There is a possibility that some of the producing areas may have less vegetable oils available for export than during prewar years if the expected improvement in the local levels of living develops. Similar experiences in some parts of Europe, where the home population has obtained a greater voice in the production and use of food supplies, indicate that greater quantities will be consumed at home and less will be available for export. This could be true to an even greater extent in Asia where foreign companies have often decided whether particular products would be exported, apparently without much regard to local need and with only the location of the most remunerative markets in mind.

According to a recent estimate the total production of fats and oils in the world in 1945 was 20 percent below the 1935–39 average.[7]

[7] Office of Foreign Agricultural Relations. Fats and Oils: World Production and Trade, Foreign Agriculture Report No. 11, p. 2, August 1946. (Processed.)

Production of vegetable-oil crops was only about 10 percent below prewar, mainly because of the expansion of soybeans in the United States and sunflower seed in Argentina. Animal fats were 15 percent and marine oils 50 percent below prewar levels.

Already some of the losses in production during the war have been restored, but few have yet ventured to estimate how long it will be before prewar levels are reached. Some informed "guesses" on the part of unofficial British sources suggest that world production of fats and oils will be back to about prewar levels by 1949, although the world net export might be only 80 to 90 percent of prewar because of increased consumption in the areas of production. Other British sources are more pessimistic.

Trends in World Trade

The trends in net export for the major oil crops and the leading exporting countries are shown in tables 5 and 6. These data represent the combined net exports of individual oil crops from most of the exporting countries. The totals are the net quantities of each oil crop in terms of oil equivalent which entered world trade from individual countries. A country that has an exportable surplus of a single oil crop may therefore show up in this tabulation with a net export although the same country may have a large net import of several other oil crops. Thus a net export is shown for Europe, although this continent is a deficit area and normally imports tremendous quantities of oil and oil seeds. The net export shown consists mainly of olive oil exported from Mediterranean countries to other countries in Europe and in the western hemisphere. The small surpluses of oils traded between countries make up a part of world trade and represent a net export of the individual oils.

An analysis of the increase in the net export of the major vegetable oils since 1909–13 reveals the striking growth in volume of the tropical tree oils (table 5). The quantity of this type of vegetable oil entering the world markets annually was about three times as great during 1934–38 as in 1909–13.

Of the total increase in the volume of vegetable oils entering world trade from the primary producing countries during this period, the coconut and palm-tree oils accounted for 61 percent or 1,173 thousand of the 1,924 thousand metric tons total increase. The dominant position of these oils in world trade during coming years seems likely to increase rather than decline. During this same period the net export of the other food oils rose by 50 percent while the drying oils rose by 44 percent. The fact that the tropical tree oils are important both for food and for nonfood purposes is partly responsible for the rapid growth in the volume of these oils in international trade. Another influential factor is the comparative advantage and low cost of the tropical oils as compared with the oils produced in the temperate zones. This advantage has become particularly marked since the introduction of the plantation system of production.

Some of the annual oil crops have also shown large increases. The average quantity of peanuts in terms of oil which entered the international market in 1934–38 was more than three times that

TABLE 5.—*Average net export of major vegetable oil crops in terms of oil from leading producing countries, selected 5-year periods and 1955*

Crop	1909–13	1924–28	1929–33	1934–38	1955 [1]
	1,000 metric tons	*1,000 metric tons*	*1,000 metric tons*	*1,000 metric tons*	*1,000 metric tons*
Food:					
Olive	116	138	147	121	140
Cottonseed	247	142	114	162	200
Soybean	156	398	534	404	480
Peanut	221	546	612	681	[2] 805
Sesame	132	48	80	68	75
Rapeseed and mustard seed	132	80	53	41	60
Sunflower	14	22	37	29	45
Coconut	386	802	913	1,060	[3] 1,260
Palm	121	215	279	445	654
Palm kernel	147	241	250	310	337
Babassu	.....	12	6	12	30
Total	1,672	2,644	3,025	3,333	4,086
Nonfood:					
Flaxseed	568	700	659	644	780
Tung	[3] 32	55	62	78	100
Perilla	.....	4	11	52	30
Castor bean	.....	.....	70	88	100
Total	600	759	802	862	1,010
Grand total	2,272	3,403	3,827	4,195	5,096

[1] Tentative estimate—not a forecast.
[2] If new plans for increased peanut production in East Africa are carried out net exports in 1955 may be increased about 200,000 tons over this figure. (See Foreign Crops and Markets, Mar. 3, 1947, Vol. 54, No. 9.)
[3] Export data for 1914 to 1918.

Estimates based mainly on data published by the International Institute of Agriculture, Rome.

of 1909–13. Substantial increases have taken place also for soybeans and for babassu kernels and castor beans, although the last two still remain insignificant in foreign trade. The decline in the quantities of cottonseed, sesame, and rape and mustard seed entering world trade during the last 30 years has been mentioned. These oil crops are grown mostly in deficit areas where the demand for vegetable oils is high and little is left for export.

Olive oil, one of the oldest known vegetable oils, has maintained almost the same quantity of net exports for most of the period covered. In part, this has been possible because of the import of peanut and other oils by the countries that produce the olives. Tung oil, also known for a long time, has shown a steadily increasing export during this period, practically all from China. In coming years, other countries may also export this oil.

The two major surplus-producing areas for vegetable oils are in the Far East and in Africa. Data on net export by countries are less adequate than the statistics by crops and are not dependable for the period 1909–13. However, the importance of Southeast Asia and Central and West Africa may be indicated by the

TABLE 6.—*Average net export of major vegetable oil crops in terms of oil by leading countries for selected periods and 1955* [1] *(approximate distribution by countries of origin)*

Country	1924–28	1929–33	1934–38	1955 [2]
	1,000 metric tons	*1,000 metric tons*	*1,000 metric tons*	*1,000 metric tons*
Europe (includes U. S. S. R.)	130	147	110	135
Africa				
French West and Equatorial Africa	138	173	244	299
French Cameroons	20	24	27	29
Algeria and Tunisia [3]	30	47	45	50
Nigeria	287	322	383	399
British East Africa [4]	23	27	40	[5] 50
Belgian Congo	50	67	97	205
Egypt	57	52	63	60
Others	173	163	163	156
Total	828	875	1,062	1,248
Asia				
China	215	291	187	245
Manchuria	357	494	513	504
Korea	28	26	19	2
India [6]	371	379	366	460
Ceylon	99	98	106	110
Netherlands East Indies	278	371	525	641
Malaya [7]	70	84	131	213
Philippines	239	277	344	450
Japan	7	9	16	10
Oceania [8]	60	67	76	160
Asia Minor [9]	8	15	13	16
Others	70	68	81	35
Total	1,802	2,179	2,377	2,846
North America				
United States	24	15	1	35
Canada	28	2		
Mexico	3			
Central America	8	10	5	
Total	63	27	6	35
South America				
Total	571	599	640	832
Grand total [10]	3,403	3,827	4,195	5,096

[1] Net exports in this report are the totals of the net exports for the individual oil crops from each country.
[2] Tentative estimate—not a forecast.
[3] Includes French Morocco.
[4] Uganda, Tanganyika, and Anglo-Egyptian Sudan.
[5] A new project to increase production of peanuts by some 230,000 tons in terms of oil has not been included.
[6] Includes French India.
[7] Some re-export included.
[8] Solomon and Fiji Islands and New Guinea.
[9] Turkey, Syria, Lebanon, and Palestine.
[10] Does not include a few countries with small production. Derived mainly from data published by the International Institute of Agriculture, Rome.

increase in net export from 1924–28 to 1934–38 (fig. 2). The total increase during this period was 792 thousand metric tons of which more than 80 percent came from these two broad areas. About

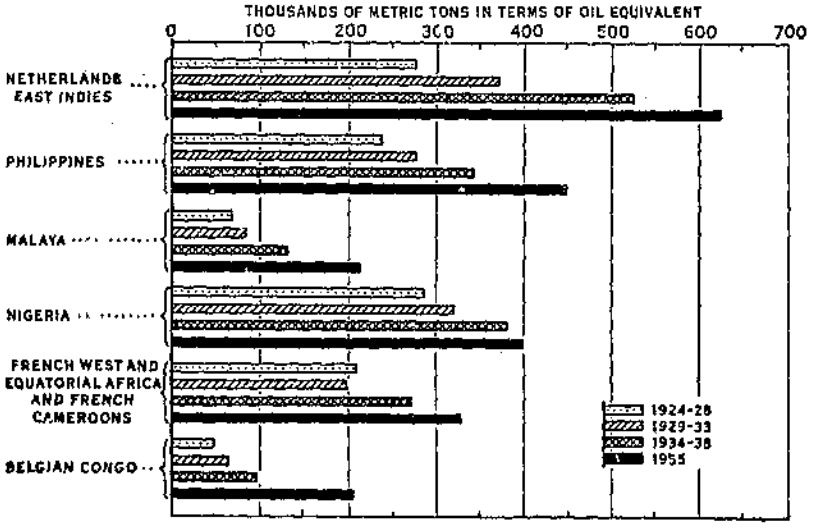

FIGURE 2.—Average net export of the major oil crops from six leading areas for selected periods and an estimate for a year about 1955 (this is not a forecast).

one-third originated in the British, French, and Belgian colonies in West and Central Africa and two-thirds came from Malaya, Oceania, the Netherlands Indies, and the Philippines (table 6). These two areas together supplied nearly one-half of the major vegetable oils entering world trade during the period 1934–38 and provided most of the increase in international competition in vegetable oils during the last prewar decade. The production possibilities indicate that these two areas will continue to play a dominant role because of the comparative advantage of the tropical vegetable oils over other sources. Additional production, particularly of peanuts, may be possible in East Africa where recent reports indicate that large undeveloped areas may be brought under cultivation during the next 5 to 10 years.

Looking at the world from the continental point of view, Europe and North America are deficit producing continents in regard to fats and oils, whereas Asia, Africa, and South America are surplus producing continents. Of the world net export, almost one-third went to North America in the years just before the war. Vegetable-oil production in both Europe and North America is very large but was insufficient during prewar years to supply the huge domestic demand in these areas.

Net import of fats and oils into Europe in the future may be considerably larger than prewar trends would indicate because of the abandonment of extreme measures for self-sufficiency and perhaps the greater participation of the Soviet Union in world trade.

The heavily subsidized domestic oil-crop production in several of the European nations encouraged whaling, and increased the use of substitute materials for fats and oils. Before World War II the Soviet Union was unable to meet its requirements for fats and oils because of its restricted foreign purchasing power. This situation may change as the Soviet economy recovers and enough material is produced to provide a surplus of raw materials and finished goods to trade with other countries.

In some other countries like China and India, an improvement in the general level of living would provide large markets for food of many kinds, including vegetable oils. Such a development would in turn place these countries in the deficit column even though, from the standpoint of nutrition, they have actually been in this situation for a long time.

Outlook for 1955

The need for fats and oils in the world is likely to continue to rise with the growth of world population and the expected increase in industrialization in the Soviet Union, India, China, and other countries with undeveloped resources. Much of this potential need may not come until well after 1955. But with growing requirements, additional sources of fats and oils are likely to be needed. Fortunately, the outlook for increased supplies of fats and oils in the world markets appears to be excellent. With a few years for reconstruction work on the coconut and palm oil plantations in the Far East, fairly adequate supplies of vegetable oils will be available in the world.

Supplies may remain shorter during the next few years than was anticipated when hostilities ended in 1945. The quantity of vegetable oils available in world trade in 1946 was estimated to be only about 42 percent of the 1935–39 average.[8] It has been estimated that the total quantity of vegetable oils entering world trade even by 1949 will be below prewar.

Some oil crops have started an impressive comeback. The total export of copra from the Philippine Republic during 1946 in terms of oil exceeded 400 thousand metric tons. During 1947 the total shipments of copra and coconut oil in terms of oil from the Philippines are also expected to exceed the prewar (1935–39) average level of about 400 thousand metric tons.[9]

The total world production of soybeans and sunflower seed is probably above that of prewar years because of the wartime expansion in the United States and Argentina, respectively.[10] As only a small part of these crops is being exported this expansion so far has been of little significance to world trade. Even if Manchuria returns to its prewar position as an exporter of soybeans it

[8] Office of Foreign Agricultural Relations, Fats and Oils: World Production and Trade. Foreign Agricultural Report No. 11, p. 4. August 1946. (Processed.)

[9] Office of Foreign Agricultural Relations. Foreign Crops and Markets, Vol. 53, No. 17, p. 254 and Vol. 54, No. 21, p. 361.

[10] Office of Foreign Agricultural Relations reports production of soybeans in Manchuria in 1946 to be only about two-thirds of prewar. Foreign Crops and Markets, Vol. 53, No. 23, p. 348.

is possible that most of the available supplies will go to China and the Soviet Union.

The world production of several other oil crops has been recovering rapidly. For tung nuts and peanuts world production is close to prewar levels.[11] In both these cases production may not have changed much during the war, but because of lack of transportation facilities it was impossible to bring it to market channels.

Looking forward to the situation likely to exist in 1955, we may begin by assuming that production and trade will have returned to approximately normal conditions. The consumption of fats and oils will be higher than prewar because of the increased population and a higher level of living expected to be achieved not only in such countries as India and the Soviet Union, with expanding industrial economies, but also in many countries now having a low level of living but with unused or undeveloped resources. As these developments seem most likely to take place in some of the countries that now export considerable quantities of vegetable oils, it appears that the total world production of vegetable oils may expand somewhat more than the world net export. A preliminary estimate suggests that world total production may be from one-fourth to one-third higher, about 1955, than the average during 1934–38. In comparison, world net export would expand only by some 20 percent.

The largest expansion in production of vegetable oil crops would be likely to take place in those regions which are already among the principal producers of these commodities. Similarly, increases in net export would mainly take place in the leading export areas. The surplus-producing countries which hold an absolute or relative advantage in producing these crops would continue to provide the largest proportion of this export. Countries like India and China would contribute a relatively large part of the increased production but as a result of the even greater increase in consumption they would not furnish much of the increase in world net export. This is the principal explanation for the greater increase in production than in trade.

Among the individual oil crops the tropical oils—especially coconut, palm, and palm kernel oil—are likely to expand very rapidly and provide a large part of the imports needed by deficit areas. The tropical oil crops including babassu oil will probably increase both through expanding acreage and through higher yields per acre. They will be the world's chief guarantee of adequate supplies of vegetable oils for many years to come. The expansion may cause world overproduction during periods of unbalanced economic conditions, but the time required to expand this production seems to operate against the possibility of such surpluses before 1955, unless a severe world depression should occur.

The largest increase is anticipated in the production and net export of palm oil. An increase of at least 210,000 metric tons or almost one-third above the 1934–38 average may occur in the net

[11] Office of Foreign Agricultural Relations, Foreign Crops and Markets, Vol. 53, No. 24, p. 362.

export (table 5). The major part of this increase would come from new plantations established before the war in Malaya and in Belgian Congo. If improved machinery and methods should be introduced in Nigeria before 1955, the production and net export from this area may show a still greater increase.

Net export of coconut products in terms of oil may show an increase in 1955 over the prewar period of about 200,000 metric tons, but this would be only about 20 percent higher than the prewar net export of these commodities. As products of the coconut are more generally usable by the native population than those of the oil palm it is possible that the production may increase a great deal more, the difference being represented by the greater home consumption. The world production of coconut products is expected to reach and exceed prewar levels much sooner than palm and palm kernel oil.

The drying oils—tung, linseed, and others of lesser importance—are likely to reach new high levels of production stimulated by a world-wide demand for housing and industrial development. Although this development may be temporarily slowed down by economic conditions, it apparently will not have run its full course as early as 1955. Favorable prices for linseed oil could push the supplies in world trade in 1955 beyond the quantity tentatively estimated.

Among the annual oil crops, cottonseed oil may be expected to average somewhat higher in production by 1955 than in the immediate prewar years. Somewhat greater trade in this oil could take place with an easing in international trade restrictions.

World production of other oil crops—including peanuts, soybeans, sesame, rapeseed, and perhaps sunflower seed—does not seem likely to show any marked departure from previous trends. Somewhat greater quantities of peanuts and soybeans may enter international trade if favorable conditions prevail. Peanut exports will increase materially if the large peanut project in British East Africa fully materializes.

Finally, a word may be said about the possibilities of an overexpansion in the production of fats and oils which would lead to accumulation of surplus supplies and low prices, even in a world of fairly high prosperity and employment. There seems little reason for such a situation to develop if proper trade relations are established, based on the comparative advantage held by each area in the production of different commodities; nevertheless such overproduction could occur as it has from time to time in other individual commodities.

World Consumption Patterns

World consumption of fats and oils has increased steadily over the last 40 years, primarily because of the increasing rate of industrial progress in the more advanced western nations. Both food and nonfood uses have expanded greatly and the expansion is by no means ended.

The increased use of fats and oils for food is related to the higher level of living and the improvements in processing and

preparing fats and oils for convenient household use. The increased nonfood use of fats and oils is related to improved living standards and to increased industrialization. The expansion in use of soap, for example, may be ascribed partly to improved living standards and partly to increased use in industrial processes.

As the less developed countries become more industrialized and raise their levels of living we can expect a parallel expansion in food and nonfood uses of fats and oils. The expansion may not go so far in some countries as in others because of enduring differences in food habits and in standards of sanitation, but it will take the same direction.

Per capita consumption of food fats and oils appears to be higher in cool than in warm climates, although this may be caused mainly by other differences. Some fragmentary data indicate that food uses of fats and oils in higher income groups in the warmer climates are substantial.

Per capita food consumption of "visible" fats and oils is 50 pounds or more in the United States, Canada, Great Britain, and northern Europe. Less information is available concerning the "invisible" consumption of fats in milk, meat, and other foods, and this may be higher in some countries that have lower visible consumption.

The shift toward the use of relatively more vegetable oils and less animal fats has been going on since before World War I. Important discoveries in processing technology, making it possible to harden and refine the liquid oils, account for this shift. Margarine consumption in the United States increased from about 150 million pounds to more than 500 million pounds between 1913 and 1943.[12] Shortening consumption rose from 1,000 million pounds to about 1,300 million pounds in the same period. In Great Britain and northern Europe the consumption of vegetable fats more than doubled in the 30 years before World War II.

Comparatively little is known about the food habits of different classes of the European population, except that substantial differences in consumption of fats and oils are found. For example, lard and rye bread are used extensively by lower income groups on the continent.

MARKET OUTLETS FOR FATS AND OILS

The vegetable oils, like most of the animal fats, leave the farm as combination, or joint, products. For this reason a full review of the market outlets for oil crops embraces the consumption possibilities not only for fats and oils but also for oil meal, for cotton fiber, for the whole seeds, and for milk and meats. But as fats and oils form the common link among all the fat- and oil-bearing products they provide the most convenient point of departure in an examination of market outlets.

Trends in Domestic Use of Fats and Oils

Each fat or oil has special qualities which are desirable for certain purposes. Despite this differentiation the uses of each one

[12] Bur. Agr. Econ., Fats and Oils Situation, March–April 1946. (Processed.)

are flexible enough to span something of a range, and much overlapping and substitution have always been possible. Chemical genius and patient research have already greatly extended the areas of interchangeability so that for many purposes it is possible to think of fats and oils as a single cluster of closely related products. Much light can therefore be thrown on the problem by looking first at the over-all consumption of fats and oils in the United States.

For this purpose we turn to figure 3 which shows domestic disappearance of fats and oils from 1912 to 1946. A very marked rise in disappearance is apparent: Taking the 20-year period from 1920 to 1940, for example, the increase in round numbers was from 6 billion pounds to nearly 10 billion, or about two-thirds. Population increased about one-fourth in these 20 years and disappearance per capita about one-third.

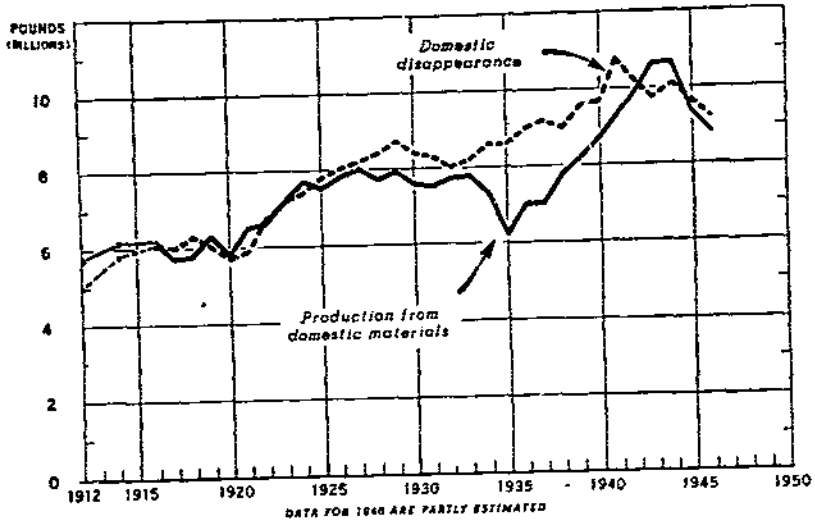

FIGURE 3.—Domestic production and disappearance of fats and oils, 1912–46.

Domestic production of fats and oils did not keep pace with this rapid rise in consumption. After some increase through the early 1920's, production leveled off, and then declined during the droughts and depression of the early 1930's. This was followed by a rapid recovery and a further sharp rise during World War II. The gap between domestic disappearance and domestic production was made up in the prewar years by imports, mainly of tropical oils.

Many economists have pointed out with increasing emphasis that a basic cause of unbalance in United States agriculture is the slackening in the rate of growth of demand for farm products just at the time when a veritable revolution in agricultural production technology is helping to increase the supplies of farm products more rapidly. Fats and oils as a group, with an expanding secular demand, seem to be an exception and there are reasons

for thinking that this favorable situation may continue for some time.

A basic reason may be that fats and oils are not used for food alone but for industrial purposes as well. Most farm products reach the consumers as food or fiber in forms which satisfy basic needs and which have rather inelastic demand schedules. Broadly speaking, most of these uses are not expanding very rapidly on a per capita basis. Some foods like potatoes and wheat are actually declining in per capita use.

In the 5-year period 1935-39, nearly one-third of the disappearance of fats and oils was for nonfood purposes. These uses have an upward trend in per capita use and show particular growth in

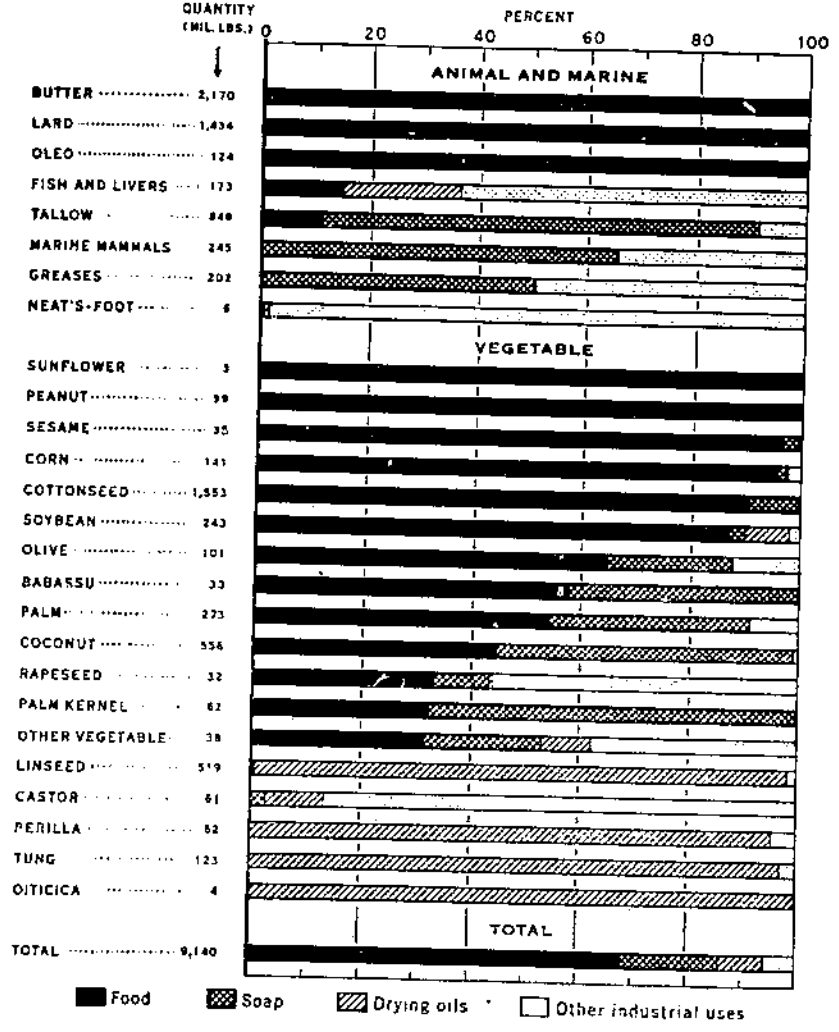

FIGURE 4.—Percentage distribution of fats and oils among four major uses, United States average 1935-39. (Factory consumption.)

periods of industrial expansion. The food uses of fats and oils have also shown some growth per capita but the level has remained fairly constant more recently except for the war period. Probable future increases in per capita food uses are distinctly limited by the expected dietary changes.

In presenting the over-all impression, one must remember that, beneath the surface, the situation differs considerably for individual sources of fats and oils. Cotton, for example, has faced difficult adjustments for reasons unrelated to fats and oils. Flaxseed was adversely affected by sharp decreases in the use of drying oils during the long period of relative inactivity in the building and construction industries. Soybeans had to pass through a pioneering stage. Lard faced a special surplus problem through the contraction of export markets before the war.

On the whole, however, the fats and oils have been in a relatively strong long-run position with reference to expanding consumption. The chief reservations about the outlook are found on the supply side and are related to the course of domestic production and the availability of imports from world supplies.

So much then for a first view of trends as a whole in the consumption of fats and oils. Before hazarding a forward estimate for total disappearance in 1955 it will be well to examine the separate outlets for fats and oils in more detail. A separation into food and nonfood uses is the first main division.

Some idea of the complexity of the problem of estimating future consumption of fats and oils and of determining the transferability of different fats and oils may be gained by examining figure 4 which shows the relative proportion of use of the major fats and oils going into food, soap, drying, and other industrial uses, in 1935-39. At one end of the range, butter is used entirely for food and at the other end are fats and oils used entirely for nonfood purposes. In between are many fats and oils that can be used in varying proportions for more than one purpose, depending on economic circumstances.

Domestic Market in Food Uses

Food uses accounted for about two-thirds of the total disappearance of fats and oils in the 5 years 1935–39. The distribution by types of food fats for the same period was approximately as follows:

	Percent
Butter	35
Lard	23
Shortening	24
Margarine	5
Other and undistributed	13
Total	100

The history of the per capita food consumption of fats and oils since 1920 shows a distinct rising tendency, although the greater part of this took place in the early 1920's and again just before wartime shortages operated to cut down supplies. The changes that may be expected to take place in the diet in the United States suggest that it may be difficult to obtain much further increase in

per capita intake of food fats once the current shortage is overcome. Alternative sources of energy values have been increasing incidental to general shifts in eating habits, and the increased consumption of "invisible" fats (in milk for example) may hold in check any great increase in consumption of the "visible" fats and oils. The average per capita disappearance for 1935-39 was 48.3 pounds. Although this rose to more than 50 pounds in 1940 and 1941, an estimate of 50 pounds per capita for 1955 is probably as high as should be expected.

Forward estimates of food fat consumption can be ventured on the basis of totals because of the relative inelasticity of consumption and the apparent lack of response in total consumption to variations in the availability of individual food fats. The ease with which one food fat can be substituted for another is so great that consumers readily make substitutions as long as the total supply of food fats is adequate.

Butter represented about one-third of the total food fats just before the war. Variations in butter consumption per capita in the past have been moderate (except for war shortages) and have been caused almost entirely by fluctuations in supply resulting from the changing consumption of other dairy products. This is likely to be the case in the future and, because of the wartime shift in the direction of greater utilization of fluid milk and other whole milk products, it is possible that supplies of butter will not be sufficient to permit a full return to prewar per capita consumption levels for several years.

If this situation prevails, margarine will make up a slightly larger proportion of the edible fats. Many people have become accustomed to it during the war and this may bring about a change rather quickly if supply conditions warrant. If supplies of both butter and margarine are plentiful, butter will be used, but the spread between butter and margarine prices may become less than formerly. As indicated later, total butter consumption is likely to be greater than prewar even with some increase in the proportion of margarine and other fats.

Relative quantities of lard and shortening used by the housewives in this country will be determined considerably by the size of the hog crop and by the availability of foreign outlets for lard and perhaps soybeans. The war experience in the use of whatever cooking fats were available may have increased the flexibility of household substitution. To this extent the domestic position of lard may have been improved.

As the long-run dietary factors do not suggest much possibility of expanding per capita consumption of food fats, the chief factor operating to extend the market is increased population. With an estimated population of 150 million in the United States in 1955 and with a per capita consumption of 50 pounds, this would mean 7.5 billion pounds of fats and oils for food purposes, annually. The increase in consumption is roughly 1¼ billion pounds or 20 percent more than prewar, most of which is accounted for by the increase in population.

Domestic Market in Nonfood Uses

The nonfood or industrial uses of fats and oils comprised nearly one-third of the domestic disappearance in 1935–39. They were distributed as follows:

	Percent
Soap	56
Paints and varnishes	22
Linoleum and oilcloth	3
Printing inks	1
Other industrial	18
Total	100

The character of the demand for each of these uses differs, but they all appear to share in an upward trend in per capita consumption. Data are less adequate for the earlier years than for later years, but the increase in per capita disappearance for all nonfood uses from 1920 to 1940 appears to have been more than 60 percent. Merely extending this trend to 1955 and allowing for the increased population would give a disappearance estimate of approximately 4.5 billion pounds of fats and oils in nonfood uses.

Such an extension should be based on a more detailed bill of particulars than for food fats and oils, however. The aggregate demand for food uses is the summation of a group of closely related demands. They are so closely interrelated that a change in one category of food fats is likely to be accompanied by an opposite change in another. The nonfood uses on the other hand are a group of diverse and rather unrelated demands. A change in the demand for one use has no very direct relationship to the quantities going into another use, except as each is influenced by the general state of the economy.

Soap.—The demand for soap is relatively inelastic in the short run, although prosperity and depression appear to influence the rate of consumption (fig. 5). The outstanding fact is the marked upward trend in the consumption of soap over the long run. This trend seems to be associated with the increasing spread of appliances available to the average citizen in the modern kitchen, bathroom, and laundry. Doubtless the increased use of prepared soaps in chips, powder, and liquid form also contributes to increased consumption.

As stated by Alsberg and Taylor in 1928: "The increased use of soap and cleansing materials is one of the characteristics of our times. Indeed, the per capita use of saponaceous materials is almost an index of civilization, considered either from the sanitary, the hygienic, or the esthetic point of view" (*1*). At that time fats and oils used in soap manufacture came to about 1.6 billion pounds. Recent record levels have been considerably above 2 billion pounds.

A competing factor is the increased use of other types of detergents—dry cleaners, hard water softeners, petroleum soaps, and so on. Although these agents are increasing in use especially in industry and by commercial laundries and cleaners and were estimated at some 300 million pounds in 1946, they do not appear to have deflected the upward trend in the use of soap (*6*). Fats

and oils used in the manufacture of soap rose to even higher levels during the war although still probably not fully meeting the total demand. An estimate for 1955 of 2.4 billion pounds of fats and oils for soap manufacture would seem to be reasonable, still allowing for some increase in the use of other detergents. This level was almost reached both in 1941 and in 1944; with a larger population in 1955 it could easily be exceeded.

Paints and varnishes.—Paints and varnishes represent the next largest market outlet for fats and oils for nonfood purposes. These protective coverings are used in original construction and maintenance in the building industries and in the manufacture of a wide variety of durable industrial products for both consumers and producers. Despite the development of many other types of protective finishes by the chemical industries, the demand for drying oils continues at a very high and expanding level. This demand is so widely based that it has a close relation to general prosperity and industrial production as a whole.

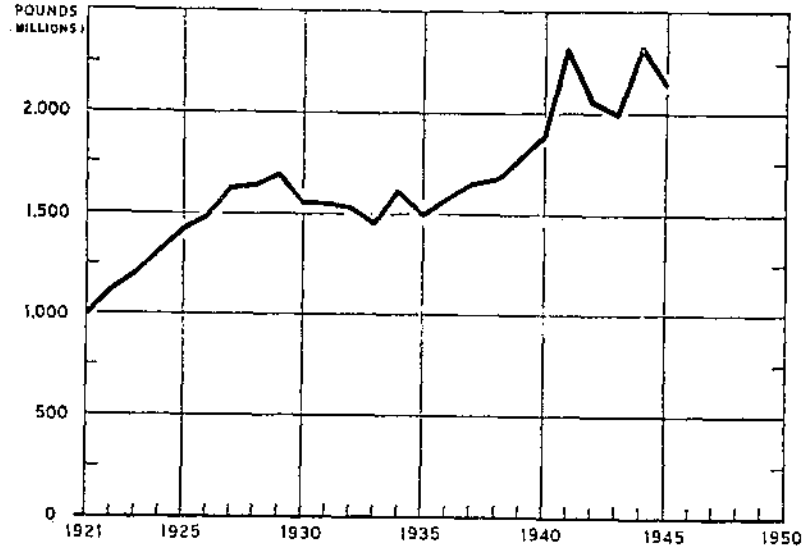

FIGURE 5.—Fats and oils used in the manufacture of soaps, United States, 1920–45.

Just before the war it was estimated that about 60 percent of the demand for paints and varnishes was in the construction and building trades and 40 percent in the industrial products field. With more building activity these proportions probably would be modified. The substitution of other types of finishes may proceed more rapidly in the industrial products field also.

A peculiarity of the demand for paints and varnishes is the fact that such a large proportion of the consumption is for maintenance. In 1940 about three-fourths of the paint and varnish used on buildings was for maintenance. It may be assumed that increased building activity would be accompanied by increased maintenance

outlay. In the manufacturing uses, maintenance is a very small item, compared with finishes for new products.

The prospect for a considerably higher level of both industrial and building activity, in the 1950's, makes any extension of the prewar trend an inadequate method of estimating the 1955 use of fats and oils for paints and varnishes.

As a broad guide one of the postwar estimates of the annual number of new urban residential housing units might be used. The survey published by the Twentieth Century Fund in 1944 may serve for this purpose (*21*). This estimate of 1,236 thousand nonfarm residential units annually compares with prewar building rates as follows:

	Thousand units
1925 building peak	935
1923–27—5-year average	872
1935–39—5-year prewar	359
1941—early war year	715
1950–55—postwar	1,236

This may also be compared with the 1946 national housing program for 1,200 thousand units of which about three-fifths were actually under way at the end of August 1946 (*11*).

Measured against the nonfarm population, 1,236 thousand units in 1955 would be a level of construction not greatly different from that of the middle 1920's. Against the present and prospective backlog of unsatisfied demand this would probably be a conservative annual rate of construction.

In addition to the nonfarm residential, there are the farm residential and the commercial construction which may be expected to expand somewhat in accordance with the same rates under the assumed conditions. This volume of construction would be about 3½ times that of 1935-39, but of course consumption of paints and varnishes would not increase correspondingly. Maintenance demand would expand at a lesser rate and allowance for alternative materials must be made, especially in commercial construction.

Among industrial products, the introduction of alternative coatings and finishes has already gone far and may be expected to operate more widely than in building. Assembly-line and factory-processing methods lend themselves more readily to innovations and can be more easily controlled, but this is an area in which much expansion may occur if the economy is healthy. A great deal of transfer from oil to synthetic finishes could take place and still leave room for substantial increases in oil paints and varnishes.

As the existing capital plant of durable goods—in the hands of industrial concerns, the Government, and private citizens—grows larger the maintenance demand for protective coverings tends to grow progressively. This is an important element of stability.

Out of the preceding considerations a careful judgment might place the consumption of fats and oils in paints and varnishes at about 1,100 million pounds in 1955.

Linoleum and oilcloth.—Linoleum and oilcloth used only 3 percent of the fats and oils going into nonfood uses before the war,

but the trend seems to be sharply upward. Because of the close association of these materials with building activity and maintenance the preceding discussion is pertinent. Linoleum has provided a great variety of satisfactory and relatively inexpensive floor coverings for replacing wood and other substances that were formerly more economical. Recent developments in plastics, pressed wood, and other materials promise to increase the competition in the whole field. A tentative estimate for 1955, after these factors are examined, is that 120 million pounds of drying oils may be used in linoleum and oilcloth.

Printing inks.—Printing inks use a relatively small volume of drying oils, accounting for about 1 percent of the total nonfood uses of fats and oils. When the paper shortages of the emergency period have been overcome, there is likely to be considerable expansion in the publication of books, magazines, papers, and other printed matter. The trend in the use of printing inks is therefore definitely upward over the longer run.

Other industrial uses.—The prewar volume of fats and oils employed in the category of other industrial uses was almost as much as that employed in paints and varnishes. Many different and unlike uses are grouped here because good historical data are not available on a separate basis. Oils used in foundry cores, in tinplating, in rubber making, and in many manufacturing operations are included. Many of these uses take place in the manufacturing process and the oils do not enter the final article as specific ingredients.

Some of the older uses under this heading are declining in volume; for example harness dressings, illuminants, candles, pharmaceuticals, and certain lubricants. The outstanding characteristic of the whole group of other industrial uses, however, is its tendency for continued expansion.

Total nonfood uses.—Most of the nonfood uses for fats and oils represent but a small element in the expense involved in the production of the final products of which they are a part. House paint, printing ink, core oil, furniture finishes, and floor coverings illustrate the point. The demand for fats and oils in these uses is consequently rather inelastic in the short run, but it is so widely spaced through industry as to be quickly affected by changes in the over-all level of industrial production.

The more important circumstance for the long run is the tendency toward expansion in the nonfood uses on a per capita basis. An estimate of the total nonfood uses for 1955 was made on the basis of the foregoing considerations by examining each category separately and then adding the separate estimates. The total is approximately 4.5 billion pounds of fats and oils (table 7). On a per capita basis this comes to 30 pounds as compared with 22.4 pounds for 1935-39, or an increase of one-third.

Food and Nonfood Outlets Combined

The sum of the preceding estimates for both food and nonfood uses of fats and oils for 1955 comes to about 12 billion pounds. This quantity may be used in the United States if industrial production and employment remain at reasonably high levels and if

the domestic and imported supplies of fats and oils are sufficient. It is not a forecast. As compared with the average per capita disappearance for 1935-39 this represents an increase of about 12 percent, which seems conservative in view of the differences between the two situations.

TABLE 7.—*Use of fats and oils for nonfood purposes, average 1935–39, 1943, 1944 and estimated 1955*

Use	1935-39	1943	1944	Estimated 1955
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*
Soap	1,572	1,853	2,109	2,400
Paints and varnishes	641	691	668	1,100
Linoleum and oilcloth	95	74	83	120
Printing inks	22	22	30	30
Other industrial	519	904	950	850
Total nonfood	2,849	3,544	3,840	4,500

All data except the 1955 estimates come from The Fats and Oils Situation, May–June 1946, table 9, and August 1946, table 6. Bureau of Agricultural Economics.

During the war the disappearance of fats and oils for food and nonfood purposes never exceeded the peak reached in 1941 when nearly 11 billion pounds were used. In the war years that followed, the use for food purposes was held down and the total stayed but slightly higher than the 1935–39 average, while the nonfood consumption increased more (table 8). Because of increased buying power much greater quantities could have been used had they been available. Nevertheless it is probably true that the use of fats and oils for food and some nonfood purposes came near to the saturation point in 1941. The per capita disappearance in 1955, with a somewhat higher level of living, is therefore likely to be only moderately higher.

TABLE 8.—*Total use of fats and oils in food and nonfood products, United States, average 1935–39, annually 1940–45, and estimated 1955*

Period or year	Food [1]	Nonfood	Total
	Million pounds	*Million pounds*	*Million pounds*
1935–39	6,230	2,849	9,079
1940	6,638	3,089	9,727
1941	6,883	3,998	10,881
1942	6,667	3,619	10,286
1943	6,423	3,544	9,967
1944 [2]	6,417	3,840	10,257
1945 [2]	6,096	3,682	9,778
1955	7,500	4,500	12,000

[1] Butter included at actual weight.
[2] Preliminary.

All data except the 1955 estimates come from The Fats and Oils Situation, Aug. 1946, table 6. Bureau of Agricultural Economics.

These tentative projections may be placed in perspective by referring to the cautious estimates made by economists of the Food Research Institute nearly 20 years ago when they were examining the same question. They concluded "that the trend of per capita consumption of fats and oils is probably on the

increase, owing largely to increasing consumption of soap. Probably per capita consumption for food is somewhat decreasing. In industry aside from soap, per capita use is possibly decreasing because of substitution of petroleum and synthetic products" (*1*). These conclusions were too conservative in the light of events that have taken place since then, and consumption has increased more than they anticipated, especially in the case of food uses. Today, the statistical evidence is less fragmentary than in 1928 and with the additional experience it is possible to look ahead with somewhat more assurance.

Role of Technology in Widening the Market

Chemical technology in the processing of fats and oils is more significant than in the case of most agricultural products. There is a long history of advancing knowledge in this field and new developments are constantly occurring over a wide front. These affect the utilization of fats and oils for food, soap, paints, and scores of industrial uses. Some changes in technology tend to widen the market by opening entirely new uses, and others by increasing the range of substitution between different fats and oils.

Hydrogenation was the outstanding development among several associated advances during the last generation. This is a process for hardening liquid oils into solid fats by the addition of hydrogen to the unsaturated fatty acids. This relatively simple transformation brought about a revolutionary change in utilization, because it became possible to use normally liquid vegetable and marine oils on a larger scale for making margarine and shortening. The international results are of interest. European markets for American lard were affected as the European nations turned more toward margarine and shortening made from whale oil and vegetable oil. The tariff policy of the United States in the 1930's and foreign exchange difficulties were also factors.

Along with hydrogenation there were other substantial advances in the technology of refining and processing fats and oils and in preparing them for use in the food industries. Similarly in the nonfood and industrial fields a continued stream of new technology has greatly modified the production of soaps, paints, and other industrial products. In Germany, synthetic fats have been developed from coal and considerable quantities were manufactured during the war because of a shortage of natural fats.

Recent research in this country has resulted in several processes for producing high-quality drying oils and for improving food fats and oils by preventing the development of undesirable flavors. A dehydrating process applied to castor oil made it possible to use this oil in the drying industries during wartime. The development of suitable antioxidants for lard now makes possible the production of bland shortenings from animal fats. Initial commercial success with this process indicates that it may be a notable further step affecting the interchangeability of fats.

Enormous expansion in soybean production in the United States has directed much attention to the processing methods for soybean oil. Soybean oil may be said to be rather intermediate between food oils and drying oils in its characteristics. Hence research

efforts have been devoted to improving its qualities in either direction. Lack of stability in flavor has been one of the chief difficulties in using soybean oil in food preparations. Considerable progress has been made in overcoming this problem. The wartime findings of German chemists, recently made available, are especially significant as they indicate a more effective and efficient method of eliminating and preventing the development of objectionable flavors.

The Northern Regional Research Laboratory of the U. S. Department of Agriculture has been testing several methods for attaining improved drying qualities. One process has been discovered which gives a marked increase in drying ability. This consists in heating soybean oil in the presence of a special preparation of nickel and carbon (*7*).

Perhaps the most promising new process is that of "fractionation." By this is meant the physical separation of an oil into two or more fractions or segments, each differing in chemical structure. In the case of soybean oil one fraction would be a superior food oil and the other a better drying oil. Pioneering research on this problem has been carried out by the Northern Regional Research Laboratory and by several industrial laboratories. At least one commercial concern has been building a plant to put a new liquid-liquid process of fractionation into commercial operation (*17*). It is described as a liquid extraction and cold fractionation process for the refining of edible and industrial oils. The process as applied to soybean oil yields about 68.5 percent food oil, 30 percent paint oil, and 1.5 percent other products. Apparently the costs of processing are not excessive, although a period of operation will be necessary to establish this point fully. Another concern has developed a different fractionation process and has had a plant in operation for several years.

Several other processes for separating soybean and other oils have been studied and have been tried with some success. These include fractional distillation, crystallization, selective absorption, and molecular distillation. Distillation procedures are at present the most important of the fractionation processes and are used commercially by several companies. With improvements likely to follow, fractionation may become as striking a landmark in the history of fats and oils technology as hydrogenation. Like hydrogenation, fractionation operates to increase the range of substitution possible between different fats and oils.

Development of fatty derivatives for industrial use is another field of current chemical research that holds promise. The fatty acids that are found in the vegetable oils are an important source of raw materials for manufacturing detergents, emulsifiers, resins, plasticizers, synthetic drying oils, and many other products.

Several new products were derived from soybean oil and produced commercially during the war. One of these, a rubber substitute, Norepol, was produced on a large scale for a short time and was satisfactory under commercial conditions. Another material, Norelac, a type of resin, was developed for use in protective coatings and for coating papers to make them waterproof and is now commercially marketed.

MARKET OUTLETS FOR OIL MEALS

The principal outlet for the oil meals from the oil crops is in livestock feed. Small quantities are used for human food and for various industrial purposes, but probably more than 90 percent of the total disappearance is for animal feed use. Attention centers on the prospects for feed, because even with a considerable expansion in other outlets, the demand for feed is likely to be the most influential factor affecting the average price of oil meals a decade hence.

Feed Uses of Oil Meals

Oil meals belong to a class of concentrates known as high-protein feeds. The total supply of these feeds has experienced a remarkable expansion in the last 20 years, increasing more than 50 percent. The supply per animal unit has increased about 25 percent (table 9). This expansion has been largely in the oil meals and especially in soybean meal. A primary reason has been the greatly increased production of soybeans and the fact that soybeans carry a higher percentage of oil meal than the other oil crops.

The most rapid increase in the supply of high-protein feeds came during the war when livestock production was expanding and demand for feed was very strong. Much more of the high-protein feed would have been fed had it been available.

Another stimulant in the demand for oil meals, even before the war, has been the growth of the mixed-feed industry. The manufacturers of mixed feeds find it profitable to utilize high-protein feeds in their prepared mixtures.

Protein-feed deficit.—Most livestock producers have never fed enough protein to meet "recommended allowances" set up by livestock specialists and based on the nutritional needs of animals. This has long been recognized, but few attempts have been made to measure the extent of the protein "deficit." Such a measurement was recently attempted by Jennings in connection with the present study.[13]

Jennings started with the feeding year 1941-42 as a base and compared the protein content of the rations actually fed each class of livestock, State by State, with recommended allowances of protein. He found a protein deficit for all classes of livestock for the country as a whole. As an over-all average, about 10 percent more digestible protein should have been fed to supply the recommended quantities for good animal nutrition. To supply the deficit would have required about 23 percent more protein for hogs, 14 percent more for poultry, 12 percent more for beef cattle, and 5 percent more for dairy cattle in terms of the percentages needed above the digestible protein in all feeds except pasture (fig. 6).

Computations for the feeding years since 1941-42 show approximately the same over-all deficit in protein despite some changes in the make-up of the protein supply. If oil meals were used to make up the deficit it would require about 80 percent more than was actually fed in recent years.

[13] Jennings, R. D. "The Deficit in Protein for Livestock." U. S. Bur. Agr. Econ., 28 pp., 1946. (Processed.)

TABLE 9.—*Estimated use for feed of specified high-protein feeds, United States, 1926–46* [1]

Year beginning October 1	Cake and meal						Gluten feed and meal	Animal protein [2]	Total high protein feeds	Use per animal unit [3]
	Soybean	Cotton seed	Peanut	Copra	Linseed	Total				
	1,000 tons	*1,000 tons*	*1,000 tons*	*1,000 tons*	*1,000 tons*	*1,000 tons*	*1,000 tons*	*1,000 tons*	*1,000 tons*	*Pounds*
1926	32	2,207	10	87	427	2,763	645	2,745	6,153	103.0
1927	61	1,571	22	96	493	2,243	703	2,655	5,601	91.8
1928	91	1,894	18	110	439	2,552	702	2,757	6,011	98.9
1929	114	2,015	35	110	368	2,642	647	2,760	6,049	99.7
1930	123	1,821	18	96	334	2,392	541	2,828	5,761	94.4
1931	133	1,741	14	75	204	2,167	511	2,877	5,555	89.5
1932	113	1,680	17	95	202	2,107	590	2,965	5,662	89.4
1933	99	1,701	11	117	142	2,070	577	2,890	5,537	93.7
1934	267	1,524	47	113	202	2,153	444	2,768	5,365	105.3
1935	614	1,718	48	128	263	2,771	588	2,843	6,202	113.0
1936	531	2,099	67	137	273	3,107	511	2,804	6,422	115.5
1937	719	2,333	50	117	177	3,396	545	2,809	6,750	110.7
1938	1,020	2,013	75	129	202	3,439	567	2,883	6,889	110.0
1939	1,276	1,762	38	179	393	3,648	614	2,926	7,188	107.9
1940	1,491	1,862	137	175	740	4,405	759	3,090	8,254	121.9
1941	1,785	1,821	71	71	891	4,639	964	2,947	8,550	114.2
1942	3,074	2,077	109	34	794	6,088	927	2,884	9,899	115.0
1943	3,323	1,790	111	33	998	6,255	842	2,186	9,283	108.4
1944	3,627	1,982	96	42	459	6,206	864	2,606	9,676	122.2
1945	3,640	1,432	83	69	562	5,786	776	2,459	9,021	115.7
1946 [4]						5,800	950	2,450	9,200	120.5

[1] Production plus imports, minus exports, minus estimated utilization for food, industry, and other nonfeed uses.
[2] Includes skim milk.
[3] Excludes horses and mules.
[4] Estimated.

Jennings, R. D., "The Deficit in Protein for Livestock, April 1946." U. S. Bur. Agr. Econ. (Processed) with later revisions

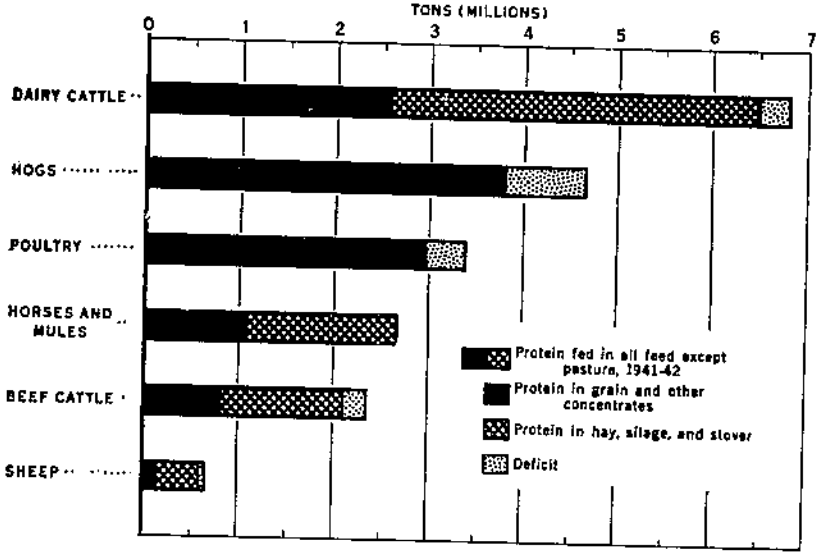

FIGURE 6.—Utilization and deficit in digestible protein by classes of livestock, United States, 1941–42.

The fact that such a nutritional deficit of protein exists does not necessarily mean that it would pay farmers to feed the additional quantities. Growth may be retarded or production of milk or eggs may be checked by shortage of protein, but this is not conclusive evidence of how much it would pay to feed nor of how much will be fed. It does set a level toward which producers may tend to go if conditions are economically favorable.

Future feed consumption of high-protein concentrates.—The future feed consumption of high-protein concentrates will closely follow supply changes because of the byproduct nature of most of the output. Changes in the demand for high-protein feeds will be reflected in prices, except for concurrent changes in supply due to other causes.

Changes in the future demand for high-protein feeds are especially important for soybeans because they will have considerably more effect on soybean prices than on the prices of the other oil seeds. This is simply because the oil meal is a larger physical proportion of a bushel of soybeans than is the case for other oil seeds (nearly twice as much as for cottonseed, three times as much as for flaxseed in relation to oil). Primarily because of its importance to soybeans, it is desirable to appraise the strength of the demand forces that will be pressing on high-protein supplies in the next decade.

It is necessary to bear in mind at this point that we are thinking of a reasonably prosperous period, because it is obvious that the general state of the economy will affect the demand situation.

It appears probable that the supply of high-protein feeds may not advance much beyond the level of the wartime period. The

combined prospects for cotton, flaxseed, soybeans, animal proteins, and other high-protein sources do not suggest very great expansion in output.

The demand for high-protein feeds is primarily affected by the level of livestock production. Such preliminary indications as we have from the bench-mark studies reported in "Peacetime Adjustments in Farming" suggest a level of livestock production 5 to 10 percent higher than during the war years (*26*). Although the bench-mark estimates are not forecasts, they can be taken as indicating a general direction in which livestock production is likely to go under favorable conditions.

An offsetting circumstance tending to decrease the demand for purchased feeds, is the expected improvement in hay and roughage. Increased use of fertilizers and other improved practices will surely increase the protein content of the home-produced ration for dairy cows and for beef cattle.

Urea is a new source of protein that may have some usefulness for cattle. This chemical substance, although not a nutrient, can be converted to protein by bacteria that live in the digestive tract of the cow if fed in limited quantities with low-protein feeds. It can be used only by cud-chewing animals.

The mixed-feed industry will probably continue production at a higher level than before the war and this will influence the demand for high-protein concentrates

Food Uses of Oil Meals

Several of the oil meals have future possibilities for expansion in the field of direct food use. Small quantities of peanut flour and cottonseed flour have been successfully prepared and utilized. But the main commercial possibility seems to lie in the expanded use of soya flour and grits. The important nutritional values present in soybean meal make these products especially useful in improving diets at relatively low cost. If problems of taste and flavor can be solved a rapid rise in consumption can be expected in the future.

Recent research with an alcohol-extraction process has reached the pilot-plant stage and a highly palatable flour has been produced. Should this method prove economical in operation, soya flour will probably be increasingly popular.

Just before the war less than 1 percent of the production of soybean meal was used in making soya flour but in 1943 the quantity produced had risen to 3 percent of the total crop. A large proportion of this output was bought by the Government for Lend-Lease and Relief. Soya grits were promoted during the war chiefly as a meat extender and soya flour as a fortifier of cereal products (*24*).

Some reaction from the wartime substitute uses may be anticipated as meat and cereal supplies become more plentiful, but if there is an improvement in taste and flavor some permanent gains may be counted on.

Industrial Uses of Oil Meals

Industrial uses of the oil meals are varied and have promise for the future. At present, they account for only a small proportion, probably less than 5 percent, of the use of total oil meal. Its use in mixed fertilizer provided one prewar outlet which will probably be available again. It is also used to make coverings and coatings, cold water paints, synthetic fibers, plastics, and adhesives.

The future of plastics made from oil meal has attracted attention. The concept of a plastic age captures the imagination and invites speculation. Some of the early success with soybean plastics has not been followed up, and it must be recognized that competition with other materials is especially keen in the plastic industries.

The basic raw materials for most plastics are derived from coal tar, petroleum, and alcohol. The oil meals have served mainly as extenders when they have been used. The most recent chemical developments in plastics seem to involve the manufacture of new synthetic raw materials with special properties ranging all the way from the older types of synthetic resins to the new synthetic rubbers. With research and development taking this direction it is not clear how far the oil meals will share in the probable expansion in plastic production.

Possibly more important than plastics, at least in supplying an outlet for soybean oil meal, is its use in plywood adhesives. Plywood bonded with soybean adhesives is considered water resistant but not waterproof. During the war, the plywood industry was required to produce large quantities of waterproof plywood for the aircraft industry. Phenolic resins were used. From 1942 to 1944 their use increased from 21 to 29 million pounds, while the use of soybean adhesives decreased from 45 to 37 million pounds. In the meantime, researchers at the Northern Regional Research Laboratory developed a method of using soybean adhesives as an extender in the phenolic resins. One commercial company employing this method used half a million pounds of soybean meal in a 12-month period in 1944–45 (*7*). This development helped to extend supplies of phenolic resins for adhesives during the closing phases of the war when they were critically short.

The examples of the uses made of soybean oil meal serve to illustrate the highly competitive nature of industrial outlets for oil meals. In more normal times phenolic resins are less likely to be short and the need for stretching their supply will be less acute.

The most important peacetime use of plywood will probably prove to be in prefabricated housing. In this industry a water-resistant adhesive may be sufficient for most construction; consequently the demand for soybean adhesives may improve with the growth of prefabrication.

Summary of Market Outlets for Oil Meals

After all of the market-outlet possibilities for oil meals have been appraised, it appears that the demand for them will be more

favorable than it was before the war. The food and industrial demands, though small, may increase. The demand for livestock feed which is most important seems even stronger. The part of the oil-crop price which derives from the oil meal should be relatively higher in 1955 than it was before the war for any given supply of high-protein feeds.

DOMESTIC PRODUCTION OF FATS AND OILS

Trends in Production

The longtime trend in the production of fats and oils from domestic materials has been irregularly upward during the last 35 years (fig. 3). A period of relatively stable production from about 1924 to 1933 was followed by a drop during the drought years and then a recovery and rapid expansion during the war. The expansion was based mainly on the remarkable development in soybeans, increased hog production, and larger plantings of flaxseed. Increased domestic output of oils from peanuts, corn, and other sources, contributed in lesser degree. Cottonseed production, on the other hand, declined somewhat, especially in more recent years.

In the prewar period the difference between the production of fats and oils from domestic materials and total disappearance was made up by a net import consisting mainly of tropical oils. A considerable expansion in world exports of tropical oils occurred at about the time that domestic production slackened, in the 1930's.

In examining the reasons for the prewar changes in production of fats and oils from domestic materials, the byproduct nature of much of the production must be recognized, or to put it differently, there is relatively little production response to changes in the prices of fats and oils. Production of cottonseed oil, for example, is mainly influenced by the prices of cotton fiber and other circumstances related to fiber production. The production of lard, grease, and tallow, is curtailed when prices of meat animals are adverse or when feed supplies are short. Even the output of butter is influenced by the prices of other dairy products which cause milk to move toward or away from butter production. Linseed oil and soybean oil are the only major fats and oils that can be said to respond readily to changes in their own relative prices. Recognition of the fact that production does not necessarily respond to changes in the prices of oils and fats simplifies the making of acceptable estimates of future production of the joint and related fats and oils products.

Coming trends in production.—In appraising the 1955 production of fats and oils from domestic materials, no attempt is made to present exact forecasts. Rather, the objective is to indicate directional trends. To lend some precision to our thinking, it is necessary to use specific data, but these must be understood as being related to the general conditions assumed.

The several steps to be followed in making estimates of the production of fats and oils in 1955 include:

(1) Sizing up the world situation and its probable effect on United States imports of fats and oils.

(2) Appraising domestic market outlets.

(3) Estimating domestic production of byproduct and minor fats and oils.

(4) Estimating domestic production of soybeans and flaxseed.

Up to this point we have examined the world situation and the domestic market outlets with respect to fats and oils. In appraising the world trade situation in 1955, it seems probable that United States imports of fats and oils will be less than in 1935-39. A considerable expansion in world production and world exports of oil crops is anticipated. But this will be at least partly offset by reduced world supplies of whale oil and increased imports by countries like India and the Soviet Union that have rapidly growing populations.

The European demand situation is complicated by boundary changes and reorientation of agricultural production and trade, but imports of fats and oils are likely to be at least as high as prewar levels, by 1955. Meanwhile they may be higher until the European livestock production is more nearly restored.

Most of the increased disappearance over that of 1935-39 in the United States will therefore come from increased domestic production. This suggests a fairly firm price situation for fats and oils unless the output of one or more of the domestic fats and oils should expand excessively.

Major Domestic Fats and Oils

Major fats and oils produced from domestic materials in the United States are shown in the following tabulation with their average annual production for 1935–39.

Fats and Oils

	Million pounds	
Butter (actual weight)	2,170	
Lard and rendered pork fat	1,630	
Tallow, greases, and other	1,110	
Marine oils	270	
Total animal fats	5,180	
Cottonseed oil	1,425	
Soybean oil	261	
Linseed oil	178	
Corn oil	128	
Peanut oil	63	
Olive oil	4	
Tung oil	1	
Total vegetable oils	2,060	
Total fats and oils		7,240

Very important changes in relative proportions have occurred during the emergency years but the first three animal fats and the first three vegetable oils continue to represent the bulk of the production.

The study of which this report is one part was directed to oil crops and especially to soybeans and flaxseed. The whole problem of fats and oils production is so complex that recourse must be had to other recent studies to build up the necessary total-produc-

tion framework. Reference will frequently be made to the cooperative study of "Peacetime Adjustments in Farming" sometimes called the bench-mark study (*26*). That study assumed prosperity conditions and referred to 1950, but the adjustments involved are probably equally appropriate to 1955. Certain assumptions about improved practices may have resulted in estimates for some crops and perhaps for milk production that are too high for attainment even by 1955.

Animal Fats

The prewar domestic production of animal fats was more than twice as much as the production of vegetable oils. Butter, lard, and tallows and greases make up most of the animal fats.

Butter.—Production of butter led the field in the production of fats and oils from domestic materials just before the war. Production during the emergency period has been low because of the diversion of milk to whole milk uses of higher value. Under peacetime conditions, output of butter will rise again but perhaps not to so high a level as prewar per capita consumption might suggest.

There are two reasons. First, the demand for fluid milk and for whole-milk products will probably take a larger proportion of the total supply of milk than before the war. Second, the competition from margarine may be somewhat more effective than before the war.

The chief uncertainty about butter production in 1955 may relate to the total level of milk production. If United States production should expand to 140 to 150 billion pounds of milk under the conditions assumed in the bench-mark study, there would be large quantities of butter (*26*). However, a level more in line with the conditions assumed in this study and fitting in with the gradual expansion which has characterized the longtime trend in milk production would be between 130 and 135 billion pounds of milk. With this production one might associate a butter production of about 16 pounds per capita. This would be somewhat below prewar levels and would allow for some increase in per capita margarine consumption although a consumption at less than wartime levels. Total butter production in 1955 would then be estimated at about 2,400 million pounds.

Lard.—The output of lard and rendered pork fat is directly related to hog production. Because lard is a byproduct, the demand for it has relatively little influence on the level of hog production which is influenced mainly by the market outlet for meats and by the supply of feed grains. In appraising the future level of lard production, the prospect for hog production must be examined.

For this purpose we may make use of the bench-mark estimates (*26*). Although we are thinking of 1955 rather than 1950, the bench-mark estimates for meat animals may be reasonably close to the mark in terms of feed production and livestock production.

That estimate for hog production involved a pig crop of 102 million head. This may be compared with historical pig crops in figure 7. In terms of long-time trends and population growth

a pig crop of this size does not seem out of line with prosperity conditions.

The quantity of lard associated with the hog production from a pig crop of this size comes close to 3 billion pounds. This would be the largest single item in the estimated 1955 production of fats and oils. It is nearly double the output of 1935-39, when hog production was unusually low because of drought and reduced feed supplies.

The bench-mark estimates assumed hogs of lighter weight but this probably would not greatly affect the percentage of lard obtained from a given quantity of liveweight. It would, of course, reduce the percentage of fat in fat cuts which are sold as meat and in this way would affect the so-called invisible supply of fats available to consumers.

Tallows, greases, and other animal fats.—The domestic output of tallows and greases is particularly important to the soap industry. Of the total annual production only a relatively small proportion consists of edible fats and these are used principally in the manufacture of shortening and margarine. Production data for recent years are shown in table 10.

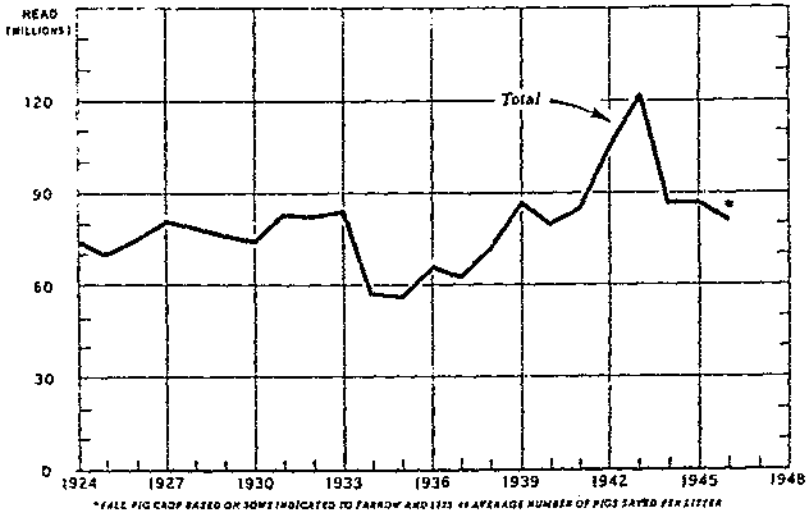

FIGURE 7.—Total pig crops, United States, 1924–46.

In the edible group three major fats are tallow and oleo oil and stearine. The inedible group consists almost entirely of tallow and grease in the approximate relationship of 2 to 1. This relationship varies from year to year depending mainly upon hog production.

The probable production of tallows and greases, about 1955, depends of course on the livestock production at that time. The bench-mark estimates also furnish a basis for estimating the output of these animal fats. The group as a whole is difficult to estimate because of the variety of miscellaneous items in the total. The most influential factor is the size of the pig crop in 1955 which

we have assumed to be 102 million head. The proportion of edible to inedible fats will vary with relative demand and perhaps with changes in technology. The aggregate estimate is made on the basis of estimated total livestock slaughter with proper emphasis on each class of livestock.

Marine oils.—Marine oils include whale oil and various fish oils. Whale oil, although important in world trade and one of the principal oils used in margarine in Europe, is practically without significance in the United States. As a result of the restrictive character of our national regulations and the more recent international agreements to conserve the whaling industry by protecting the whales it is not likely that the United States will participate in whaling to any great extent in the near future.

TABLE 10.—*Production of animal fats other than butter and lard, United States, average 1935–39 and annually 1940–45 and estimated 1955*

Period or year		Edible	Inedible [1]	Total
		1,000 pounds	*1,000 pounds*	*1,000 pounds*
Average:	1935–39	219	891	1,110
	1940	187	1,388	1,575
	1941	234	1,568	1,802
	1942	277	1,762	2,039
	1943	259	1,667	1,926
	1944	198	1,962	2,160
	1945	202	1,771	1,973
Estimated:	1955	280	1,820	2,100

[1] Includes wool grease and neat's-foot oil.

In contrast with whale oil there has been a considerable increase in the production of fish oil. In a large measure this increase is the result of technological advances in handling the fish and in utilizing parts that formerly were wasted.

The prewar production of marine oils of 270 million pounds annually (1935-39) has decreased. The average was 192 million pounds during 1940-44. With new methods, which make it possible to obtain greater yields of vitamin and medicinal oils at lower costs, the annual production may reach 300 million pounds by 1955.

Vegetable Oils

The principal vegetable oil crops are cottonseed, soybeans, and flaxseed. Corn, peanuts, olives, and tung nuts are also valuable sources and there are several minor oils.

Cottonseed.—Cottonseed is one of the more important elements in the production of fats and oils in the United States. In the 5-year period, 1935-39, cottonseed oil made up 20 percent of the total production of fats and oils from domestic materials. Crushings of cottonseed in individual years since 1920 have ranged from a little more than 3 million tons to more than 6 million tons (fig 8). The output since 1938 has been around 4 million tons with a downward drift in the last few years.

The future level of production of cottonseed is extremely difficult to estimate because of uncertainties about future agricultural programs and about the adjustments that Southern farmers will be able to carry through in meeting the difficult production problems that face them. The long-time outlook for cotton fiber must take into account serious competition from synthetic fibers, from substitute products, and from cotton grown in other countries. This competition will bear heavily on the demand for cotton (*25*). If prosperity conditions prevail, however, increased supplies of these other materials may be consumed both at home and abroad, without decreasing the absolute consumption of cotton fiber.

Increased mechanization of cotton production, especially in harvesting, will probably take place, particularly in the areas best adapted to machinery such as the Delta and the Southern Plains. Adjustments toward a more efficient agriculture through larger farms, recombinations of enterprises, and improved practices will vary between areas and will greatly affect the outcome.

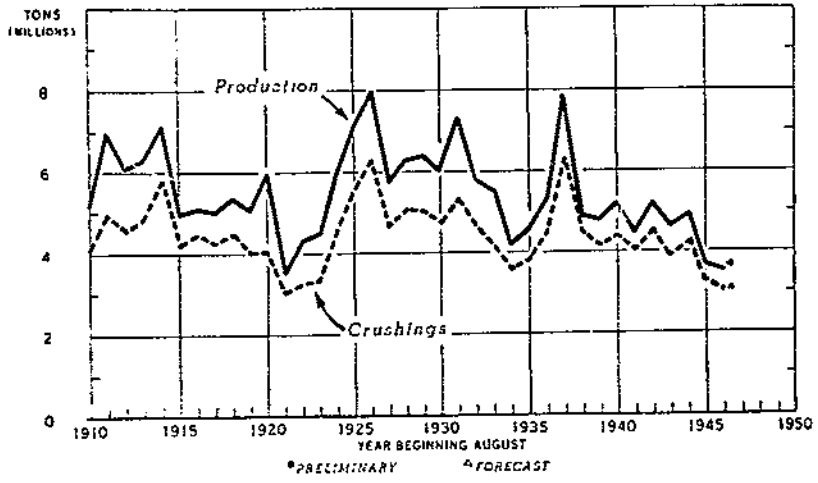

FIGURE 8.—Production and crushings of cottonseed, United States, 1910–46.

The 1955 level of cotton and cottonseed production might be tentatively approached on the basis of recent history, on the assumption that similar conditions would be duplicated under a prosperous situation. If this approach were used cotton production might be placed at 10 to 12 million bales. But in many of the recent years exceptionally good opportunities for urban employment prevailed. The wartime opportunities were probably greater than could be counted on even under peacetime full-employment conditions. Hence recent production may have been lower than can be expected later on, especially as mechanization increases.

Two recent studies of production adjustments for Southern farms have included forward estimates of the production of cotton under specified prosperity conditions. No one of these estimates constitutes a forecast but is rather an indication of what might

occur under the particular conditions set up in each case. Both may be helpful in suggesting directions.

The first of these studies placed production of cotton in 1950 at about 15 million bales (*26*). The framework conditions in this study included prices appropriate to prosperity and involved the projected use of improved practices that it would pay farmers to adopt. This production is perhaps a little on the high side, especially as it has been judged to be in excess of the quantity of cotton fiber that would move into domestic and foreign consumption channels.

The second and more recent study was carried on jointly in 1946 by nine Southern agricultural experiment stations and the Bureau of Agricultural Economics and other agencies.[14] This study estimated cotton production at 12.9 million bales under competitive conditions and with prices and employment approximately like those of 1943.

It has been estimated that about 13 million bales of cotton will move into consumption at home and abroad under conditions and relative prices in the neighborhood of those assumed. There will undoubtedly be a strong tendency for cotton production to rise to a level at least as high as would be consumed. The competitive price of cotton would probably rise sufficiently to bring this about.

All things considered, a 13-million-bale crop may be about right under the conditions assumed for 1955. In terms of cottonseed and cottonseed oil this would come to about 4⅓ million tons and about 1,400 million pounds, or approximately the same as the 1935-39 average of 1,425 million pounds of cottonseed oil.

Flaxseed.—The United States usually grows only a part of the flaxseed it needs and imports most of the rest from Argentina, despite substantial tariffs. The recent emergency years with their attendant shipping restrictions and other problems constitute a special situation that must not be given too much weight in a study of future flaxseed production.

A detailed examination of trends and prospects in regard to flaxseed in the United States is included in another report; hence the discussion here is limited to some of the main points (*12*).

Flaxseed production in the United States has fluctuated considerably since 1910 (fig. 9). Up to 1938 there appeared to be some downward trend. Since then, the war demands and several favorable years have brought about a very marked increase. The production during the war years has been double and triple the prewar average.

Over the years flaxseed production in the United States has shifted geographically so that proportionately less of the crop is now grown in Minnesota and the Dakotas, and more is grown in California and other States. But the principal flaxseed-growing States continue to be Minnesota and North Dakota, with South Dakota and California next in importance.

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[14] "Adjustments Toward an Efficient Agriculture in the South." Nine Southern Agricultural Experiment Stations and the United States Department of Agriculture cooperating. 71 pp. 1947. (Processed.)

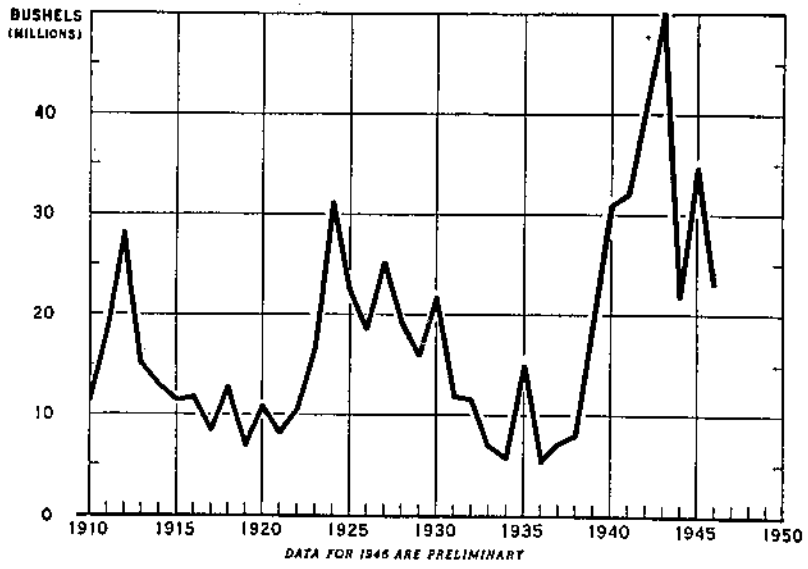

FIGURE 9.—Flaxseed production in the United States, 1910–1946.

Improvements in methods of production have taken place and plant breeders have brought out new higher yielding varieties, so the crop is perhaps a better alternative than before. Weeds have always been one of the principal problems in growing flaxseed. Improvements in cultural methods and recent developments with chemical weed killers promise more adequate control of this hazard. Flaxseed still remains a relatively minor crop except in parts of Minnesota and in two counties in California.

Flaxseed frequently serves as a companion or nurse crop with new seedings of hay crops but is most significant as an alternative cash crop. In areas in the Dakotas where the alternative choice of crops is limited some flaxseed will probably be grown even at relatively low prices.

In order to estimate 1955 production under alternative economic situations three relative price assumptions were set up in the study referred to. These were expressed as the ratios of flaxseed to wheat prices of 2.5, 2.0, and 1.5. For example, if wheat were worth $1, flaxseed would be alternatively $2.50, $2.00, and $1.50 per bushel. Prices of other commodities were kept in a normal relationship to wheat.

Estimates were made for each of the flaxseed-growing States of the probable 1955 acreage, yield, and production of flaxseed for each of the three price situations. These estimates were based partly on information obtained from interviews with farmers and partly on judgments of those familiar with each area and with past responses.

TABLE 11.—*Estimates of 1955 planted acreage, and production of flaxseed in the United States and in six of the major flaxseed States, with three price assumptions for flaxseed* [1]

State	Flaxseed-wheat price ratio of 1.5		Flaxseed-wheat price ratio of 2.0		Flaxseed-wheat price ratio of 2.5	
	Planted acreage	Production	Planted acreage	Production	Planted acreage	Production
	1,000 acres	*1,000 bushels*	*1,000 acres*	*1,000 bushels*	*1,000 acres*	*1,000 bushels*
United States	1,000.0	9,615.0	2,600.0	23,833.5	3,500.0	29,994.3
Minnesota	400.0	5,120.0	800.0	9,600.0	975.0	11,212.5
North Dakota	350.0	2,100.0	850.0	4,675.0	1,125.0	5,625.0
South Dakota	100.0	800.0	275.0	2,062.5	400.0	2,840.0
Montana	50.0	300.0	100.0	560.0	200.0	1,040.0
Kansas	37.5	322.5	162.5	1,300.0	237.5	1,806.0
California	20.0	420.0	160.0	2,656.0	250.0	3,878.0
Other States [2]	42.5	552.5	252.5	3,030.0	312.5	3,593.8

[1] 1955 assumed United States farm prices per bushel: Wheat $1.10, oats $0.50, barley $0.70, and corn $0.90. The three prices for flaxseed were $1.65, $2.20, and $2.75, respectively for the three price ratios indicated above.

[2] Includes Wisconsin, Michigan, Illinois, Iowa, Missouri, Oklahoma, Texas, Nebraska, Wyoming, Idaho, Arizona, Washington, and Oregon.

A summary of the estimates finally derived is given in table 11. From these estimates it can be seen that relative price changes on the order of those indicated would probably produce rather wide differences in production. From our earlier discussion of the prospective market outlets it would seem that the demand for drying oils in 1955 would be rather strong both in the United States and elsewhere. Hence, a flaxseed-wheat-price ratio of about 2.25, or halfway between the upper two ratios, may be considered a likely one. If this level is assumed, one may by interpolation arrive at a crop of about 27 million bushels. Of this quantity it would be necessary to allow about 5 million bushels for seed and other direct uses. This would leave sufficient flaxseed for crushing to produce about 425 million pounds of linseed oil annually. It would be necessary, under our assumptions regarding consumption, to import at least an equal quantity of flaxseed in terms of oil.

Soybeans.—Recent remarkable expansion in the acreage of soybeans in the United States places this crop in a unique position (fig. 10). The acreage harvested for beans during the war reached a level more than three times as high as it was during the immediate prewar period. Much of the expansion was made to meet emergency needs, but even without the war the acreage probably would have increased considerably.[15]

[15] Strand, Edwin G., "Soybean Production in War and Peace," U. S. Bur. Agr. Econ. 41 pp. 1945. (Processed.)

The future place of the soybean crop is especially difficult to appraise because of this relatively short experience with it. Measurements of probable responses to different price situations made by usual statistical means are not possible because there are too few observations, and even these are obscured by other factors making for the upward trends. Only careful judgment and analysis of profitable and likely farm adjustments will assist in reaching sound conclusions.

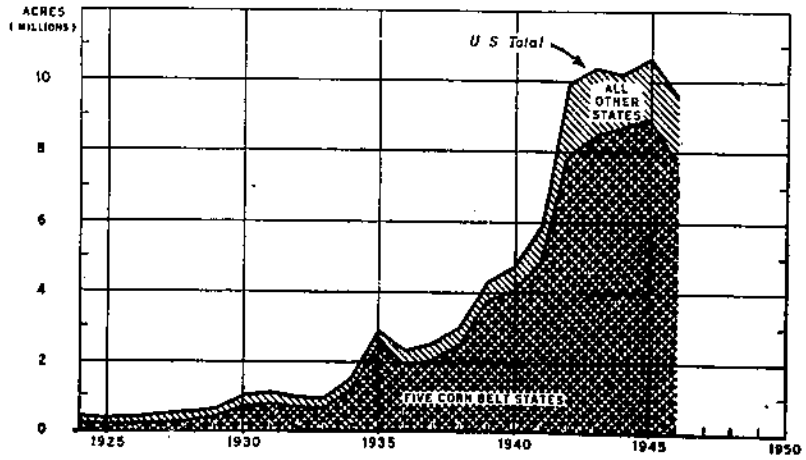

FIGURE 10.—Acreage of soybeans harvested for beans, United States, and five Corn Belt States, 1924–46.

About 85 percent of the total acreage of soybeans harvested for beans (and nearly 90 percent of the production) in recent years was produced in the five Corn Belt States. The Mississippi Delta and the Middle Atlantic Coast States are two distinct minor areas Expansion has been general in all these areas since 1924. By far the greater part of the wartime expansion took place in the five Corn Belt States although the relative rate of increase in soybeans harvested for beans was greater in the Delta and in the fringe areas in Minnesota, Nebraska, and Kansas.

From 1924 to 1933 the increase in the acreage harvested for beans was very gradual. Progress was made in selecting adapted varieties and in working out improvements in production techniques. Difficulties in marketing and processing had to be overcome.

Soybeans came in as a good alternative crop to fit in with the cropping plans developed with the agricultural conservation program during the late 1930's. Yields per acre increased as better varieties became available and as management of the crop became better understood. By the time the war stimulated demand, the stage was set for rapid expansion.

Because of the erosion hazard, soybeans are best adapted to areas in which the land has comparatively little slope. This is especially important if the percentage of the cropland in inter-

tilled crops is already high. The level cash-grain areas in Iowa and Illinois are especially well suited to the crop. The high degree of mechanization in such places also favors soybeans.

Returns per acre from soybeans are intermediate between corn and oats, within the usual range of prices and of yields. They are competitive with both of these crops and with others in particular areas. In studying the relative advantage of soybeans in different areas in the Corn Belt, much attention has been paid to the corn-soybean yield ratios. Oat-soybean yield ratios and others may be of greater significance in particular areas.

Changes in relative yields are influential elements in inter-crop competition. Corn, oats, and soybeans have all shown upward trends in yield in recent years and the trend seems likely to continue for a while. Hybrid corn has lifted corn yields 15 to 20 percent and may do still more. Soybean yields have been rising as better adapted varieties have been found for each area. The widespread adoption of the Lincoln and other newly developed varieties gives prospect of further substantial increases in average commercial yields of soybeans.

Recent developments in oat varieties have shown some rather startling increases in yields. This may be especially important in northern Iowa and southern Minnesota. The appearance in 1946 on a wide scale of a relatively new oat disease, helminthosporium, probably represents a temporary problem, as resistant varieties are already available.

Soybeans as a new crop have been relatively free from disease and insect hazards. There are some signs that this relative immunity is about to end and some of the means of control may involve cropping practices that will limit acreage in certain areas.

Estimates of probable acreage and production of soybeans in 1955 have been developed in a special study (*18*). These were worked out in most detail for Iowa and Illinois by type-of-farming areas. This made it possible to consider differences in farming systems and how soybeans fitted in under alternative conditions.

For other States, estimates were based on the estimates made by State Production Adjustment Committees for the bench-mark study, and on trends in acreages and yields, on progress in developing improved varieties, and on other information (*26*).

The analysis for Iowa and Illinois was aided by assistance from an experiment station committee in each State. It also made use of available background information prepared for other studies. In addition, farmers' reactions toward and future plans for growing soybeans were obtained in four selected areas in each State. With the help of a small group of farmers in each area the recent history and probable trend in soybean production in the area was explored. Estimates of future soybean production by about 1955 for typical farms were made on the basis of what would be profitable under specified conditions.

In dealing with the estimates by type-of-farming areas, account was taken of trends in the production of soybeans and of other crops and livestock; of relative crop yields, soils, and slope of land; and of agronomic and farm-management practices. Three alter-

native price situations were assumed for soybeans. Under these three situations, the price of soybeans was alternatively 2.0, 1.6, and 1.2 times the price of corn. With these assumptions the estimates for Illinois and Iowa were as follows:

Soybean-corn price ratio:	Production	
	Illinois (million bushels)	*Iowa (million bushels)*
2.0	67.5	36.0
1.6	60.0	28.8
1.2	45.0	14.4

These quantities are below wartime levels of production, but with the exception of the lowest price alternative they are still much higher than prewar quantities. Production at different relative prices appears to be more elastic in Iowa than in Illinois; that is to say, the expansion and contraction with higher and lower prices seem to be more marked. This is accounted for by several factors including yield ratios and stronger competition from livestock alternatives in Iowa.

Extending the estimates to the United States involved judgments for the rest of the Corn Belt, for fringe areas, for the Mississippi Delta, and for the Middle Atlantic Coast States. The development of adapted varieties has been carried farther in the Corn Belt than in other areas, and additional improvements are in prospect. Soybean research and breeding work in the Southern States has been intensified, however, and this may have the effect of increasing yields relatively more in these States than in the Corn Belt. This would tend to hold acreage in these areas at a relatively high level. With relatively favorable prices there may be less recession from wartime production levels outside the Corn Belt than in it.

Special factors will be operating in each area. In the Delta, for example, mechanization of cotton production may cause some increase in soybean acreage in the new cropping systems that will develop. In the fringe States of Minnesota, Nebraska, and Kansas, some additional soybean acreage may balance and give stability to existing cropping plans.

As most of the soybean acreage and production will still be in the Corn Belt States, major interest will continue to center on the situation there. A summary of the estimates for the Corn Belt and for the United States is shown in table 12.

If we can assume a price relationship between soybeans and corn in 1955 in the neighborhood of a 1.6 ratio, then a national production of about 160 million bushels of soybeans can be estimated for the United States. This would result in about 1,150 million pounds of soybean oil with a 75-percent crushing. A price relationship of 1.6 would depend on continued technological progress in improving soybean oil for both food and industrial uses and upon a strong demand for soybean meal. Without these elements of strength soybean prices might weaken and a less favorable ratio would develop.

Compared with wartime and emergency levels the above estimates represent some reduction. The adjustments will usually not be difficult in the Corn Belt under favorable economic condi-

tions, because other alternative enterprises are readily available on most of the farms. Most of the adjustment will occur on farms on which too high a proportion of the cropland has been kept in intertilled crops. Much of it will take place on farms that have soils or topography that are less well adapted to soybeans than to other crops.

TABLE 12.—*Estimated acreage and production of soybeans harvested for beans in the United States and five Corn Belt States in 1955 under three alternative soybean-corn price ratios*

Soybean-corn price ratio	United States		5 Corn Belt States	
	Acreage harvested	Production	Acreage harvested	Production
	1,000 acres	*Million bushels*	*1,000 acres*	*Million bushels*
2.0	8,700	191	6,750	160
1.6	7,200	159	5,700	135
1.2	4,800	107	3,875	92

It must be recognized that the capacity of the United States for producing soybeans is now such that surplus supplies of soybeans could readily develop in the event that general demand conditions became unfavorable, or even if total supplies of fats and oils became excessive.

Peanuts.—Peanuts occupy a relatively small part of the total crop acreage in the United States. But in a few States they are a major crop. The most important peanut States include Virginia, North Carolina, Alabama, and Georgia.

Peanut production has shown an upward trend in the United States over the last 35 years (table 13). During the war, 1942–44, the acreage of peanuts grown alone averaged 228 percent of the 1935-39 average. Total production of peanuts picked and threshed was 176 percent of the prewar period, the average yield for the 3 war years being well below the yield of the prewar years. The average yield dropped during the war principally because of the poorer land used in expanding the total acreage in peanuts.

The expansion was relatively greatest in the Texas-Oklahoma area where the yields are low. Considerable increase also took place in the peanut area covered by Georgia, Florida, and Alabama. Only in the old peanut area of Virginia and the Carolinas was the increase in production relatively small. Postwar decreases in peanut production are most probable in the States or areas that expanded most during the war.

According to a recent study roughly three-fourths of the peanut

TABLE 13.—*Average annual production of peanuts by regions and by 5-year periods, United States, 1911–1945*

Period	Total	Virginia and the Carolinas	Georgia, Florida, Alabama	Texas and Oklahoma	Other
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*
1911–15	402	246	103	37	16
1916–20	797	289	390	93	25
1921–25	641	295	287	39	20
1926–30	789	364	328	74	23
1931–35	997	392	467	95	43
1936–40	1,349	470	697	148	34
1941–45	2,013	487	1,058	411	57

crop is shelled.[16] About one-half of the shelled peanut output is used for peanut butter, one-third for salted peanuts, and most of the remainder for candy making. The proportion of the total crop used for crushing is usually about 15 to 20 percent and includes the peanuts unsuitable for other uses.

Forward estimates of the production of peanuts likely to be picked and threshed in 1950 or 1955 have been made in several studies. One of these estimated 2,600,000 acres and a total production of 1,820 million pounds under conditions of average technology (*27*). Another estimate indicates that under conditions of improved technology it would be possible to obtain 2,400 million pounds of peanuts from the same acreage (*36*).

The estimated consumption of peanuts in 1955 has been placed at about 9 pounds per capita (farmers' stock basis). This consumption is 35 percent higher than the 1935-39 average but is based on full employment.[17] Less favorable employment conditions would probably mean a lower per capita consumption. If a production of 1,820 million pounds of peanuts were achieved, enough peanuts would be left over to produce 75 million pounds of oil. If peanut production approaches that estimated under conditions of improved technology there would be an additional production of peanut oil of perhaps 250 million pounds.

In view of the general price situation assumed for 1955, the acreage of peanuts would probably be reduced to a point where only poor or low-quality peanuts would be crushed. The 1955 production of peanuts would probably average about 1,800 million pounds with an annual peanut-oil production of about 75 million pounds unless there are specific programs to support production.

Other domestic oil crops.—In addition to the four principal domestic oil crops several others are produced on a small scale in the United States. Chief among these are tung nuts and sunflower seed. Castor beans, rapeseed, mustard seed, and safflower seed are grown occasionally or in small quantities. Other vegetable oils produced are corn oil and sorghum oil, byproducts from the manufacture of corn and sorghum products respectively, and olive oil obtained from surplus production of edible olives. Corn oil is usually produced in larger volume than peanut oil.

Production of tung nuts in the United States has only recently reached a volume of commercial importance. The greatest part is grown in Mississippi, Louisiana, and Florida, although some of the nuts are grown in Georgia, and Alabama. The total production of tung nuts from 1940 to 1946 was as follows:

Year	*Tons of nuts*
1940	11,000
1941	8,750
1942	16,350
1943	6,200
1944	26,680
1945	37,080
1946	47,300

[16] Bachman, K. L., Crowe, G. B., and Goodman, K. V. "Peanuts in Southern Agriculture." U. S. Bur. Agr. Econ. 1947. (Processed.)

[17] "Adjustments Toward an Efficient Agriculture in the South." Nine Southern Agricultural Experiment Stations and the United States Department of Agriculture cooperating. 71 pp. 1947. (Processed.)

The oil content of the nuts is reported to be from 16 to 20 percent; hence even in 1946 the total production of oil would be less than 20 million pounds if all were crushed as compared with the average prewar import of 120 to 140 million pounds. The increased production of tung nuts in this country is a result of the difficulty experienced in obtaining tung oil from China over a number of years. It is difficult to anticipate the position of this industry in the United States when normal exports from China again are possible. However, at the relative prices paid for tung oil in normal times, very much expansion in the domestic industry would probably be unprofitable unless methods of production were developed that are less costly than those now used.

Production of sunflower seed in this country is small but seems somewhat more permanent in character than the production of some of the other minor oil crops. Usually the seed is used for feed and food rather than for oil. The total production over more recent years has averaged less than 5 million pounds. California is the principal sunflower-seed producing State, accounting for about 80 percent of the average domestic production. Other important producing States are Missouri and Illinois.

Castor beans, rapeseed, mustard seed, and safflower seed have been grown experimentally or on a very limited commercial scale in this country. All of these crops can be grown successfully in certain areas, but they have yield or labor problems that seem to make their early expansion unlikely. Castor beans, for example, require too much hand labor in harvesting, and machinery or other methods of meeting this situation have not yet been developed. Mustard seed is grown mainly for the condiment trade and oil is merely a byproduct.

In contrast to the minor oil crops the corn oil produced in this country each year is sufficient to make this oil one of our more important vegetable oils. The annual production for recent years (beginning October 1) has been as follows:

Year:	Million pounds
1940	186
1941	242
1942	240
1943	214
1944	217

Although this production is substantial it is of course small in comparison with soybean oil or cottonseed oil. As corn oil is a byproduct in the manufacturing of other corn products, the total quantity produced depends more on the demand for these than upon the demand for corn oil itself.

Production of olives in the United States has been so high in some years that frequently it has been necessary to crush more than half the total crop. The first year this was the case was in 1935 when 54 percent of the total crop of 32,000 short tons was crushed for oil. The proportion of the crop crushed has been greater than this several times since then. But it should be noted that the production of olive oil is very small in comparison with the normal annual import of this oil. The annual production of

domestic olive oil is of interest mostly as a measure of the oversupply of olives for table use.

Total Production from Domestic Materials

Our estimates of the production of the different domestic fats and oils for 1955 total more than 11 billion pounds (table 14). The estimated production for 1955 is about the same as the 1943 wartime level. It is considerably higher than the average for 1935–39; but the prewar period includes several years when drought conditions in a large part of the Midwest held production below normal levels. The indicated increase over prewar for animal fats is substantial although only slightly higher than in some of the war years. It is in this group that surpluses are most likely to occur. As the quantity of lard obtained as a byproduct of the anticipated large hog production would be considerably in excess of the domestic demand for this type of fat, it would be necessary to find foreign outlets for a part of the supply. There are potential markets in many countries in Europe and South America if international trade is not restricted.

Our earlier estimates of market outlets indicate that the total consumption of fats and oils in this country may be about 12 billion pounds annually. This would mean an average per capita disappearance of 80 pounds with a population of 150 million. Of this, some 50 pounds would be for food uses and the other 30 pounds for industrial purposes. The use in food has been at the 50 pound per capita level several times and is not likely to exceed this by very much. The total use for nonfood purposes might go beyond the 30 pounds suggested if the proper combination of industrial and building activities came about.

TABLE 14.—*Production of fats and oils from domestic materials, year beginning October, average 1935–39, 1943, and estimated 1955*

Item	1935–39	1943	1955 [1]
	Million pounds	*Million pounds*	*Million pounds*
Butter	2,170	2,015	2,400
Lard	1,630	2,865	3,000
Tallow, grease, and other	1,110	1,927	2,100
Marine oils	270	175	300
Total animal	5,180	6,982	7,800
Cottonseed oil	1,425	1,313	1,400
Soybean oil	261	1,234	1,150
Linseed oil	178	715	425
Corn oil	128	239	200
Peanut oil	63	153	75
Olive oil	4	10	6
Tung oil	1	5	14
Total vegetable	2,060	3,669	3,270
Grand total	7,240	10,651	11,070

[1] Estimate with assumed conditions; not a forecast.

To meet the demand for industrial oils it would be necessary to import substantial quantities. Total imports might reach 1,800 million pounds if 600 to 800 million pounds of lard and perhaps some soybean oil could be exported. The imports would consist largely of fats and oils for use in the manufacture of soaps, paints, and varnishes—purposes for which we either do not have sufficient quantities of domestic oils or for which our domestically produced oils are not fully as desirable. Even at this level net imports would average less than in 1935-39 when only small quantities of domestic fats and oils were available for export. Imports would be chiefly such oils as olive, palm, coconut, palm kernel, babassu, linseed, tung, and minor drying oils. The relation between imports and exports—to and from the United States—will be determined mainly by the freedom from trading restrictions in the world as a whole and by our own trade barriers. It is not probable, however, that gross imports of industrial fats and oils will drop much below a billion pounds annually.

PLACE OF OIL CROPS IN THE FUTURE

The appraisal of foreign and domestic production and consumption of fats and oils discussed in this publication, assumes a reltively high level of employment and somewhat greater freedom of international trade than before the war. These are, of course, basic elements in appraising the place of the oil crops in farming in the United States. Several other factors may influence the production of fats and oils. These include the measures, both public and private, that may be taken to further soil conservation, to improve agricultural adjustments, and to develop better nutrition and health.

The pattern of our foreign trade policy is yet to be fully established. The form that this policy takes is likely to be of considerable significance to our export of fats and oils, especially lard. Tariffs, international commodity agreements, State trading, and other factors are variables to be reckoned with.

Protective tariffs and other trade restrictions on fats and oils seem to be particularly difficult to make effective because of the substitutability of many fats and oils for one another and because of the importance of this country in international trade. Thus, a tariff on coconut oil imported by the United States might result in a diversion of this commodity to a country that customarily buys our lard. The import of coconut oil into this country would be reduced but so would the export of lard to some third country. Our recent trade agreement with the Philippine Republic will benefit that country by giving it an advantage over other coconut-producing areas in the United States market until 1974.

Agricultural production in the United States was greatly increased during the war. This was done with a smaller labor force and despite difficulties in obtaining machinery. Greater efficiency than ever before has been attained in the production of many crops and the competitive position of these crops in the world market has been improved. It is believed, for example, that this country now can compete with Manchuria in the world market for soybeans.

Internal agricultural policy is perhaps of even greater significance for the oil crops than is foreign trade policy. The Nation's domestic farm policy is constantly evolving in order to meet changing conditions and might turn in various directions under different circumstances. It may be desirable to examine the probable effect of some of the alternative possibilities.

Under the favorable conditions assumed in the main analysis the need for special farm programs to support agriculture would be minimized. The maintenance of employment has come to be recognized as one of the most important elements in maintaining purchasing power. Whatever may be accomplished in the general economy to further employment will help maintain the demand for nearly all farm products, including fats and oils.

Specific measures necessary for the support of agriculture meanwhile may be of at least three kinds:

(1) Steps to expand consumption and improve nutrition through education and other means.
(2) Programs for further development of conservation of soils and natural resources.
(3) Efforts to improve agricultural adjustment including the development of methods of production at lower costs.

Special measures to expand consumption more rapidly than current incomes seem to permit may include education, reducing costs of distribution, school lunch programs, national food allotment plans, and so on. These may have less effect on the consumption of visible fats and oils than on other foods but the emphasis such programs are likely to place on improved nutrition and increased use of dairy products, especially, will probably increase the consumption of "invisible" fats.

Conservation programs that were in effect before the war aimed to maintain soil fertility and prevent erosion. When the present world-wide shortage of food ends, new emphasis may be expected on soil conservation. Among the measures most likely to affect the production of certain oil crops are those designed to reduce the acreage of intertilled crops and to increase the acreage of soil-improving crops like clover and alfalfa. The latter may provide protein for livestock feed which otherwise would have to be supplied, at least in part, from oil meal and oil cake.

Improvement of agricultural production through the adjustment of crop and livestock patterns and development of methods of production at lower costs in the interest of greater efficiency, may have special repercussions on the oil crops. If agricultural control programs are undertaken to meet particular situations they may also affect these crops. The price supports that will be available for at least the immediate future may serve as a stabilizing influence in enabling necessary adjustments to be worked out gradually.

The oil crops have a great stake in favorable economic conditions at home and abroad. Under favorable circumstances their market outlets will tend to expand more than those for most agricultural products. Under adverse conditions, market outlets are likely to contract sharply and acute surpluses will probably accumulate.

SUMMARY

Signs of an approaching world surplus of fats and oils appeared in the 1930's. But war brought severe shortages which have continued into the postwar period.

To meet the emergency, the production of soybeans, flaxseed, and peanuts was greatly expanded in the United States. Growers of these crops are necessarily interested in the longtime outlook for fats and oils.

The trend in total world production of vegetable oils has been strongly upward since before World War I. This trend has been especially pronounced for the tropical oil crops—coconuts, palm oil, and palm kernel oil. Improved transportation and the spread of the plantation system have been principal factors in this development.

World trade in vegetable oils increased even more rapidly than world production over the same period of time. Domestic production in importing countries was unable to keep up with increasing demand and the exporting areas could ship an increasing proportion of their production.

The potential for future production and export of vegetable oils seems greatest in the same tropical areas that have been outstanding in this respect in the past. The total net export of the tropical oil crops was nearly three times as great in 1934-38 as in 1909-13. Most of this export came from the Netherlands Indies and the Philippines and from West and Central Africa. Several oil-palm projects, begun in Africa during the war, will soon be producing on a large scale and current plans may also enlarge peanut production in Africa. The volume of vegetable oils entering world trade may well be 20 percent higher by 1955 than in 1934-38.

Changes in the political boundaries of many countries in the world may cause some shifts in world trade in fats and oils, and the greater participation of various peoples in the government of their own affairs may mean an increased home consumption of foodstuffs, including fats and oils. Industrialization in India, the Soviet Union, and other areas, may also increase the utilization of fats and oils.

Our domestic uses of fats and oils for both food and nonfood purposes have increased considerably since 1920. Per capita consumption for food purposes may not expand much above 50 pounds a year, however, because of general changes occurring in the national dietary pattern. But total consumption of fats and oils will rise with population increases. Per capita consumption of fats and oils for soap and industrial uses, which came to about one-third of the total in 1935-39, may expand considerably more by 1955, and may exceed 30 pounds under favorable conditions.

Market outlets for nonfood uses are not so closely related to one another as are the various food uses. Periods of industrial activity seem to increase the consumption in most industrial lines. The use of fats and oils in soaps will probably increase. Accelerated building activity will increase the demand for drying oils.

Changes in the technology of fats and oils will have much to do

with their expanding uses and with shifts between different fats and oils. One of the most significant current developments is fractionation which promises to improve certain oils and increase their interchangeability with other competing oils. Fractionation may become as notable an achievement as hydrogenation has been in the last generation.

The oil meals are used for feed, food, and industrial purposes. Their use for livestock feed is by far the most important and will probably offer the greatest possibility for early expansion. Analysis of livestock rations fed in this country shows that considerably greater quantities of high-protein feeds would be fed if recommended practices were generally adopted.

Although only small quantities of oil meals have been used for human food even under the stress of wartime shortages, potential increases in food uses should not be overlooked. Industrial uses of oil meals have some interesting possibilities, notably in the manufacture of plastics and adhesives, although many other materials are competing with them.

Domestic production of fats and oils has had an upward trend over the years, although checked by drought and depression. Wartime expansion was pronounced.

Under favorable conditions the domestic production of animal fats by 1955 may expand to comparatively high levels. Butter production may be held in check by relatively high consumption of fluid milk and whole-milk products. Lard production will be high if hog production is maintained at high levels.

The domestic production of vegetable oils would also be at high levels in 1955 under the assumed conditions. If cotton production and southern agriculture are at least partly adjusted to face competitive conditions the output of cottonseed oil may be close to 1935-39 levels. With a strong demand for drying oils, flaxseed production is likely to remain above prewar levels.

Soybean production has had the most remarkable recent history of any of the oil crops in this country. With continued improvement in varieties and in production practices and with favorable developments in processing technology, the production of soybeans is likely to stay at much higher levels than prevailed before the war. As compared with recent emergency levels this will still represent some reduction. Assuming a period of relative prosperity the oil crops will hold a relatively strong position in 1955. But surpluses could easily arise if domestic industrial activity and employment were not maintained at high levels and if policies favorable to international trade were not developed.

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