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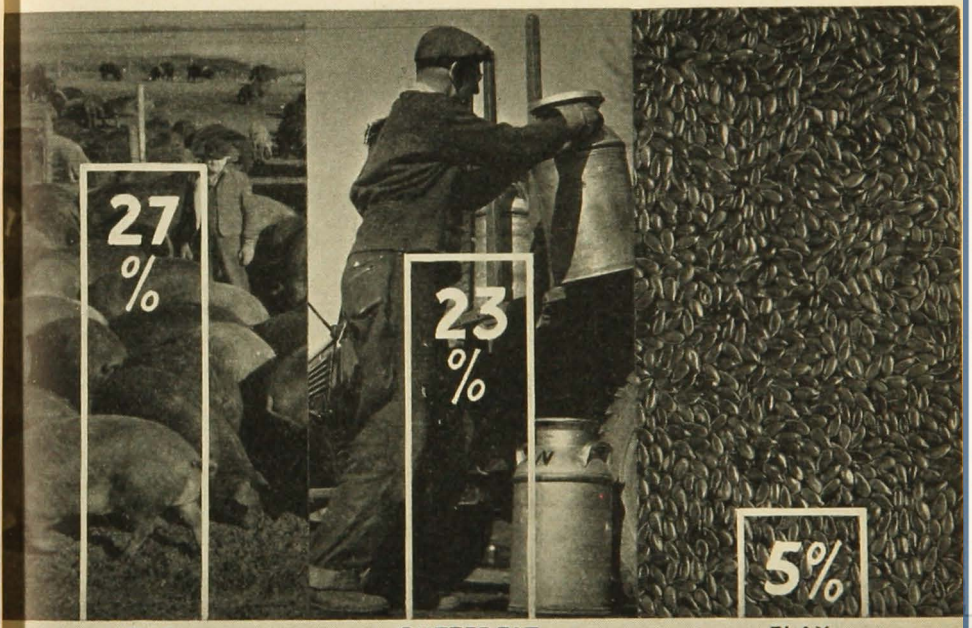
Minnesota Farmer's Interest in FATS and OILS

Rex W. Cox



Sales of Fat and Oil-Bearing Products Bring in 55% of Minnesota's Cash Farm Income

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The Minnesota Farmer's Interest in FATS AND OILS

Rex W. Cox

MINNESOTA derives more than one half of its annual cash income from the fat- and oil-bearing products, chiefly milk, hogs, and flaxseed. During the large expansion which has taken place in Minnesota agriculture within the last 33 years and which reached a peak in 1942-43, the output of these products increased more rapidly than that of most other products.

The sales of butterfat, including the butterfat equivalent of cream, whole milk, and farm butter in 1940-43, were more than two and one-half times those of 1910-14. The sales of hogs were almost four times as large, and those of flaxseed more than five times as large. The combined income received from the sale of butterfat, hogs, and flaxseed averaged 54 per cent of the total Minnesota cash farm income in 1940-43 as compared with 38 per cent in 1910-14. Although the production of soybeans increased from 11,000 bushels in 1935-39 to 3.5 million bushels in 1942-43, this crop is relatively of minor importance in Minnesota agriculture.

Minnesota occupies an important position in its contribution to the total supply of fats and oils originating in the United States. In 1940-43 this state contributed about 20 per cent of the supply of butter, 7 per cent of the supply of lard, and 43 per cent of the supply of linseed oil. The output of oil obtained from the 1942-43 production of soybeans represented 1.7 per cent of the United States' supply of this oil.

Table 1. Indexes of Quantity and Value of Sales of Butterfat, Hogs, and Flaxseed, Minnesota, 1910-43 (1910-14 = 100)

Year	Index of quantity				Index of value			
	All products	Butterfat*	Hogs	Flaxseed	All products	Butterfat*	Hogs	Flaxseed
1910-14	100	100	100	100	100	100	100	100
1915-19	113	106	141	62	183	156	244	117
1920-24	133	143	224	152	173	210	255	202
1925-29	156	190	201	221	226	296	384	298
1930-34	154	210	290	183	129	189	202	158
1935-39	160	217	221	203	172	227	254	195
1940-43	223	260	378	514	315	350	564	640

* Includes butterfat in sales of cream, whole milk, and farm butter.

The national fats and oils picture has changed greatly since the beginning of the war. Although the total domestic production of the fat- and oil-bearing products has increased greatly during the past two years, the supply has been relatively short because of limited imports and enlarged demands arising from a high rate of industrial activity, the need for fats and oils in the manufacture of armaments and munitions, and the operation of the lend-lease program. In consequence, these items have been rationed not only in direct consumption, but also to the processors of food and industrial products. The manufacturing technique of many of these products has undergone rapid changes, particularly in the substitution of domestically produced fats and oils for those formerly imported.

The Minnesota farmer is interested not only in the long-time and current changes in the production, trade, and utilization of the various fats and oils in direct consumption or in the manufacture of margarine, lard substitutes, soap, paints, varnishes, and other products, but also in the competitive aspects of butter and margarine, and lard and lard substitutes. He is also concerned with the postwar demand, particularly for butter, lard, and linseed oil.

The purpose of this bulletin is to analyze these various phases, but in order to do so it is necessary to consider them from a national viewpoint.

CLASSES OF FATS AND OILS

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The two large classes of fats and oils, animal and vegetable, may be subdivided into drying, semidrying, and nondrying. Generally, those of animal origin, except the marine, are nondrying, while some vegetable oils are found in each of the various subdivisions. Drying oils absorb oxygen from the air and are thereby converted into plastic, elastic, resinlike substances. Consequently, where they are exposed in a thin layer, as in painting, they form a tough, elastic, waterproof film which adheres tightly to the painted surface and protects it from the weather.[1] The most important drying oil produced in the United States is linseed which is the main ingredient entering into the manufacture of paint and other products of the drying industries. Tung and perilla oils, which have been the two chief competitors of linseed in the manufacture of these products, are imported oils. The nondrying oils have a wide variety of uses such as in the manufacture of food products, soaps, leather dressings, lubricants, and others. Some of the more common strictly nondrying oils are coconut, cottonseed, and olive. Butter and lard, the most important animal fats, are also classified as nondrying.

Soybean and corn oils are representative of the semidrying group. When exposed to the atmosphere in a thin layer, these oils and others of the group thicken but do not form a hard dry film. In consequence, they are not used in any large proportion in the manufacture of paints and varnishes, and when so used they must be mixed with oils possessing quick-drying characteristics.

Fats and oils in general fall into three classes of use, edible, technical, and special, but in only a few cases is any fat or oil confined to any one use.[2] Some oils, such as olive and peanut, obtained by cold pressing the raw material are suitable for edible purposes without further processing other than filtering. These are commonly called virgin oils. Others obtained by hot pressing or by solvent extraction usually must go through a process of re-

[1] Alsberg, C. L., and Taylor, A. E., The Fats and Oils: A General View. Pp. 5-6. Stanford University Press. 1928.

[2] U.S.D.A., Statistical Bulletin No. 59. Fats, Oils, and Oleaginous Raw Materials. Pp. 4-5. 1937.

finement before being suitable for edible purposes. Among the more common edible oils obtained in this way are coconut, cottonseed, soybean, and inferior grades of olive oil. Many fats and oils may be used for industrial purposes without being refined, but often they are processed in some way. For example, some are hydrogenated for soap; tung oil is subjected to heat treatment for use in paints and varnishes; linseed oil is blown, boiled, or refined or otherwise treated for special industrial uses; cottonseed oil must be refined for use in white soap; fish oils are usually deodorized before use and are also refined for use in paint.

The distinction between edible and inedible fats and oils is a purely practical one, for with modern methods nearly all can be refined or modified to a point of physiological edibility, although the costs of so doing might exclude them as serious competitors with others more readily adaptable for use in food products.

PRODUCTION AND TRADE

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Practically all of the animal fats and oils used in this country, with the exception of some fish and whale oils, are of domestic origin, but the supply of vegetable oils has consisted not only of those produced from both domestic and imported seeds, but also imported oils (table 2). The total production of fats and oils in the United States including butter and lard increased from over 5.8 billion pounds in 1912 to 9.5 billion in 1940, a gain of 64 per cent. Production of animal fats accounted for 65 per cent of the total in 1912 and 67 per cent in 1940. The production of vegetable oils produced from domestic materials represented 31 per cent of the total in 1912 but declined to 26 per cent in 1940, while that obtained from imported materials increased from 4 to 8 per cent.

Our imports of fats and oils totaled almost 1.9 billion pounds from July 1, 1938, to June 30, 1939.[3] The imports of coconut oil and copra in terms of oil equivalent, practically all of which originated in the Philippines, were 674 million pounds, or 35 per cent of the total imports. Flaxseed imports from South America in terms of linseed oil equivalent amounted to 349 million pounds, or 18 per cent of the total. Imports of palm oil contributed 14 per cent, about four fifths of which originated in the East Indies with most of the remaining coming from Africa. Europe and Africa supplied 104 mil-

[3] This period is taken in order to show the import situation as unaffected by war conditions.

Table 2. Production and Net Trade of Primary Fats and Oils, United States, 1921-1943*

Year	Production					Net exports or imports†		
	Total	From domestic materials			From imported materials	Total	Animal	Vegetable
		Total	Animal	Vegetable				
	Million pounds							
1921-25 (Average)	7,633	7,095	5,500	1,595	538	—586	—1,055	469
1926-30	8,551	7,808	5,675	2,133	743	18	— 780	798
1931-35	7,948	7,306	5,584	1,722	642	463	— 422	885
1936-40	8,518	7,761	5,536	2,225	757	961	— 130	1,091
1940	9,525	8,781	6,346	2,435	744	512	— 210	722
1941	10,324	9,385	6,572	2,813	939	.....	.....	.....
1942	10,521	9,965	6,777	3,188	556	.....	.....	.....
1943	11,359	10,870	7,207	3,663	489	.....	.....	.....

* U.S.D.A. Bureau of Agricultural Economics, The Fats and Oils Situation, Nos. 48, 73, and 84. Data on exports and imports are not available subsequent to October, 1941.

† Net exports are indicated by a minus sign.

lion pounds of olive oil which represented more than 5 per cent of the total. All of the 96 million pounds of tung oil imported came from China and Hong Kong, while the 39 million pounds of perilla oil originated in Japan and Kwangton. These two oils constituted about 7 per cent of our total imports. South America supplied all of our imports of castor oil and about two thirds of the imports of cottonseed oil (table 3).

The Far East has been the most important source of imported fats and oils, accounting for about 57 per cent of our total imports in 1938-39 (table 4). This is particularly significant in view of the present Japanese conquest. Coconut and perilla oils are not produced elsewhere and the imports of palm oil from Africa have not been sufficient to meet the domestic demands. Only a very limited amount of tung oil is produced in the United States. Since coconut and palm oils have been important constituents in soap, and tung and perilla in paint and varnish manufacture, the elimination of the imported supplies means that these industries must utilize substitutes which are obtainable primarily from domestically produced oils. South America contributed more than one fourth of our total imports, consisting primarily of linseed and relatively small amounts of castor, cottonseed, babassu, and oiticica oils. Europe supplied about one tenth of the total, our most important imports being olive, fish, and marine oils. Although Africa has accounted for less than one twentieth of the total, it was an important contributor to our supply of olive, palm, and palm kernel oils.

A number of changes have occurred over a period of time in tariff duties and excise taxes levied on imported seed and oil, influencing the competitive position of these and other products entering into the manufacture of both food and industrial products. Some of these changes have been made for the purpose of encouraging the importation of the seed rather than the derived oil in order to provide additional business for the oil crushers in this country.

The duties and excise taxes levied on flaxseed and its product, linseed oil, and on copra and coconut oil have been of special significance to producers and manufacturers in the United States. Flaxseed and linseed oil have been subject to heavy import duties for many years. The relative rates have been such as to discourage the importation of oil; in consequence, with the exception of a short time during 1921-22, the imports of oil have been negligible. The tariff act of 1913 levied a rate of 20 cents per bushel on flaxseed and 1.3 cents per pound on oil, which represented a reduction from the prevailing rates. The rate on flaxseed was equivalent to 1.1 cents per pound on the average oil yield. In 1921 the rate on flaxseed was increased to 30 cents per bushel, equivalent to 1.6 cents per pound of oil. The rate on oil remained the same; in consequence, imports of oil enjoying a .5 cent differential rose to 180 million pounds in 1921. The Tariff Act of 1922 increased the rate on the seed to 40 cents per bushel, equivalent to 2.2 cents per pound on the average oil yield, and the rate on the oil to 3.3 cents per pound. These rates prevailed until 1929, when, by presidential proclamation, the duty on flaxseed was increased to 56 cents per bushel, or 3.0 cents per pound of oil equivalent, and the rate on oil to 3.7 cents per pound. One year later the Smoot-Hawley Tariff Act further increased the rate on flaxseed to 65 cents per bushel, or 3.5 cents per pound of oil equivalent, and on oil to 4.5 cents per pound. These rates prevailed until the recent trade agreement with Argentina was signed. The latter became effective on November 15, 1941, and provides for a reduction of the duty on flaxseed to 50 cents,

Table 3. Imports of Specified Fats and Oils by Country of Origin, July 1, 1938-June 30, 1939*

Item	All countries	Europe	Iceland	Africa	South America	Canada and Newfoundland	New Zealand	East Indies	India and Ceylon	Philippines	China and Hong Kong	Japan and Kwangton	Unidentified origin
						Million pounds							
All fats and oils	1,899.6	179.4	9.0	87.6	522.3	13.0	1.3	225.0	1.0	664.8	126.8	64.9	4.5
Vegetable	1,818.6	126.4	.....	87.6	522.3	.....	1.3	225.0	1.0	664.8	126.8	58.9	4.5
Babassu	52.2	.....	.....	.....	52.2	.....	.....	.....	.....	.....	.....	.....	.....
Castor	56.8	.....	.....	.....	56.8	.....	.....	.....	.....	.....	.....	.....	.....
Coconut	673.7	.....	.....	.....	.....	.....	1.3	7.6	.....	664.8	.....	.....	.....
Cottonseed	74.0	6.0	.....	4.0	51.0	.....	.....	.....	.....	.....	4.0	9.0	.....
Corn	20.0	18.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.0
Linseed	348.9	.....	.....	.....	348.7	.....	.....	.....	.....	.....	.....	.....	.2
Olive	104.0	84.0	.....	20.0	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oiticica	13.0	.....	.....	.....	13.0	.....	.....	.....	.....	.....	.....	.....	.....
Palm	272.2	3.2	.....	55.6	.....	.....	.....	213.4	.....	.....	.....	.....	.....
Palm kernel	15.0	3.0	.....	8.0	.....	.....	.....	4.0	.....	.....	.....	.....	.....
Peanut	16.0	4.7	.....	.....	.....	.....	.....	.....	.....	.....	10.0	1.3	.....
Perilla	39.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.1	.2
Rapeseed	11.1	1.5	.....	.....	.6	.....	.....	.....	.....	.....	.....	8.1	.9
Soybean	2.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.1	1.3	.1
Sesame	10.4	6.0	.....	.....	.....	.....	.....	.....	1.0	.....	2.2	.1	1.1
Teaseed	13.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.0	.....	.....
Tung	96.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	96.5	.....	.....
Animal	81.0	53.0	9.0	.....	.....	13.0	.....	.....	.....	.....	.....	6.0	.....
Tallow	1.0	.....	.....	.....	.....	1.0	.....	.....	.....	.....	.....	.....	.....
Fish	62.0	39.0	9.0	.....	.....	8.0	.....	.....	.....	.....	.....	6.0	.....
Other marine	18.0	14.0	.....	.....	.....	4.0	.....	.....	.....	.....	.....	.....	.....

* U.S.D.A. Bureau of Agricultural Economics, The Fats and Oils Situation, No. 40.
U.S.D.A. Agricultural Statistics, 1942.

Table 4. Proportion of the Imports of the Specified Fats and Oils Contributed by the Different Countries of Origin, July 1, 1938-June 30, 1939

Item	All countries	Europe	Iceland	Africa	South America	Canada and Newfoundland	New Zealand	East Indies	India and Ceylon	Philippines	China and Hong Kong	Japan and Kwangton	Unidentified origin
							Per cent						
All fats and oils	100.0	9.5	0.5	4.6	27.4	0.7	0.1	11.8	0.1	35.0	6.7	3.4	0.2
Vegetable	100.0	7.0	.....	4.8	28.7	.....	.1	12.4	.1	36.5	7.0	3.2	.2
Babassu	100.0	.....	.....	.....	100.0	.....	.....	.....	.....	.....	.....	.....	.....
Castor	100.0	.....	.....	.....	100.0	.....	.....	.....	.....	.....	.....	.....	.....
Coconut	100.0	.....	.....	.....	.....	.....	.2	1.2	.....	98.6	.....	.....	.....
Cottonseed	100.0	8.1	.....	5.4	68.9	.....	.....	.....	.....	.....	5.4	12.2	.....
Corn	100.0	90.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	10.0	.....
Linseed	100.0	.....	.....	.....	99.9	.....	.....	.....	.....	.....	.....	.....	.1
Olive	100.0	80.8	.....	19.2	.....	.....	.....	.....	.....	.....	.....	.....	.....
Palm	100.0	1.2	.....	20.4	.....	.....	.....	78.4	.....	.....	.....	.....	.....
Palm kernel	100.0	20.0	.....	53.3	.....	.....	.....	26.7	.....	.....	.....	.....	.....
Peanut	100.0	29.4	.....	.....	.....	.....	.....	.....	.....	.....	62.5	8.1	.....
Perilla	100.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	99.5	.5
Rapeseed	100.0	13.5	.....	.....	5.4	.....	.....	.....	.....	.....	.....	73.0	8.1
Soybean	100.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	44.0	52.0	4.0
Tung	100.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	100.0	.....	.....
Sesame	100.0	57.7	.....	.....	.....	.....	.....	.....	9.6	.....	21.2	.9	10.6
Teaseed	100.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	100.0	.....	.....
Oiticica	100.0	.....	.....	.....	100.0	.....	.....	.....	.....	.....	.....	.....	.....
Animal	100.0	65.5	11.1	.....	.....	16.0	.....	.....	.....	.....	.....	7.4	.....
Tallow	100.0	.....	.....	.....	.....	100.0	.....	.....	.....	.....	.....	.....	.....
Fish	100.0	62.9	14.5	.....	.....	12.9	.....	.....	.....	.....	.....	9.7	.....
Other marine	100.0	77.8	.....	.....	.....	22.2	.....	.....	.....	.....	.....	.....	.....

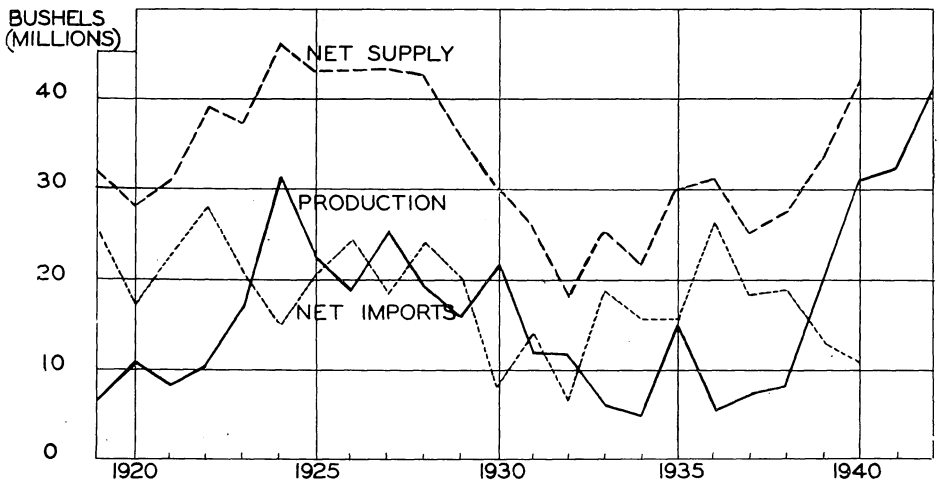

FIG. 1. Flaxseed: production, net imports, and net supply

except that the duty shall be 32.5 cents per bushel for the duration of the abnormal situation in the United States. The temporary reduction will terminate 30 days after the President of the United States, following consultation with the Argentine government, proclaims that the abnormal situation has passed.

The imports of flaxseed have constituted a very significant proportion of the supply available for crushing in the United States (figure 1). Both production and imports of flaxseed vary widely from year to year, with the tendency for imports to increase when production declines, particularly in years of heavy domestic demand for linseed oil by the drying industries. Domestic production averaged 20.1 million bushels in 1927-29 and imports 20.4 million. Although production changed but slightly in 1930, imports declined to less than 8 million owing to the greatly decreased demand for linseed oil. Domestic production amounted to only 5.3 million bushels in 1936, but the imports of 26 million were next to the highest in history. The production of flaxseed has increased rapidly since 1938 and averaged about 31 million bushels in 1940-41. Imports averaged less than 10 million bushels in these two years.

Amendments to the Act to provide for Philippine independence, which became effective in 1939, established duty-free quotas for imports of coconut oil into the United States from the Philippine Islands for the period January 1, 1940, to July 3, 1946. The quota, amounting to 440 million pounds in 1940, diminished by 5 per cent of this amount each year until 1946. With complete independence for the Philippines beginning July 4, 1946, all imports of coconut oil into the United States from the Philippines were to be subject to the tariff levied on imports from other countries, or two cents per pound. Imports from the Philippines during the intervening period in excess of the annual quotas were to be subject to the duty payments.[4]

In 1921 a duty of 2 cents per gallon was levied on imports of coconut oil from countries other than the Philippine Islands. The duty was changed to 2 cents per pound in 1922. Since the

[4] U.S.D.A. Bureau of Agricultural Economics, The Fats and Oils Situation, No. 31. 1939.

duty on imports from non-Philippine sources went into effect, only small amounts of coconut oil have been imported from these countries; however, imports of copra from these sources continued to be fairly large. With imposition of excise taxes of 3 cents per pound on the first domestic processing of coconut oil originating in the Philippines and 5 cents on that originating in other countries, the imports of copra declined rapidly. About 99 per cent of the coconut oil and oil equivalent of copra imported by the United States in 1939 originated in the Philippines.

Our total imports of coconut oil and copra in terms of oil equivalent declined from 627 million in 1918 to 309 million pounds in 1921. Rapid increases occurred during the succeeding years, the imports exceeding 722 million in 1929. Since the latter year, considerable variation has occurred, but, in general, the excise tax did not cause any great decline, the average for the period 1935-39 approximating 656 million pounds. Although the quota in 1940 set by the Philippine legislation was 440 million, only 371 million pounds were imported, primarily because of the shortage of shipping space.

ORIGIN AND UTILIZATION

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Domestic Utilization

The domestic utilization of fats and oils including butter and lard increased from an average of 7.1 billion pounds in 1921-25 to 9.4 billion pounds in 1936-40 (table 5). This increase was fairly evenly distributed between the utilization for food and utilization for industrial purposes. Food products accounted for 69.4 per cent of the total disappearance of fats and oils in 1921-25 and 68.4 per cent in 1936-40 (table 6). Although the utilization of fats and oils for the various food and industrial products, with the exception of lard, was significantly greater during the last five-year period, some significant changes occurred in the relative importance of the individual items. For example, butter accounted for 27.6 per cent of the total disappearance in 1921-25 and 23.4 per cent in 1936-40, while cooking compounds or manufactured shortenings and the miscellaneous group of food products changed from 18.7 per cent to 25.1 per cent. The decline in the relative importance of lard in 1936-40 was due in part to the decreased supply of this product resulting from the drouth in 1936. The relative importance of the utilization of fats and oils for the manufacture of the various groups of industrial items such as soap, products of the drying industries, and other products changed but slightly during the 20-year period.

An unusually sharp rise in the domestic utilization of fats and oils occurred in 1941, the total increasing to almost 11 billion pounds or about 12 per cent larger than in 1940. Most of this increase was for industrial purposes and was due to the enlarged demands for industrial products arising from the high rate of manufacturing and construction activity and to the extensive requirements for fats and oils in the munitions industry. The drying industries utilized 34 per cent more than in 1940 and the soap industry about 25 per cent more. Fats and oils used in the manufacture of miscellaneous industrial products increased by 42 per cent. The utilization for food rose 4 per cent, the decrease in butter and lard being more than offset by an increase of 15 per cent in the amount of fats and oils used in the manufacture of cooking compounds or shortenings, margarine, and other edible products. The total domestic disappearance declined slightly in 1942, but more than 50 million pounds were used in products for lend-lease delivery.

Table 5. Utilization of Fats and Oils in Food and Industrial Products, United States, 1921-1942*

Year	Total domestic disappearance	Food						Industrial			
		Total	Butter†	Margarine	Lard†	Compounds and vegetable cooking fats	Others	Total	Soap	Drying industries	Others
		Million pounds									
1921-25 (Average)	7,100	4,925	1,954	188	1,456	1,327		2,175	1,208	752	215
1926-30	8,414	5,700	2,137	261	1,526	1,776		2,714	1,599	845	270
1931-35	8,357	5,895	2,255	217	1,617	1,183	623	2,462	1,491	585	386
1936-40	9,332	6,384	2,180	293	1,566	1,468	877	2,948	1,674	774	500
1940	9,767	6,651	2,244	257	1,949	1,196	1,005	3,116	1,822	788	506
1941	10,965	6,921	2,185	297	1,898	1,418	1,123	4,044	2,270	1,054	720
1942	10,344	6,759	2,237	302	1,794	1,282	1,144	3,585	1,985	915	685

* U.S.D.A. Bureau of Agricultural Economics, The Fats and Oils Situation, Nos. 61, 62, 74, and 76.
† Excludes use in other products.

Table 6. Proportionate Distribution of the Total Utilization of Fats and Oils in Food and Industrial Products, United States, 1921-1942

Year	Total domestic disappearance	Food						Industrial			
		Total	Butter	Margarine	Lard	Compounds and vegetable cooking fats	Others	Total	Soap	Drying industries	Others
		Per cent									
1921-25 (Average)	100.0	69.4	27.6	2.6	20.5	18.7		30.6	17.0	10.6	3.0
1926-30	100.0	67.7	25.4	3.1	18.1	21.1		32.3	19.1	10.0	3.2
1931-35	100.0	70.6	27.0	2.6	19.3	14.2	7.5	29.4	17.8	7.0	4.6
1936-40	100.0	68.4	23.4	3.1	16.8	15.7	9.4	31.6	17.9	8.3	5.4
1940	100.0	68.1	23.0	2.6	20.0	12.2	10.3	31.9	18.6	8.1	5.2
1941	100.0	63.0	19.9	2.7	17.3	12.9	10.2	37.0	20.8	9.6	6.6
1942	100.0	65.3	21.6	2.9	17.3	12.4	11.1	34.7	19.3	8.8	6.6

Animal Fats and Oils

In addition to lard, the slaughtering and meat packing industries produce a number of other important by-products among which are grease, edible and inedible tallow, oleo oil, and oleostearine. The fat from sheep and cattle is known as tallow. Sheep fat is used widely for soap, candle making, and lubricants. Beef fat is also used thusly, and in food products as well. The fat from the heart, caul, and around the kidneys gives the finest edible tallow, the best grades of which are used to produce oleo oil and oleostearine. The distinction between edible and inedible tallow is somewhat vague and depends in part on the degree of refinement to which the tallow has been subjected and the existence of inspection and sanitary regulations governing the slaughtering processes. Tallow from condemned animals can as a rule be classified as inedible, and, in consequence, is used in soap or other industrial products.[5]

The distinction between tallow and grease originating in the meat packing industries is also rather indefinite. Grease may consist of inedible lard or the lower grades of beef and sheep fat, as well as extractions from ordinary refuse material. A significant proportion of the grease used in commercial channels originates outside of the packing industries and represents more or less the results of salvaging.

Vegetable Oils

While animal fats are obtained by rendering processes, the vegetable oils with few exceptions are obtained by compressing the seed or nut which contains the oil. Most of these oils are obtained by hot pressing, for example, coconut, palm kernel, soybean, cottonseed, and linseed. As a rule such oils undergo additional processes involving refinement before they are suitable for either edible or industrial use. Although most of the vegetable oils are edible, they enter extensively into the manufacture of inedible compounds. As in the case of certain animal fats, a number of vegetable oils are used directly. Linseed oil is commonly used by painters; olive oil is a well-known salad dressing ingredient; and cottonseed oil is used extensively for frying.

The utilization of the individual fats and oils by different outlets is shown later in table 12. The data included in this table, which are averages for 1937-41, are the proportions of the total used in the manufacture of different products and used directly.

Competitive Relationships

As indicated in the previous discussions, the main outlets for most fats and oils, aside from direct use, are the manufacture of shortenings, margarine, and various other food products; soap; paints; varnishes, and other products of the drying industries; and other miscellaneous industrial products. Fats and oils have many properties in common but some possess properties making them especially adaptable to the manufacture of particular products. Consequently, many fats and oils are both complementary and substitutable.[6] In the range within which fats and oils have properties in common and are substitutable in the manufacture of a specified product, competition is intensive, the demand for the individual item is elastic, and, therefore, the extent of its use is determined largely by the price relative to the prices of competing fats and oils. When a fat or oil has peculiar properties which make it especially suitable in a specified use,

[5] Alsberg, C. L., and Taylor, A. E., The Fats and Oils: A General View. Pp. 24-25. Stanford University Press. 1928.

[6] Alsberg, C. L., and Taylor, A. E., The Fats and Oils: A General View. Pp. 84-85. Stanford University Press. 1928.

competition of the item with others is subordinate, and, in consequence, the demand of it is likely to be inelastic. Over a period of time, technological changes involved in the preparation of an individual fat or oil may increase its adaptability to such an extent that it can be substituted for others without significant changes in the product.

Although many fats and oils are substitutable in the manufacture of a certain product, their properties may be such as to limit their adaptability to the manufacture of other products. This difference in adaptability prevails not only as between the food and industrial groups of products, but also between the products within the respective groups. Others are of such a character that they can be used for different products. In consequence, individual fats and oils not only compete among themselves in a particular use, but also the manufactured products compete one with the other for certain items because of the wide adaptability of the latter. An individual fat or oil whose properties are such as to render it a strong competitor with others, not only in one use but in one or more other uses, possesses a demand that is more elastic than if its range of competition was limited to a single use. An increasing demand for particular items resulting from their expanded use in food or other high-priced products may cause the prices of these items to so advance as to discourage their use among the products of the lower-priced field.

LARD AND OTHER SHORTENINGS

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Production, Trade, Disappearance

Lard is a joint product of pork production; therefore, its output depends largely on the number of hogs. But the demand for lard as reflected in price, as well as the demand for pork and the supply of corn, affects the weights at which hogs are marketed and hence the supply of lard. Production of lard was characterized by an increasing trend from 1912 to 1923. The production in the latter year was 64 per cent larger than in 1912. No distinct trend was evident in the following 10 years; but during the middle 1930's, the decreased number of hogs and reduced feed supplies resulted in the rapid decline of the output of lard. The production of 1,276 million pounds in 1935 was the smallest annual output of any year during the period 1900-42. During the past six years, production has increased, the output averaging about 2,300 million pounds in 1941-42.

Up to 1930 the United States was a relatively heavy exporter of lard, exports tending to increase when the production was at a high level. For the period 1923-29 they averaged about 35 per cent of the annual output. The decline in exports subsequent to 1929 was in part due to a declining export demand for lard and in part to the low rates of production prevailing during 1935-37. Although production again reached a high level in 1939-40, exports constituted less than 13 per cent of the production.

The factory production of other shortenings usually called lard substitutes increased rapidly from 1912 to 1919, but during the next five years when the production of lard was unusually high, it declined, averaging around 800 million pounds. Fairly stable but higher levels prevailed from 1925 to 1931, but production declined to less than 1,000 million pounds in the succeeding two years. Since 1935, the trend of factory production of shortenings has been almost opposite to that of lard with a peak output of 1,595 million pounds in 1937.

The combined per capita consumption of lard and its substitutes during the past 31 years has ranged from a

low of 17.8 pounds in 1921 to a high of 24.8 pounds in 1941 (figure 2). Although the per capita consumption of both lard and lard substitutes has been quite variable, the annual changes in consumption of the two types of shortenings have usually tended to be in opposite directions. Consequently, the variation in the combined consumption has been much less than that of either of the components. Lard consumption was maintained at especially high levels in 1923-24, 1932-33, and 1940, but consumption of lard substitutes reached relatively low levels during these periods.

Prices and Relative Rates of Consumption

The prices of both lard and lard substitutes were unusually high in 1919 and 1920. Since the latter year the general trend of both series of prices has been downward, particularly that of lard. The annual fluctuations of the prices of lard have also been larger (figure 3).

The relative rates of consumption of lard and its substitutes have been closely associated with the relative prices of the two products; that is, when the price of lard is high relative to the price of the substitutes, the proportion that the per capita consumption of lard is of the combined per capita consumption of lard and its substitutes tends to be lower than when the reverse price situation prevails (figure 4). From 1925 to 1931 the price of lard relative to the price of substitutes declined rapidly, but the proportion representing the consumption of lard remained at fairly uniform levels, indicating that the demand for lard was declining relative to the demand for substitutes. Since 1931 both of the two series of proportions have shown marked changes from year to year, but in reverse directions. In view of the close correspondence between the production and the consumption of lard substitutes during the past 10 years, it

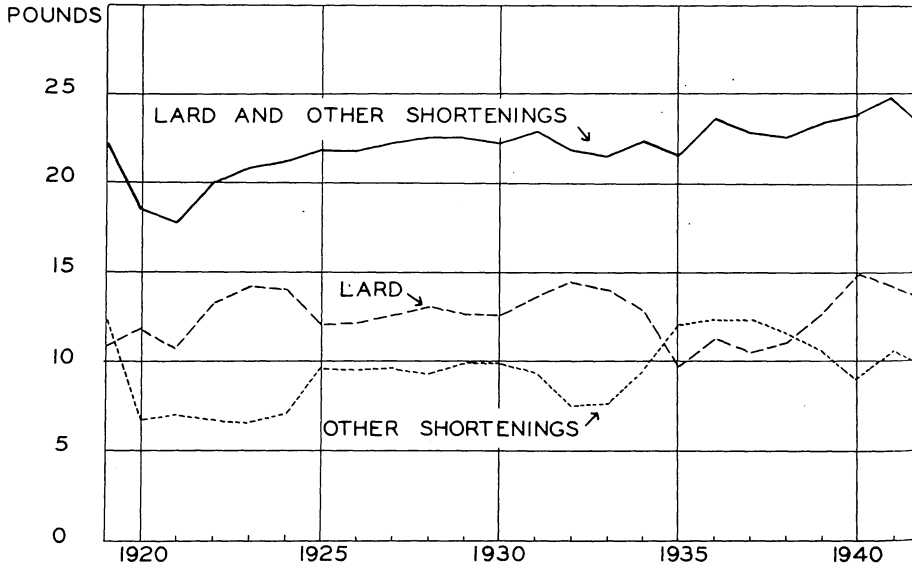

FIG. 2. Per capita disappearance of lard and other shortenings

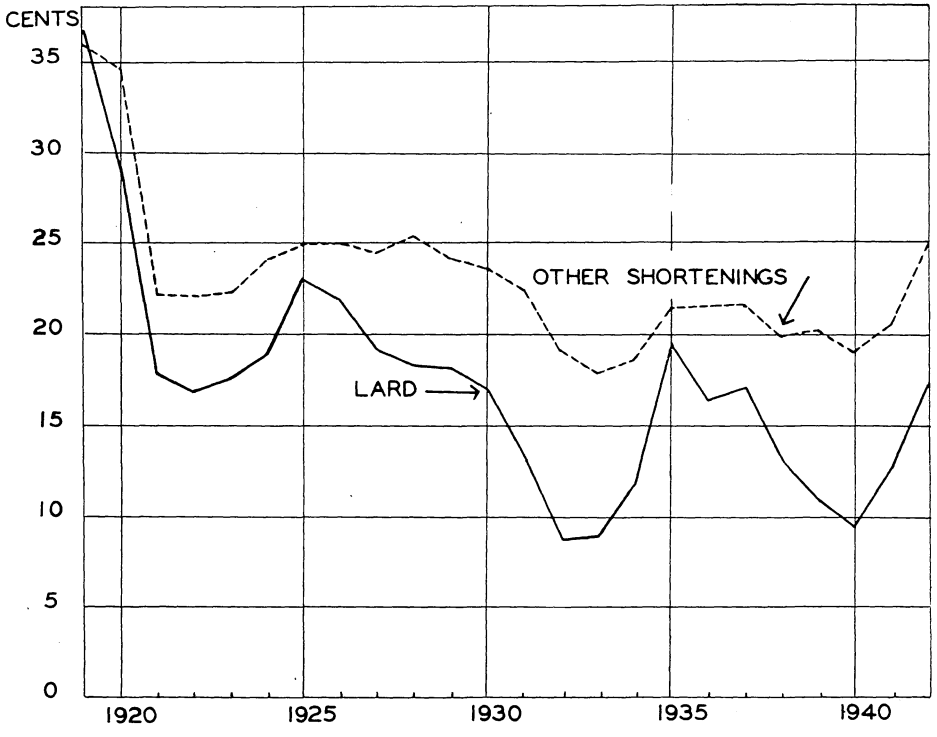

FIG. 3. Retail prices per pound of lard and other shortenings

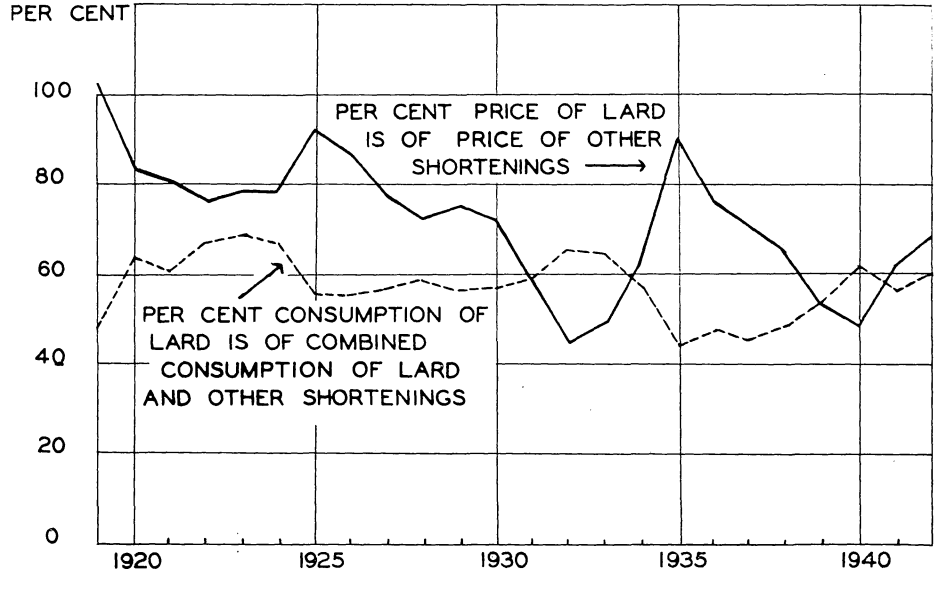

FIG. 4. Relative prices and relative rates of consumption of lard and other shortenings

is evident that the manufacturers of these compounds curtail their output when the prospects are very favorable for a large available supply of lard at relatively low prices.

Consumer Expenditures

The annual fluctuations of the prices of lard and lard substitutes are larger than the changes in the per capita consumption. Since extreme fluctuations in demand occur when the nonfarm income changes rapidly, the more extreme fluctuations in per capita expenditures are also associated with the changes in nonfarm income. In general, the per capita expenditures for lard have shown a downward trend during the past 23 years, although the annual fluctuations have been somewhat less than those of lard substitutes. From 1920 to 1927, per capita expenditures for lard exceeded those for substitutes, but since 1928 they have been less. Expenditures for lard averaged $1.79 per capita in 1937, and expenditures for substitutes $2.67, a differential of 88 cents. In 1941 the differential declined to 32 cents.

Utilization of Fats and Oils in Manufactured Shortenings

Domestic fats and oils have always accounted for a large proportion of the total fats and oils used in the manufacture of shortenings. It was not until 1931 that foreign oils made up as much as 10 per cent of the total. The proportion was highest in 1935 and 1936, reaching 18.1 per cent in the latter year, but by 1942 it had declined to 4.7 per cent (table 7).

Table 7. Shortenings: Percentage Contributed by Principal Items to the Total Weight of Fats and Oils Used in Manufacture, United States, 1920-42*

Item	Average 1920-23	1929	1931	Average 1932-34	Average 1935-36	Average 1937-39	1940	1941	1942
					Per cent				
All fats and oils	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Vegetable	91.0	90.6	88.8	91.5	88.1	92.2	92.9	91.4	88.2
Domestic	88.3	88.8	78.8	87.9	71.5	82.1	88.5	83.7	83.3
Cottonseed	84.0	88.8	76.9	87.0	60.4	68.7	68.8	62.7	54.0
Soybean	.8	.....	.9	.2	5.3	9.7	17.7	15.2	26.1
Peanut	2.5	.....	.5	.5	5.7	3.6	1.9	5.8	2.9
Corn	1.0	.....	.5	.2	.1	.1	.1	†	.3
Foreign	2.7	1.8	10.0	3.6	16.6	10.1	4.4	7.7	4.7
Palm	.....	.1	2.9	2.0	9.0	7.8	2.8	6.1	2.3
Coconut	1.7	1.6	2.8	.8	2.6	1.3	1.5	1.6	.4
Sesame	.....	.....	2.8	.6	2.1	.8	†	†	†
Others	1.0	.1	1.5	.2	2.9	.2	.1	†	2.0
Animal	9.0	9.4	11.2	8.5	11.9	7.8	7.1	8.6	12.0
Land	9.0	8.2	9.6	7.4	9.8	6.5	6.2	8.2	11.6
Tallow, edible	1.7	2.1	5.8	5.2	7.5	4.3	3.3	2.9	4.3
Oleostearine	5.7	3.6	2.3	1.8	2.0	2.0	1.4	1.6	2.4
Oleo	.2	.6	.8	.1	.1	†	.1	.1	.1
Lard and pork fat	1.4	1.9	.7	.3	.2	.2	1.4	3.6	4.8
Marine	.....	1.2	1.6	1.1	2.1	1.3	.9	.4	.4
Total weight, million pounds	777	1,220	1,208	1,052	1,583	1,509	1,196	1,418	1,282

* From data reported in: U.S.D.A. Bureau of Agricultural Economics, The Fats and Oils Situation, Nos. 27, 65, and 76.

† Less than .05 per cent.

Vegetable oils of domestic origin contributed at least 86 per cent of all the fats and oils used in production of shortenings previous to 1931, with cottonseed oil being the main contributor and accounting for no less than 80 per cent of the total. Other oils of the vegetable group were relatively of minor importance except during the years 1917-20. In these years, substantial amounts of peanut and soybean oils were used, the former contributing 4.6 per cent in 1918, and the latter 6.4 per cent in 1920. Coconut oil was the most important foreign oil used previous to 1931, but even it was of relatively minor importance. Among the animal fats, oleostearine contributed around 5 per cent annually to the total weight of all fats and oils used.

Although a considerable amount of cottonseed oil was replaced by other oils, particularly those of the foreign vegetable group in 1931, the more significant changes in the technology of the manufacture of shortenings did not occur until 1935. In the latter year cottonseed oil contributed only 63.9 per cent to the total as compared with 87.2 per cent in the previous year. This decrease was balanced mainly by increases in the proportions contributed by soybean and peanut oils of the domestic vegetable group, and oils of the foreign vegetable group, particularly palm, coconut, and sesame oils. The use of edible tallow also reached its highest level in 1935. For some years the use of this animal fat had been increasing, while that of oleostearine had been decreasing. The decline in the relative importance of cottonseed oil and the increase in the relative importance of soybean oil and oils of the foreign group continued in 1936. In this year cottonseed oil contributed 56.9 per cent, soybean oil 7.1 per cent, and peanut oil 5.5 per cent. The foreign group accounted for 18.1 per cent, palm oil alone making up almost three fifths of the contribution by this group. The more significant changes occurring during the past six years have been the increasing importance of soybean oil and the declining importance of the foreign group. The proportion contributed by soybean oil was almost four times larger in 1942 than in 1936.

Soybeans are produced primarily for the oil content. Increased domestic production of soybean oil in recent years and its adaptation to use in edible products has been mainly responsible for the marked increase in the utilization of this oil in shortenings. Cottonseed oil is a by-product of cotton production, so the supply of it is dependent on the output of cotton. These two oils are distinctly competitive, but the influence of relative prices on the proportions contributed by each to the manufacture of shortenings and other food products is obscured at present because of wartime restrictions regarding their utilization. It is likely that soybean oil will continue to be one of the main competitors of cottonseed oil, and with the removal of restrictions, the extent of its use will be governed mainly by its price relative to the price of cottonseed oil.

BUTTER AND MARGARINE

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Production

The combined production of creamery and farm butter amounted to 1,684 million pounds in 1914 with creamery production accounting for 44 per cent of the total. The combined production of 2,349 million pounds in 1933 was the highest on record up to 1941. Creamery butter production in 1933 was 75 per cent of the total. Following the decline during the next few years, production again increased in 1938 and reached the record high of 2,370 million pounds in 1941. In the

latter year creamery production constituted 80 per cent of the total.

It was not until World War I that the annual production of margarine exceeded 150 million pounds. The output of 315 million pounds in 1918 was more than twice that of 1914. Following the high output of 369 million pounds in 1920, production declined to 185 million in 1922, but in the succeeding years it again rose rapidly and exceeded 366 million pounds in 1929. The variations since 1930 have been wide, ranging from a low of 203 million pounds in 1932 to the peak output of 397 million pounds in 1937. The production of colored margarine has never exceeded 6 per cent of the annual total, and since 1931 the proportion has been less than 2 per cent.

Consumption and Prices

Practically all of the annual production of butter and margarine is consumed during the current year; consequently, the per capita disappearance of these products corresponds closely to the per capita production. During the period 1919-42, the combined per capita disappearance of butter and margarine maintained a high degree of uniformity from year to year (figure 5). This was due mainly to the increased production and utilization of margarine in those years when the amount of butter available for consumption was less than normal. The annual per capita disappearance of margarine averaged 18.7 per cent of the combined per capita disappearance of butter and margarine in 1918-20, but in subsequent years the proportion has never exceeded 15.8. It averaged 12.6 per cent during the period 1931-42. The inverse relationship between the annual changes in the per capita consumption of butter and margarine is shown in figure 6.

Manufacturers of margarine tend to expand their output when the production of butter is low, realizing that limited supplies and relative high prices of butter result in an expansion of the market for margarine, particularly among low-income consumers. The close correspondence between annual changes in the retail price of butter and the per capita disappearance of margarine is shown in figure 7.

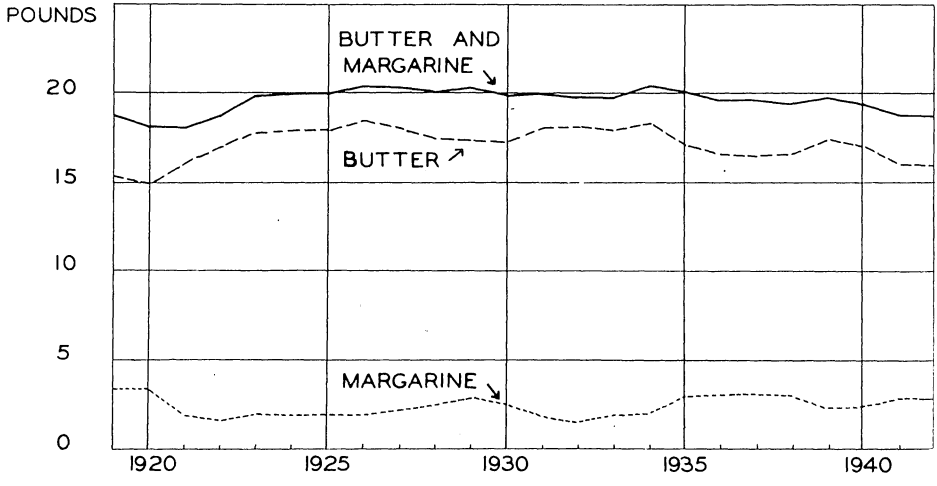

FIG. 5. Per capita disappearance of butter and margarine

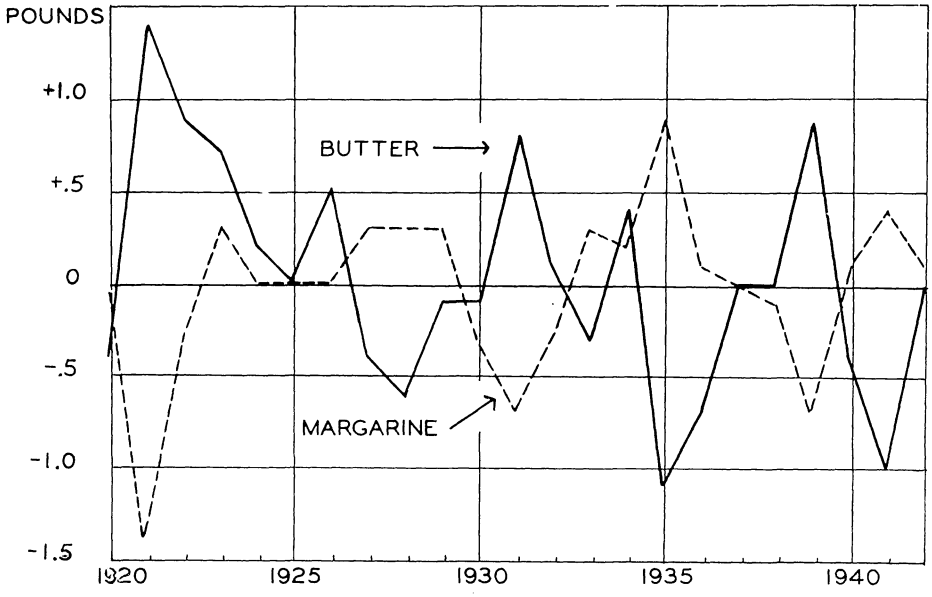

FIG. 6. Annual changes in the per capita disappearance of butter and margarine

Consumer Expenditures for Butter

The annual changes in United States retail price of butter has been closely associated with the annual changes in nonfarm income. As a consequence of this relationship and the relatively small variation in the consumption of butter, the annual changes in consumer expenditures for butter also depend primarily on changes in nonfarm income. For the period 1919-42, a one per cent change in nonfarm income was accompanied by an average change of .89 per cent in consumer expenditures (figure 8).

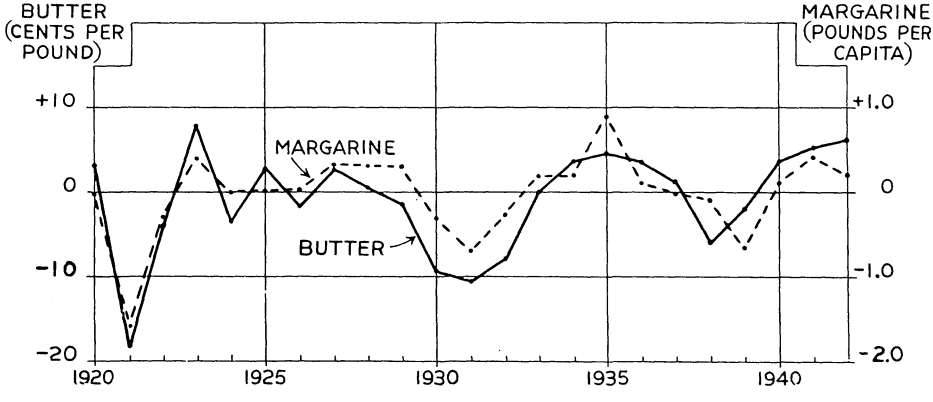

FIG. 7. Annual changes in the price of butter and the per capita disappearance of margarine

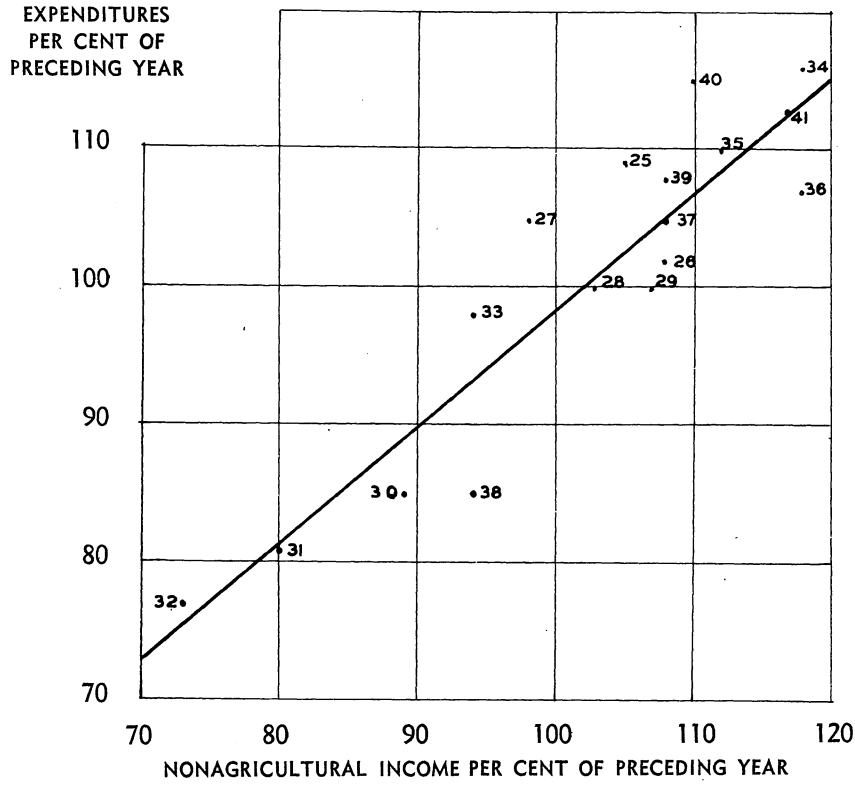

FIG. 8. Relation between nonagricultural income and consumers' expenditures for butter (The numbers within graph refer to individual years)

Utilization of Fats and Oils in Margarine

Fats and oils of domestic origin contributed 75 per cent to the total weight of 276 million pounds of fats and oils used in the manufacture of margarine during the period 1916-20 (table 8). Animal fats were twice as important as the vegetable oils. Oleo oil and lard of the animal group and cottonseed and peanut oils of the vegetable group were the only items of domestic origin which were used in significant amounts. Coconut was the only oil of foreign origin that was used at this time. During the following years and continuing through 1933, the use of fats and oils of domestic origin declined rapidly in importance. In the latter year animal fats contributed only 14 per cent and vegetable oils of domestic origin about 11 per cent to the total of 200 million pounds of fats and oils used in margarine. Coconut oil accounted for 75 per cent of the total utilization. Beginning in 1934, a rapid rise occurred in the relative importance of the vegetable oils of domestic origin, with cottonseed replacing coconut oil. This change was in part a response to the tax levied on the processing of coconut oil. The transition from the use of coconut to domestic vegetable oils was particularly marked during the past three years owing to the rapidly disappearing stocks of the former.

The rise in the use of soybean oil

Table 8. Margarine: Percentage Contributed by Principal Items to the Total Weight of Fats and Oils Used in Manufacture, United States, 1916-1942*

Item	Average 1916-20	Average 1921-25	Average 1926-30	Average 1931-35	Average 1936-39	1940	1941	1942
				Per cent				
All fats and oils	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Vegetable	49.6	54.3	69.4	85.5	92.7	90.6	89.2	89.1
Domestic	25.0	14.8	12.6	18.6	62.9	79.7	76.9	87.4
Cottonseed	14.2	10.5	10.2	16.8	43.6	45.0	50.5	48.0
Soybean	.8	†	.2	.2	18.0	33.8	25.5	38.5
Peanut	9.4	4.1	2.2	1.6	1.0	.7	.7	.3
Corn	†	.1	†	†	.3	.2	.2	.5
Others	.6	.1	†	†	†	†	†	.1
Foreign	24.6	39.5	56.8	66.9	29.8	10.9	12.3	1.7
Coconut	24.6	39.4	56.3	66.4	24.4	8.5	10.0	1.0
Babassu	.....	.....	.....	.1	4.3	2.4	.3	.1
Palm kernel	.....	.....	.....	.....	1.0	.....	.3	.....
Palm	.....	.1	.4	.4	.1	†	1.7	.4
Others	†	†	.1	†	†	†	†	.2
Animal	50.4	45.7	30.6	14.5	7.3	9.4	10.8	10.9
Oleo	31.0	25.0	17.9	8.2	4.7	5.6	6.2	6.5
Oleostearine	1.2	2.8	2.2	1.8	1.2	1.3	1.0	.8
Lard, neutral	14.6	15.6	8.9	4.0	.9	2.0	2.8	2.3
Oleo stock	1.8	1.4	.7	.5	.5	.5	.7	1.1
Butter	1.6	.9	.9	†	†	†	†	†
Others	.2	†	†	†	†	†	.1	.2
Total weight, million pounds	276	188	261	216	302	257	297	347

* From data reported in U.S.D.A. Bureau of Agricultural Economics, The Fats and Oils Situation, Nos. 27, 37, 49, 60, 72, and Oleomargarine, August 1936.

† Less than .05 per cent.

is of special significance to farmers in the north central states. Less than 2 million pounds of this oil were used in the manufacture of margarine in 1935 as compared with 100 million pounds of cottonseed; but by 1940 more than 87 million pounds were used. In 1942 cottonseed oil accounted for 48 per cent, soybean 38.5 per cent, and coconut oil only one per cent of the 347 million pounds of fats and oils used in margarine.

SOAP

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Utilization of Fats and Oils in Soap

The manufacture of soap utilizes both hard and soft oils. A number of the former are of a quick-lathering character, the more common of which are coconut, palm kernel, and babassu oils. Others of the hard type which are slow-lathering include tallow, grease, whale and fish, palm and small amounts of edible tallow, and oleostearine.

The soft oils used in manufacturing soap are of vegetable origin, the more important of which are cottonseed and cottonseed oil foots, inedible olive and olive oil foots, and soybean oil. In addition to fats and oils, a considerable amount of rosin is used, contributing between 5 and 8 per cent of the total weight of saponifiable materials used in manufacture. The use of rosin in soap has declined somewhat during the past 10 years, as a result of growing consumer preference for soap flakes and powders and a diminishing demand for yellow laundry soap.

The total weight of fats and oils used in the manufacture of soap increased from less than 1,000 million pounds in 1921 to almost 1,700 million pounds in 1929. From 1930 to 1938, utilization averaged around 1,530 million pounds, but it increased rapidly during the next three years and exceeded 2,200 million pounds in 1941. Fats and oils of domestic origin have been the most important items entering into soap manufacture, accounting for about two thirds of all fats and oils used.

The group of slow-lathering oils is the most important contributor to the total weight of fats and oils used in making soap (table 9). In terms of five-year averages, the proportions changed but slightly from 1921 to 1940, ranging from 61.1 per cent in 1926-30 to 63.9 per cent in both of the five-year periods 1931-35 and 1936-40. Accompanying the decline in the available supply of the oils of the quick-lathering group, particularly coconut oil, the proportion rose to 83.4 per cent in 1942. The trends in the use of the various fats and oils of the slow-lathering group have been quite irregular. Inedible tallow, the most important item of this group, accounted for 34.1 per cent of the total weight of fats and oils used in the manufacture of soap in 1921-25. The proportion declined to 28.0 per cent in the succeeding five-year period but averaged 41.4 per cent in 1936-40. The large increase in the use of the slow-lathering oils in 1942 was largely due to the more extensive use of inedible tallow. Grease, a fat closely resembling the lower grades of inedible tallow, also has been used more extensively during the past three years than during the preceding 10-year period.

Although whale and fish oils contributed 9 per cent to the total in 1936-40, the proportion declined to 3.7

Table 9. Soap: Percentage Contributed by Principal Items to the Total Weight of Fats and Oils Used in Manufacture, United States, 1921-1942*

Item	Average 1921-25	Average 1926-30	Average 1931-35	Average 1936-40	1940	1941	1942
				Per cent			
All fats and oils	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Hard oils—tallow class	83.8	84.1	85.9	86.8	92.0	92.4	91.5
Slow-lathering	62.4	61.1	63.9	63.9	67.9	69.6	83.4
Tallow, inedible	34.1	28.0	38.0	41.4	43.2	46.6	59.8
Whale and fish	6.1	8.0	7.3	9.0	5.9	3.4	3.7
Grease	16.2	15.5	8.4	7.7	14.1	13.7	17.1
Palm	5.7	9.2	10.0	5.8	4.7	5.7	2.8
Others	.3	.4	.2	†	†	.2	†
Quick-lathering	21.4	23.0	22.0	22.9	24.1	22.8	8.1
Coconut	20.6	19.6	20.8	19.6	21.8	21.3	7.0
Palm kernel	.8	3.4	1.2	2.0	†	.1	.1
Babassu	.....	.....	.....	1.3	2.3	1.4	1.0
Soft oils	16.2	15.9	14.1	13.2	8.0	7.6	8.5
Cottonseed oil foots and other foots	6.3	7.3	10.2	10.1	5.5	5.5	5.9
Cottonseed	1.8	.6	.2	.2	.2	.1	.1
Soybean	.4	.2	.2	.6	.9	1.1	1.6
Olive	2.3	3.2	2.3	1.2	.9	.4	.3
Others	5.4	4.6	1.2	1.1	.5	.5	.6
Total weight, million pounds	1,208	1,599	1,491	1,674	1,822	2,270	1,985

* From data reported in U.S.D.A. Bureau of Agricultural Economics, The Fats and Oils Situation, Nos. 27, 64, and 74.

† Less than .05 per cent.

per cent in 1942. The available supply of these oils has been definitely restricted by the war.

Palm oil reached the peak of relative importance in the manufacture of soap in 1931-35, accounting for 10 per cent of all of the fats and oils used. The reduction since 1935 has been due in part to the processing tax of 3 cents per pound, and to the limited supply particularly during the past two years.

The importance of the group of quick-lathering oils has been due primarily to coconut oil. Previous to 1942, the latter contributed about 20 per cent to the total weight of fats and oils used in the manufacture of soap. The limitations in the supplies of coconut oil resulted in the proportion declining to 7.0 per cent in 1942. The other two quick-lathering oils have been relatively unimportant. It is likely that the use of babassu oil, an important product from South America, may be increased in the future, depending in part on the greater cultivation of the babassu nut in that area.

The proportions contributed by the soft vegetable oils experienced a declining trend during the 21-year period, dropping from an average of about 16 per cent in 1921-30 to around 8 per cent in 1940-42. The decline in recent years has been due mainly to the decrease in the use of cottonseed oil foots and other foots, and to a lesser extent in the use of olive and other miscellaneous oils. Soybean oil has never been an important contributor in the manufacture of soap, although the trend has been slightly upward.

Price and Substitution of Fats and Oils

There is a wide range of adaptation among fats and oils in the manufacture of the different kinds of soap, and, as shown by the above, a number of these are substitutable.[7] While the extent of substitution from year to year is in part a response to relative prices, the influence of the price situation is somewhat obscured. The different types of soap—toilet, laundry, and household—have their own basic demands, and data are not available to show the relative production of the different types. Further, manufacturers of trade-mark soaps endeavor to keep them uniform in order to retain established markets. In consequence, there is a certain range within which they can substitute the various fats and oils and still maintain uniformity in the soap, but probably within this range they purchase the raw materials on the basis of price. Outside of this range, they cannot substitute fats with maintenance of uniformity, but must buy the fats and oils at market prices. The properties of trade-mark toilet soaps are held more rigid than those of trade-mark household and laundry soaps, but the properties of the latter are held more rigid than those of unbranded soaps. As a rule, the lower the type of usage, the less the necessity for uniformity. In consequence, the range of substitution tends to vary inversely with the price of the soap.

The marked changes which occurred in 1942 in the manufacture of soap were due primarily to the limitation of supply and to government restrictions relative to the use of specific fats and oils, rather than to the price differentials prevailing between the different items. Although the quick-lathering oils have been restricted to processes such as soap manufacture in which a high percentage of glycerine can be recovered, the limited supply of these oils is such that the hard-lathering group will continue to account for a very high proportion of all fats and oils used in the soap industry. The

[7] Alsberg, C. L., and Taylor, A. E., The Fats and Oils: A General View. Pp. 86-87. Stanford University Press. 1928.

reversal of the tendencies in 1942 will depend mainly on how soon the imports of coconut oil from the far east can be resumed.

The use of the soft vegetable oils in hard soap manufacture, with the exception of cottonseed and other oil foots, is limited not only by the nature of the product but also by the demand for these oils in other uses. The prices of cottonseed oil and soybean oil normally are too high relative to prices of tallow and grease to permit hydrogenation and use in the manufacture of hard soap on any wide scale.

PAINTS, VARNISHES, AND OTHER PRODUCTS OF THE DRYING INDUSTRIES

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Fats and oils are used not only in the manufacture of the products of the drying industries, such as paints and varnishes, linoleum, oil cloth, and printing ink, but also in mixing with prepared paints and varnishes. The rate of production and utilization of the products of the drying industries depend to a large degree on the rate of industrial activity; consequently the major changes in the rate of utilization of the various fats and oils in these industries are closely associated with the major changes in the rate of industrial activity (figure 9). The disappearance of fats and oils in the drying industries and the index of industrial activity increased rapidly from 1921 to 1929, and then declined to relatively low levels in 1932. In the latter year the disappearance of fats and oils approximated 474 million pounds as compared with 931 million in 1929. Both disappearance of fats and oils and industrial activity increased rapidly during the next 10 years, except for the recession in 1938, and reached their highest levels in 1941-42. The utilization of fats and oils in the drying industries in 1941 was

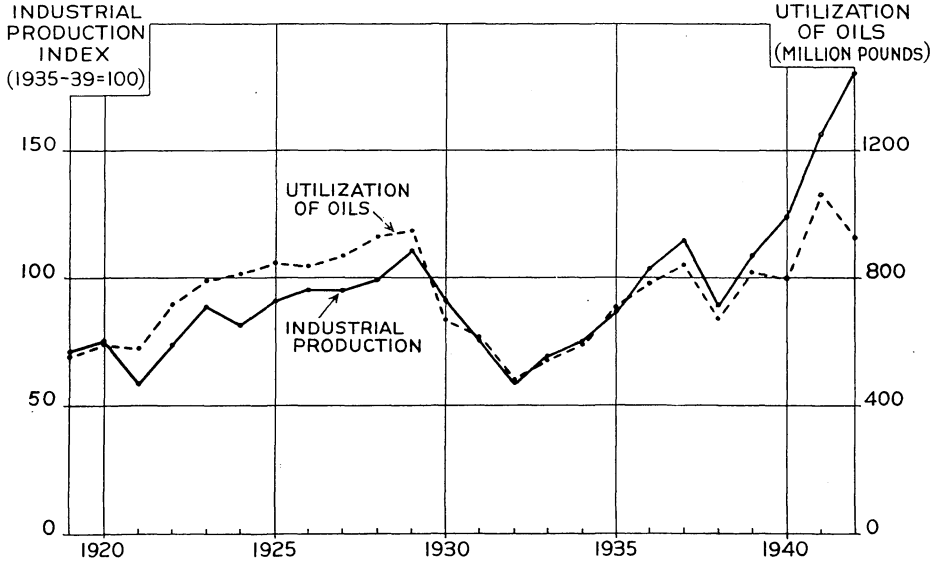

FIG. 9. Industrial production and utilization of fats and oils in the drying industries

Table 10. Products of the Drying Industries: Percentage Contributed by Principal Items to the Total Weight of Fats and Oils Used in Manufacture and Used Directly, United States, 1931-1942*

Item	Average 1931-35	1936	Average 1937-40	1941	1942
			Per cent		
All fats and oils	100.0	100.0	100.0	100.0	100.0
Linseed	71.1	61.7	70.4	74.4	85.2
Tung	17.1	14.9	12.9	6.6	1.8
Perilla	4.3	13.6	4.9	.8	.4
Fish	4.3	5.1	5.2	5.3	2.9
Soybean	2.3	2.3	3.3	4.7	2.8
Castor	.4	.6	1.6	4.4	5.8
Oiticica	.....	.4	1.4	3.5	1.0
Others	.5	1.4	.3	.3	.1
Total weight, million pounds	586	774	774	1,054	915

* From data reported in U.S.D.A. Bureau of Agricultural Economics, The Fats and Oils Situation, Nos. 39 and 75.

1,054 million pounds, or 13 per cent larger than in 1929.

During the period 1937-41, the consumption of fats and oils in the paint and varnish industry accounted for 84 per cent of the total utilization by the drying industries; the manufacture of linoleum and oil cloth accounted for 13 per cent; and the manufacture of printing ink, 3 per cent. Of the total utilization in paints and varnishes, about two thirds entered into the manufacture of these products and one third was used directly.

The more important fats and oils used in the drying industries are linseed, tung, perilla, fish, soybean, castor, and oiticica. Data on the percentage contribution of these oils to the total weight of all fats and oils used in these industries are available only for the period 1931-42. During this period significant changes occurred in the relative importance of the different items (table 10). From 1932 to 1936 the use of linseed oil, while gaining in absolute volume, decreased proportionately from 77 per cent to 61 per cent. This decline in the proportion contributed by linseed oil was balanced mainly by a marked increased use of perilla oil and a slight increase in fish and some of the minor oils. During the following years the proportion contributed by linseed oil increased, as likewise did the proportions contributed by soybean, castor, and oiticica oils. The use of tung and perilla oils declined in importance as a result of decreased supplies and relative high prices. Linseed oil accounted for more than 85 per cent of the fats and oils used in the drying industries in 1942, tung oil 1.8 per cent, and perilla oil .4 per cent. Castor oil has become increasingly important in the drying industries, particularly in the manufacture of paints and varnishes. This oil contributed 5.8 per cent to the total weight of fats and oils used in the drying industries in 1942, compared with less than one per cent in 1938.

THE SUPPLY AND DEMAND SITUATION

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One of the first results of the outbreak of the war in Europe was the reduction in outlets for fats and oils of exporting countries; in consequence, large surpluses accumulated in these countries, particularly in the Philippine Islands, East Indies, British India, West Africa, and Argentina. The United

Table 11. Purchases of Fats and Oils by the Food Distribution Administration, 1941-43*

Item	1941	1942	1943
		Million pounds	
Butter	†	34	120
Lard and rendered pork fat	326	654	882
Other animal fats and oils‡	2	30	61
Linseed oil	.....	70	1,391
Other vegetable oils	.....	100	71
Shortening	.....	46	62
Margarine§	1	77	72
Soap (fat content)§	.....	16	23
Total fat equivalent	329	1,027	1,682

* U.S.D.A., The Fats and Oils Situation, No. 84, p. 6.
† Less than 500,000 pounds.
‡ Includes fish and fish liver oils.
§ Fat content estimated at 80 per cent for margarine and 55 per cent for soap.

States was not materially affected during the first two years of the war in Europe, 1940 and 1941, although the imports of some oils from the Far East were restricted either because of the decreased shipping facilities or the conflict between China and Japan. In consequence, the supply of fats and oils in the United States was such as to fulfill the domestic requirements without much difficulty.

The Japanese aggression in the Far East, the reduction in fishing and whaling activities, and the difficulties of shipping changed the fat and oil situation in the United States in 1942 from one of comparative abundance to one of relative scarcity. Although the domestic production of fats and oils increased about 10 per cent in 1942, the requirements, under the stimulus of war needs and rising incomes, increased even more rapidly. The relative scarcity became even more marked in 1943, and probably will continue until the cessation of the war.

Increased war needs have arisen not only because of the enlarged demands of the military and manufacturers who are producing armaments and munitions, but also as a result of the operation of the lend-lease program. The purchases of fats and oils by the Food Distribution Administration, intended primarily for lend-lease export, increased from 329 million in 1941 to 1,027 million pounds in 1942, the latter figure representing about 10 per cent of the domestic production in 1942. The purchases amounted to 1,682 million pounds in 1943 (table 11).

Lend-lease exports will continue to be large not only during the remaining period of the war but also in the early postwar period because of the necessity of supplying fats and oils for relief of the populations of continental European countries. It is estimated that at least one half of the fats and oils required for relief in Europe during the first postwar year will probably be drawn from the United States.[8]

The civilian demand for fats and oils or the products into which they have been manufactured has been greatly intensified as a result of an increase in nonfarm income arising from the high level of employment and high wages in industry. This expanded demand, in conjunction with the restricted supply for civilian consumption and the application of price ceilings, has necessitated rationing of practically all the fats and oils, not only to consumers, but also to the processors of the various food and industrial products.

[8] U.S.D.A. Bureau of Agricultural Economics. The Fats and Oils Situation, No. 79, p. 12. 1943.

The national fat and oil situation is a complex one, owing in part to the interchangeability of the various items in manufacture and to the competition that prevails between certain products. In consequence, supply and demand as they relate to some particular fat or oil affect and are affected by the supply and demand for other items. It is seldom that any one fat or oil occupies an independent status. Soybean and cottonseed oil are strong competitors in the manufacture of both margarine and lard substitutes. Without restrictions, the relative rates of the consumption of these items in the manufacture of margarine and lard substitutes will depend mainly on relative prices. To a lesser extent, soybean and linseed oil are competitors in the manufacture of paints and varnishes, but the utilization of soybean oil is limited because linseed oil possesses superior drying qualities. In the case of all manufactured products, the respective utilization of the various items tends to change, either because of changes in relative prices or because of an increase in the range of adaptability of the specific items.

The influence of price is also evident on the relative rates of consumption of food products. The consumption of oleomargarine is influenced primarily by the price of butter; that is, as the price of butter increases, the per capita consumption of margarine tends to increase, as long as consumer income remains the same and in particular when consumer income is at a relatively low level. A similar situation prevails in the case of lard and lard substitutes, although an additional factor in the situation is of considerable importance. Lard substitutes apparently possess certain physical properties which make them somewhat more desirable than lard to many consumers. Progress is being made at the present time in developing a type of lard more attractive to those consumers and which will, therefore, improve the competitive position of lard.

The rapid expansion in the production of milk, hogs, flaxseed, and soybeans during the past few years has been in part a response to favorable prices and in part due to the endeavor to meet wartime demands. It is hardly to be expected that the present enlarged demands and relatively high prices will be maintained indefinitely following the cessation of the war. Much will depend on the level of nonagricultural employment. If a high level of employment prevails, the Minnesota producer of butterfat, even at the present rates of production, will benefit greatly because the price of butter and the expenditures for this product depend primarily on the income status of the nonfarm population. The economic status of the dairy farmer is so closely associated with that of the nonfarm group that full nonfarm employment is of prime interest to him.

While the demand for lard is also influenced by the rate of employment in industry, but to a much lesser degree than that for other pork products, the main factors influencing the lard situation in the postwar period will be the degree of competition between this product and its substitutes and the availability of export outlets. The development of a type of lard possessing more desirable physical characteristics from the consumer's standpoint will be of distinct value to the hog producer. It is doubtful if the export market for lard again will be as favorable as in the 1920's when exports of this commodity represented about 35 per cent of the domestic output. The large decline in the export trade during the 1930's was in part due to the lower rates of production, but it was definitely influenced by the development of a greater self sufficiency in the continental countries of Europe, particularly in Germany and Italy, and the empire preference policy of Great Bri-

tain which favored the imports of fats and oils from the various British dominions. Nevertheless, a greater freedom of trade during the postwar period, resulting from a continued removal of international trade barriers, will greatly facilitate the movement of lard and other pork products in export channels and will be of definite value to the domestic hog producer.

It is likely that a higher rate of building construction, particularly residential, will prevail during the postwar period. If so, the producer of flaxseed will benefit because the demand and price of linseed oil, the most important item used in the manufacture of paints and varnishes, are dependent primarily on the rate of construction activity. The acreage planted to flax in Minnesota in 1940-43 was about two and one-third times the acreage in 1935-39. The production of flaxseed in the United States in 1940-43 was about 40 per cent greater than the total crushings of flaxseed in 1935-39, including the crushings from the domestic crop and imported seed, and 10 per cent larger than in 1925-29. Even though a high rate of building construction does occur during the postwar period, it is evident that the Minnesota and other producers of flaxseed in the northwest whose costs are relatively high will find it necessary to adjust their acreage because of the resumption of imports of flaxseed from Argentina and tung oil from China. This assumes that the tariff rate on flaxseed in the postwar period will be that provided by the existing reciprocal trade agreement with Argentina.

Termination of the war will be followed in a relatively short period of time by the resumption of imports of tropical oils which will become competitors of cottonseed and soybean oils in the manufacture of margarine and lard substitutes. As soybeans are produced primarily for the oil content in contrast to cottonseed which is a by-product of cotton production, it is probable that a reduction in soybean acreage may be necessary. This reduction is more likely to occur in those regions where the acreage has increased so rapidly during the past few years. Although soybeans have never reached a place of major importance in Minnesota agriculture, the continuation of the present expanded acreage will depend on the success that farmers in southern Minnesota have achieved in producing this crop and the returns received relative to the returns from competing crops.

OUTLETS FOR FATS AND OILS

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The following discussion of the utilization of individual fats and oils by different outlets and the data in table 12 are based on the average disappearance of the various items during the five-year period 1937-41.

Animal Fats and Oils

Edible Tallow—Factory consumption of this fat averaged 62 million pounds in 1937-41 or more than two thirds of the total disappearance of 90 million pounds. Factory use was primarily in the manufacture of shortenings.

Inedible Tallow and Greases—The total disappearance of these fats averaged 1,165 million pounds or almost 20 per cent of the total disappearance of all animal fats and oils except butter and lard. Practically all went into industrial uses, the manufacture of soap accounting for 83 per cent of the total disappearance, and miscellaneous factory products, 17 per cent.

Oleo Oil—About 80 per cent of the total consumption of 76 million pounds was used directly, primarily as a cooking and frying oil. Most of the remainder was used in the manufacture of oleomargarine.

Oleostearine—The manufacture of food products furnishes the most important outlet for this fat. Shortenings accounted for 61 per cent of the total disappearance, margarine almost 8 per cent, and other edible products 11 per cent. About 19 per cent was used directly.

Fish and Fish Liver Oils—These oils, in general, are obtained from various types of fish and have a wide variety of uses, but more than 40 per cent of the average annual consumption of 238 million pounds went into the manufacture of soap and 18 per cent into the manufacture of products of the drying industries. While fish oils cannot be used to replace linseed oil in the manufacture of ordinary paints, they possess certain qualities which make them especially adaptable to the preparation of special paints.[9] The group of miscellaneous products which accounted for 16 per cent of the total consumption includes caulking compounds, core oils, illuminating oils, insecticides, lithographing products, and patent leathers. Its use in food manufacture is limited to shortenings.

Marine Mammal Oils—The use of these oils which are obtained principally from the whale is mainly in the manufacture of soap. Seventy-one per cent of the consumption of 59 million pounds was used in soap manufacture, and 12 per cent in miscellaneous manufactured products.

Vegetable Oils

Babassu—This oil is obtained from the babassu nut imported from Brazil. It has been only in recent years that its domestic use has reached significant amounts, the disappearance in 1937-41 averaging 49 million pounds. Soap furnished the most important outlet, accounting for 54 per cent of the total consumption. About 37 per cent of the total consumption was used in manufacturing margarine and other foods.

Castor Oil—The use of this oil has increased rapidly in recent years. The total consumption averaged 89 million pounds in 1937-41, the manufacture of the products of the drying industries and miscellaneous products accounting for 54 per cent of the total. Dehydrated castor oil has been used increasingly in the drying industries as a substitute for tung and perilla oils.

Coconut—Most of the coconut oil used in the United States arrives here as oil but some is obtained from crushings of imported copra, the dried product of the meat of the coconut. The most important outlet for the use of this oil is the manufacture of soap which accounted for almost 63 per cent of the total consumption of 604 million pounds. The proportions used in the three groups of food products were: shortenings, about 3 per cent; margarine, 8 per cent; and other edible products, 9 per cent. The use of coconut oil in the manufacture of margarine has declined rapidly. In 1935 the manufacture of margarine utilized 174 million pounds, or 23 per cent of the total consumption of coconut oil; but in 1941, less than 30 million pounds were used or about 4 per cent of the total. Large amounts of this oil are also used directly in cooking. The short supply of coconut oil and government restrictions on its use resulted in its disappearance declining to 183 million pounds in 1942.

Corn—More than 50 per cent of the average annual consumption of 164 million pounds of this oil was used in the manufacture of various products, the most important of which was "other edible products," such as salad dressings. Its extensive direct use is as a salad and cooking oil. An increased industrial use of corn will probably result in an increased output of corn oil.

Cottonseed—With the exception of lard and butter, this oil is used in

[9] Fats and Oils Situation, No. 26.

larger amounts than any other fat or oil, the consumption averaging more than 1,550 million pounds in 1937-41. While significant amounts were used directly, almost 87 per cent was used in manufacture of various food products. Shortenings accounted for 62 per cent of the total disappearance; margarine, 9 per cent; and other edible products, 16 per cent.

Linseed—The use of linseed oil is confined almost exclusively to the manufacture of the various products of the drying industries or in mixing with prepared paints and varnishes. In consequence, the variation in consumption

Table 12. Utilization of Various Fats and Oils in Manufacture of Food and Industrial Products and in Direct Use, United States, Average 1937-1941

Use	ANIMAL FATS AND OILS					
	Edible tallow	Inedible tallow and greases	Fish and fish liver	Marine mammal	Oleo	Oleo-stearine
	Per cent					
Total	100.0	100.0	100.0	100.0	100.0	100.0
Manufacture	68.5	100.0	81.6	83.0	20.2	81.0
Food products	65.5	.....	6.4	*	19.5	79.5
Shortenings	61.6	.....	6.4	*	.8	60.5
Margarine	.....	.....	.....	.....	18.6	7.8
Other edible	3.9	.....	.....	.....	.1	11.2
Industrial products	2.8	99.9	74.7	83.0	.7	1.5
Soap	1.4	82.8	40.1	71.0	.2	.8
Products of the drying industries	.....	.1	18.3	.....	.....	.....
Miscellaneous	1.4	17.0	16.3	12.0	.5	.7
Loss	.2	.1	.5	*	*	*
Direct use	31.5	.....	18.4	17.0	79.8	19.0
Average disappearance, million pounds	90.3	1,165.1	237.9	58.9	75.9	42.3

Use	VEGETABLE OILS							
	Babassu	Castor	Coco-nut	Corn	Cotton-seed	Lin-seed	Olive, edible	Olive, inedible, and foots
	Per cent							
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Manufacture	94.9	56.0	88.6	50.4	93.7	63.8	6.6	84.2
Food products	36.8	.....	20.4	40.1	86.9	.1	6.3	.....
Shortenings	.8	.....	3.3	.5	62.2	.1	.....	.....
Margarine	18.9	.....	8.4	.5	8.8	.....	.....	.....
Other edible	17.1	.....	8.7	39.1	15.9	.....	6.3	.....
Industrial products	53.8	56.0	62.8	4.0	.5	63.7	.3	84.2
Soap	53.8	1.8	61.7	2.2	.3	.3	.1	67.2
Products of the drying industries	.....	22.0	.2	.1	*	60.9	.....	.....
Miscellaneous	.....	32.2	.9	1.7	.2	2.5	.2	17.0
Loss	4.3	.....	5.4	6.3	6.3	.....	.....	.....
Direct use	5.1	44.0	11.4	49.6	6.3	36.2	93.4	15.8
Average disappearance, million pounds	48.7	88.5	604.1	163.9	1,552.6	609.5	53.3	24.7

Table 12. Utilization of Various Fats and Oils (Continued)

Use	VEGETABLE OILS (Continued)							
	Palm	Palm kernel	Peanut	Perilla	Rape	Sesame	Soybean	Tung
	Per cent							
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Manufacture	93.3	95.2	71.6	87.1	86.8	58.7	84.1	84.2
Food products	35.1	28.8	65.3	.....	9.7	51.1	65.6	.....
Shortenings	34.1	.9	54.5	.....	9.7	42.2	42.9	.....
Margarine	.4	6.0	2.6	.....	.....	.....	15.3	.....
Other edible	.6	21.9	8.2	.....	.....	8.9	7.4	.....
Industrial products	51.2	62.2	2.0	87.1	76.3	4.9	14.1	84.2
Soap	39.7	62.1	.6	.....	1.9	4.3	3.7	.....
Products of the drying industries	.....	.....	.....	84.9	.9	.....	7.5	81.9
Miscellaneous	11.5	.1	1.4	2.2	73.5	.6	2.9	2.3
Loss	7.0	4.2	4.3	.....	.8	2.7	4.4	.....
Direct use	6.7	4.8	28.4	12.9	13.2	41.3	15.9	15.8
Average disappearance, million pounds	276.9	47.0	98.0	32.9	11.4	16.9	399.7	97.8

* Less than .05 per cent.

from year to year is quite closely associated with industrial activity. The consumption averaged 609 million in 1937-41, factory consumption accounting for about 64 per cent of the total, most of which was used in the manufacture of paints and varnishes. Although current prices of linseed oil in 1942 were above those of oils commonly used in manufacture of shortenings, such as cottonseed and soybean oils, the scarcity of fats ordinarily used in edible products made it desirable to use linseed oil, which was relatively more abundant, as an ingredient in shortenings for lend-lease export.

Olive Oil—This oil is classified as either edible or inedible. The former may be virgin, refined, or pure. Virgin oil represents the first processing of the olives and has not undergone any chemical process. Refined oil is that which has been subjected to some refining process usually for the purpose of clarification. Inferior grades are frequently refined by use of caustic soda. Pure olive oil means that it has not been mixed with other oils, but it may consist of a mixture of virgin and refined. Only a small proportion of edible olive oil is used in food manufacture. Over 93 per cent of the average annual consumption of 53 million pounds, 1937-41, was used directly.

Inedible olive oil which is obtained from the third or fourth pressing and sulfur olive oil or foots are used primarily in the manufacture of soap and miscellaneous industrial products.

Palm—All of the palm oil consumed in the United States is imported from Africa or the East Indies. Most of it is used in factories, the manufacture of shortenings accounting for 35 per cent of the total disappearance of 277 million pounds; soap, 40 per cent; and miscellaneous industrial uses, including the tin and terne plate industry, 12 per cent. The total disappearance of palm oil declined to 131 million pounds in 1942.

Palm Kernel—This oil is similar to coconut and is used largely for the same purposes. Other edible products constituted the most important outlet in food manufacture, accounting for

22 per cent of the average total disappearance of 47 million pounds. About 62 per cent was used by the soap industry. Only small amounts of this oil will be available during the remaining years of the war.

Peanut—The use of this oil is confined principally to the manufacture of food products and direct consumption. The total consumption for the period averaged 98 million pounds, 54 per cent of which was used in shortenings, with smaller proportions in margarine and other edible products. More than 28 per cent was used directly.

Perilla—About 85 per cent of the annual consumption of 33 million pounds of this oil was used in the drying industries. Most of the remainder was used directly. The consumption of perilla oil has declined rapidly during the past six years owing to the difficulties involved in obtaining it from Japan. The disappearance amounted to 112 million pounds in 1936 but was less than 4 million pounds in 1942.

Rape—This oil which is imported from the Far East is of minor importance, the consumption for the period averaging around 11 million pounds. About 10 per cent of this total was used in the manufacture of shortenings and 73 per cent in the manufacture of miscellaneous industrial products.

Sesame—The consumption of sesame oil which is imported from Europe and the Far East averaged 17 million pounds. Shortenings accounted for 42 per cent of the total disappearance, and other edible products 9 per cent. This oil is a superior edible oil and is considered desirable for salad, table, and cooking uses. It is sometimes used as a substitute for olive oil. Direct use averaged more than 41 per cent of the total consumption.

Soybean—The relative importance of soybean oil has been increasing rapidly during the past 10 years. Less than 36 million pounds were consumed in 1931 but more than 718 million pounds were used in 1942. The average for the period 1937-41 was 400 million pounds. The increased use of this oil has resulted primarily from its substitution for other oils in the manufacture of various food and industrial products. The manufacture of shortenings averaged 43 per cent of the total consumption during the five-year period; margarine, 15 per cent; and other edible products more than 7 per cent. Although soybean oil is difficult to saponify, it is used to some extent in hard soap, and hydrogenated soybean oil can be used successfully in soft soap. The soap industry accounted for almost 4 per cent of the total consumption. This oil when subjected to heat treatment is particularly adaptable to the manufacture of white or light-colored enamel paints for interior use. It is one of the semidrying oils and as such cannot be considered a satisfactory substitute for linseed oil. When used with the latter, it usually has been mixed with perilla oil. A mixture of 40 per cent perilla and 60 per cent soybean oil produces a degree of hardness in paints similar to raw linseed oil. About 8 per cent of the total disappearance was used by the drying industries in 1937-41. This oil is also used extensively in cooking, direct use accounting for 16 per cent of the average annual consumption.

Tung—A very small amount of this oil is produced in the United States; consequently, the annual consumption has depended on the volume of imports from China. It is similar to linseed and perilla oils in its properties, and its use is confined mainly to the manufacture of the products of the drying industries. The consumption averaged 98 million pounds in 1937-41, factories using 84 per cent of the total. Most of the remainder was used directly in mixing with prepared paints and varnishes. The disappearance declined to 17 million pounds in 1942.