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THE FIRST PROGRESS REPORT FOR THE STUDY RELATED TO THE REGIONAL DEVELOPMENT PLAN OF THE GREAT CARAJAS PROGRAM OF THE FEDERATIVE REPUBLIC OF BRAZIL

Vol. 2

AGRICULTURAL PRODUCTS PART I

NOVEMBER 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

THE FIRST PROGRESS REPORT
FOR
THE STUDY RELATED TO
THE REGIONAL DEVELOPMENT PLAN
OF THE GREAT CARAJAS PROGRAM
OF
THE FEDERATIVE REPUBLIC OF BRAZIL

Vol. 2
AGRICULTURAL PRODUCTS PART I

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COOPERATION AGENCY

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[1] OILSEEDS

[1] OILSEEDS

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[1-1] GENERAL DESCRIPTION ON OILSEEDS AND OILS

1. INTRODUCTION

Oilseeds are those seeds which are used as materials for the extraction of oil, and the crops which produce oilseeds are called oil crops as against food crops, fiber crops and other group of crops. However, this grouping of crops is not very distinct. For example, soybeans fall under both food crops (especially in Asia) and oil crops, and although cotton is a fiber crop, it can also be classified as an oil crop because its byproduct, cottonseed, is a material for the production of oil. Thirteen kinds of seeds; i.e., soybeans, peanuts, castor beans, sunflower seeds, rapeseeds, sesame seeds, cottonseeds, flux seeds, sufflower seeds, olives, coconuts, palm and Indian hemp seeds, are categorized into oilseeds in the FAO Production Yearbook (Cotton and flax are also included in fiber crop group in the yearbook).

All of the oilseeds obtained from these oilcrops are on the market, with the exception of oil palm. As palm oil is extracted from fresh palm fruit in or nearby the farm, the fruit are not marketed as oilseeds. However, palm kernels, which are the core of the palm fruit, are an internationally marketed commodity for the production of palm kernel oil. Palm kernel oil is an oil quite distinct from palm oil, and they are different in chemical composition and in their uses. The details will be set forth in the following chapter.

Coconut oil is produced from copra, which is produced by drying the endosperm of coconuts (coconut meat). Although copra is not a seed it is one of the important commodities of the oilseed market.

This report, in accordance with the Terms of Reference of the Study, deals with soybean, peanut, castor bean, sunflower seed, cottonseed, coconut, oil palm including palm oil and palm kernel oil, corn oil and babassu oil.

These oilseeds will be individually examined in the following chapters. This chapter gives a general description of vegetable oils and oilseeds. Oil cake and oil meal, obtained after the extraction of oil from oilseeds, will be touched on in other chapter on animal feeds.

2. CULTIVATION OF OILCROPS AND PRODUCTION OF OILSEEDS

Oilcrops can be classified into annual crops such as soybean, sunflower and peanut, and perennial plants such as oil palm and coconut. Annual crops account for the major share of both production and planted area. World production of the major oilseeds is shown in Table 1, and production by selected countries is shown in Appendix Table 1.

Most of the annual crops are widely cultivated throughout the temperate and tropical areas. Whereas the most important tree oil crops, i.e., oil palm and coconuts can be grown only in the tropics, olive, camellia and other tree oil crops [1] are grown in temperate zone but they are of minor importance.

Table 1 World Production of Major Oilseeds

(1,000 MT)

	1979	1980	1981
Soybean	89,010	80,870	87,941
Cottonseed	26,838	27,039	29,337
Peanut	18,333	17,131	19,368
Sunflower seed	15,308	13,519	13,765
Rapeseed	10,535	10,597	12,147
Sesame seed	1,929	1,774	1,959
Safflower seed	1,064	897	889
Flax seed	3,083	2,116	2,274
Castor bean	894	808	810
Copra	4,483	4,663	5,054
Palm kernel	1,714	1,832	1,891
Total	173,191	161,246	175,435

Source: FAO, Production Yearbook, 1981

The total area under cultivation of the major annual oilcrops amounts to a little less than 10% of the total cultivated area for all annual crops in the world (There is no data available on the total planted area of tree oil crops in the world). If a rough estimate of the above area is added to the total cultivated area of the major annual oilcrops, it is certain that the sum would become larger.

1) Wild oil palm is used for the extraction of oil in western Africa and Brazil, but the amount of production is negligible.

Table 2 World Cultivated Area under Oilcrops (1980)

	(million ha)
Total area	1,452.2
Annual crops	1,358.4
Perennial crops	93.8
Oilcrops	
Total for the major annual oilcrops	140.2
Soybean	51.8
Peanut	18.7
Sunflower seed	12.2
Rapeseed	10.6
Sesame seed	6.1
Flax seed	5.1
Safflower seed	1.3
Cottonseed	32.9
Castor bean	1.5

Source: FAO, Production Yearbook, 1981

As shown in Table 2, soybean ranks first followed by cotton in terms of cultivated area. The cultivation of cotton, however, is primarily for getting cotton fiber, cotton seed being by-product.

The production of annual crops undergoes large changes from year to year in comparison with perennial crops. One of the reasons for this is that annual crops are subject to the effects of nature, such as the climatic conditions. Another reason is that the farmers increase or decrease the planted area according to the fluctuations in price of the annual crops.

In respect of type of cultivating annual oilcrops, large-scale mechanized farming is carried out in the United States and the USSR, while small-farmer planting is dominant in the developing countries. Among tree crops, oil palm is planted mostly in large estate, in which cultivation of oil palm and oil extraction are done. Since the 1960s, "nucleus estate system" has developed rapidly, originally in Malaysia but spread widely in other countries (described in detail in later chapter). Coconuts are cultivated both in estates and also by small holders, the latter type being more common.

3. PROPERTIES, TYPES AND USAGE OF OILS

The oils obtained from oilseeds have a variety of types and contents of fatty acids, such as linoleic acid, oleic acid and palmitic acid, according to the type of oilseed. Consequently, their physical and chemical properties, such as their melting point and iodine value, also vary. The usage of these oils is therefore such that can make the best use of their respective characteristics. The major characteristics are as follows.

Almost all of the oils are produced together with their oil cake at a certain oil extraction ratio for each oilseed, except for palm oil which is extracted from the meat of the fresh fruit and does not yield the oil cake. For most of the oil crops, oil is more economically important than its cake (remnant), but soybean cake is more important than soybean oil. The share of soybean cake (meal) is estimated at about 60 to 65% of the total sales of all soybean products produced in Japan, while it is estimated at a little less than 70% for the United States. In a sense, soybean oil can be considered as by-product of cake. Thus the price of the soybean oil is greatly influenced by the price of the cake. Fig. 1 shows the classification of oils and fats by materials and Fig. 2 shows the classification by the uses.

Vegetable oils can be classified according to the property of drying or the physical state, i.e. liquid, semisolid or solid, at room temperature. The oils in the form of a liquid at room temperature are called vegetable oils, whereas those in the form of a solid are known as vegetable fats. The former are further classified into drying oils, semidrying oils and non-drying oils, according to their drying properties. The degree of drying increases with the degree of unsaturation of the fatty acids to a certain extent. Therefore, the vegatable oils are usually classified according to their iodine value into drying oils with an iodine value of more than 130, semidrying oils with an iodine value of 100 to 130 and non-drying oils with an iodine value of less than 100. The major vegetable oils classified in this way are as follows:

a. Drying oils - flax seed oil, perilla oil, tung oil, hemp seed oil, safflower seed oil, kaya oil, walnut oil, poppyseed oil, oiticica seed oil, sunflower seed oil;

b. Semidrying oils - cottonseed oil, rapeseed oil, soybean oil, mustard oil, kapok seed oil, rice bran oil, sesame seed oil, corn oil;

c. Non-drying oils - peanut oil, olive oil, camellia oil, tea seed oil, castor oil;

d. Solid fats - coconut oil, palm oil, palm kernel oil, babassu oil, cocoa butter, shea fat, Bornean fat, sal fat, etc.

The drying oils consist mostly of glycerides of linoleic acid, linolenic acid or conjugate acids. Owing to their properties, they are

Fig. 1 Classification of Oils and Fats

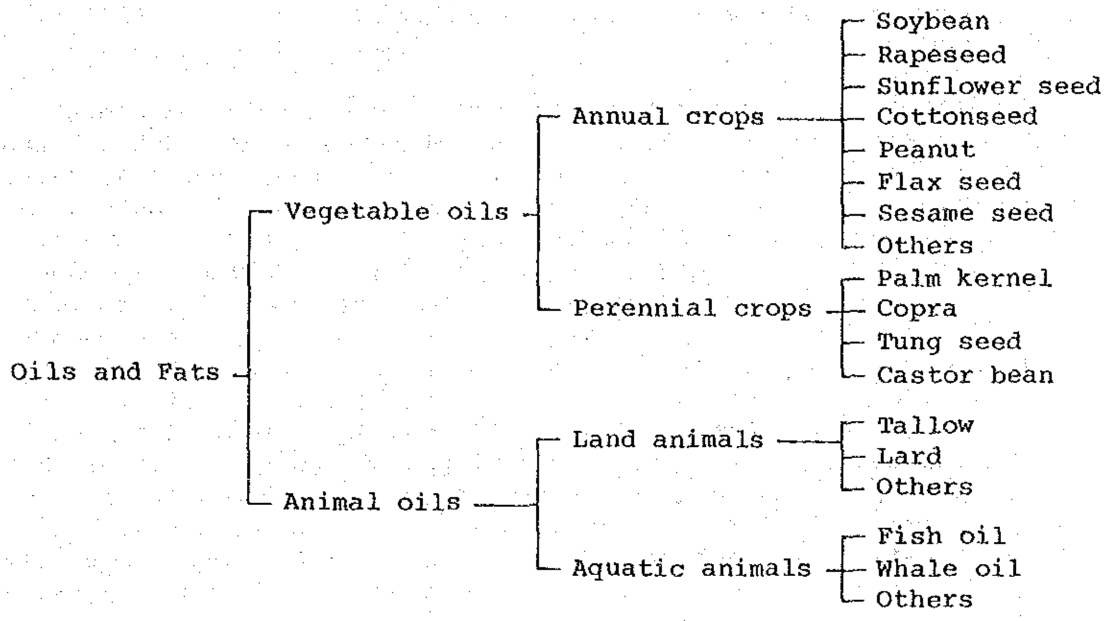
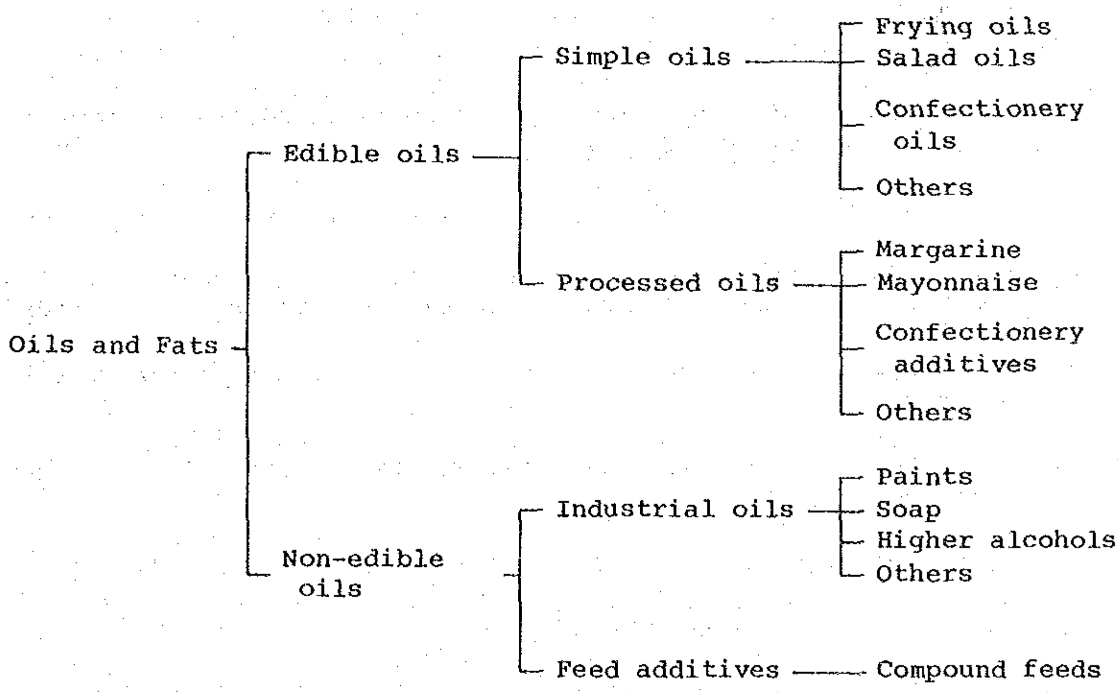


Fig. 2 Uses of Oils and Fats



supplied mainly for industrial use, such as in paints, varnish, linoleum, industrial inks, oiled fibers, artists' paints, etc. Some drying oils, such as safflower seed oil, sunflower seed oil or kaya oil, can be used for cooking purposes.

The semidrying oils consist mainly of linoleic acid and oleinic acid, and also contain a small amount of saturated acids. Most of them are used as the major cooking oils or fats, such as frying oils, salad oils, margarine, shortening, mayonnaise, etc. Soybean oil contains a comparatively large amount of linolenic acid and its iodine value is about 130, so that it can also be classified into a drying oil. Some soybean oil is used as an industrial oil, such as in paints.

The non-drying oils consist mainly of oleinic acid. They are used mostly for cooking, although some are used as lubricating oils, hair oils, cosmetics, etc. Castor oil consists mainly of ricinoleic acid, and therefore its usage is generally limited to industrial rather than edible applications, owing to the hydroxyl radical group which it contains. The main uses are for manufacturing of lubricating oils, turkey-red oils, plasticizers, dehydrated castor oils and for paint materials such as varnish and enamel. Castor oil is also used in the cosmetic and pharmaceutical industries.

The solid fats consist mainly of glycerides of saturated acids. They also contain a small amount of oleinic acid and linoleic acid. Most of them are used for producing margarine, shortening and other confectionery additives. Coconut oil and palm kernel oil are major materials for soap, detergents and plasticizers. Vegetable waxes consist mainly of glycerides of permitic acids, and are used for producing glazing agents, candles, oiled papers and cosmetics such as pomades.

The oils obtained from oilcrops can also be classified according to industrial applications, as follows:

a. Lauric acid type —— coconut oil, palm kernel oil, babassu kernel oil;

b. Oleinic acid/linoleic acid type —— cottonseed oil, peanut oil, olive oil, palm oil, sesame seed oil, safflower seed oil, corn oil, etc;

c. Erucic acid type —— rapeseed oil (oil from conventional varieties), mustard seed oil, etc;

d. Linolenic acid type —— flax seed oil, soybean oil, perilla oil, hemp seed oil, etc;

e. Conjugate acid type —— tung oil, oiticica oil, etc;

f. Hydroxylic acid type —— castor oil;

g. Vegetable fat —— cocoa butter, shea fat, mora fat, Bornean fat, etc.

4. PRODUCTION AND PROCESSING OF VEGETABLE OILS

The processing of oilseeds consists of the steps of oil extraction, oil refining and fractionation.

4.1 Oil Extraction

The oilseeds are pressed by a machine or extracted by means of a solvent, although some quantity is still pressed by primitive methods such as pressing by hand or by an animal-driven press in some countries. Mechanical pressing includes the hydraulic pressure method and the screw pressing method. The latter method is the most widely used.

In the mechanical pressing method, the oil recovery rate is generally low in comparison with the solvent extraction method. This is because a portion of the oil remains in the oil cake, so that the mechanical pressing method is used only for materials with a high oil content, such as copra and sesame seed, or for certain types of oilseeds such as cacao bean. The solvent extraction method is used for most types of oilseeds. For rapeseed, sunflower and copra which have high oil content, the oil cake resulting from mechanical pressing may be further processed by solvent extraction to extract the residual oil.

4.2 Refining and Fractionation

The oils which are extracted from oilseeds are known as crude oils in their unrefined form. Some quantity of crude oils is marketed, while the remainder is refined. The refining process includes the steps of degumming,[1] deacidification, decoloration and deodorization.

The oils thus obtained consist of various triglycerides with different melting points. The fractionation process is then carried out in order to separate the oils into their liquid and solid components, by utilizing their different melting points or their difference in solubility in a particular liquid oil. The applications of an oil can be enlarged by this fractionation process. This process may be conducted separately or in combination with the hydrogenation process,

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1) The degumming process is a process for the removal of gummy components, e.g., phospholipids. In Europe and the United States, trade is generally conducted in degummed oils in the raw vegetable oil market. Lecithin is obtained as a byproduct at the time of degumming soybean oil, and is widely used for such applications as reducing the viscosity of chocolate, improving the spreadability of margarine and the antioxidation of food.

ester-exchanging process or other processes. The development of the fractionation process has enlarged the range of oils suitable for substitution.

5. NATURE OF OIL PRODUCING INDUSTRY

The oil industry is one of the basic material-producing industries. In countries which depend mostly on the import of food materials, such as Japan and some European countries, the material cost, not including the cost of energy or the cost of packaging, accounts for 60 - 75% of the selling price, so that generally the added value is low. However, in the countries which produce oilseeds, the percentage ratio of the material cost in the oil industry must be much lower than in the case mentioned above.

A key feature of the oil industry is that the material cost, which accounts for the major portion of the overall costs, is subject to fluctuation. Furthermore, the formation of prices has two principal features. Firstly, both the materials and the products have international markets, so that their prices are subject to sharp fluctuations. Secondly, the domestic market prices of the oils and the oil cakes directly reflect the fluctuations of the international market price or exchange rates. In Japan, about four months are required from the time of import of the materials to the shipping of the finished products, due to the time required for loading, arrival of the materials and processing of the materials. The domestic price of the finished products is also directly influenced by the fluctuations of the international market price, and consequently this time lag produces a gap between the production cost and sales price of the product.

In order to avoid risk due to fluctuations in the material cost, a hedge may be carried out in the Chicago futures market. However, this hedge can avoid such risks only when the fluctuations in the domestic price quotation are directly associated with that in the Chicago market, particularly with regard to soybean meal and the price of soybeans. In Japan, the domestic market prices fluctuate in association with the Chicago market prices over the long term, although in the short term they may vary according to the supply-demand situation in Japan, sometimes independent of the movements in the Chicago market. In this case, hedging not only fail to avoid risk but, in some cases, may even cause double loss, i.e., loss in Chicago future market and loss in the sales of products in Japanese spot markets.

In the United States, futures markets for both the materials and the finished products of the oil producing industry have been established, and a hedge system has also been developed to cover the commodities ranging from materials to finished products in one market system, so that risk from fluctuations in prices can be avoided. In Europe, a large enterprise named Unilever holds a major share of the oil market, and has sufficient influence to adjust the product price according to the material prices. The product price thus set is fairly closely associated with the international market price, because nearness to the Chicago futures market maked hedging more easy. In addition, as trading of products in futures is conducted around Rotterdam, the risk due to fluctuations in prices can be generally avoided.

In many countries, the oil industry has a structure comprising two levels of companies. In Japan, there were 170 companies producing oils at the end of December, 1980. Of these companies, only twenty four are capitalized at more than 100 million yen, and of these twenty four companies, only eleven have more than 300 employees. Most of these major companies built large-scale factories, mainly for the extraction of rapeseed oil, in coastal regions where it is convenient to import the materials, between 1961 when the free trade of soybeans began in Japan and 1971, when the free trade of oils and rapeseed commenced. The majority of the other factories were located in the rapeseed producing districts or in the cities where rice bran was produced, the latter case being due to the fact that the milling of rice has generally been carried out in the rice consuming area itself. As the domestic production of oilseeds has greatly decreased, these factories have decreased in number and in quantity of production. Although the number of major companies is less than 10% of the total number of oil producing companies, 80% of the total quantity of materials for producing oils in 1980 (5,556,000 tons) was consumed by the major companies, and this percentage is rising year by year. However, even among the major companies there are large differences in their methods of procuring materials, production capacity, marketing of the finished products and types of products. Some major companies, such as Nisshin Oil Mills, Ltd., Ajinomoto Co., Inc., and Fuji Oil Co., Ltd. are mainly producing cooking oils for home use. Other major companies have developed from being suppliers of cooking oils and oil cakes into suppliers of margarine, dressings, vegetable-protein-enriched foods, highly nutritious foods, and fat substitutes for use in chocolate. Such products are manufactured using cooking oils or oil cake as materials. The range of products manufactured by these companies has also increased by more than ten times, to between 450 and 600 items of products. Consequently, the companies which have improved the added value component tend to procure their materials and sell the finished products in a stable manner.

A comparison between the oil industries in Japan, the EC and the United States is shown as follows.

Oil Industries in Japan, the EC and the United States

	Japan	EC	USA
1. Location	1) Domestic oil seeds: rice bran 2) After the free trade of soybeans began in 1961, large-scale coastal industrial areas were constructed; i.e., Tokyo: 3 factories Kobe : 4 " Kashima, Shimizu, Nagoya and Hakata: 1 factory each	1) Domestic oilseeds: rapeseed, sunflower seed, olives, and small amounts of other oilseeds 2) Netherlands: Rotterdam, Amsterdam Germany, FR: along the Rhine River France: Bordeaux, etc. UK : Liverpool, etc.	1) Domestic oilseeds: there are many varieties. Soybean: from the mid-western region to the southern region; sunflower seed: North and South Dakota; peanut: southern region. 2) The producing area of soybean, cottonseed, sunflower seed, etc. — along the routes for exporting soybean along the Mississippi River.
2. Import and Export	Almost all of the materials are imported. The finished products are domestically consumed.	Materials and finished products are selectively imported according to the international market prices or movements in the balance of domestic supply and demand. Trade within the EC is large, and trade with Africa, the Middle East and ex-colonies is also large in scale.	The materials and finished products are each exported according to demand. Exports as foreign aid in accordance with PL 480 are of significant quantities.
3. Business	The processes from oil extraction to the refining of the oil are continuously carried out. Some oil manufacturers have developed secondary or tertiary products, such as margarine,	In general, processing only to the oil extraction stage is carried out, and the crude oil and oil cake obtained is traded. Unilever, the largest oil producer in the world, has been ahead in various fats and	Oil extractors carry out only the oil extraction process. Most of these enterprises belong to the major grain companies. Oil refining facilities are built in the consuming areas,

(cont'd.)

	Japan	EC	USA
(3. Business)	dressings, vegetable protein, or fine chemicals. The amalgamation of the manufacturers is taking place.	oil products under its continuous processing system. The amalgamation of the manufacturers to form large-scale enterprises is taking place.	and salad oils, margarine, shortening and other processed products are produced.
4. Purchase of materials	Soybean: USA, Argentina Rapeseed: Canada, Sweden, the EC, China Cottonseed: Thailand, the Philippines Sesame seed: China, Colombia, Sudan, Guatemala Copra: Papua New Guinea Castor bean: the Philippines, China	Rapeseed: within the EC, Sweden, Canada Sunflower seed: France, USA Soybean: USA, Argentina, Brazil	Within the USA
5. Method of purchase	Long-term forward buying was conducted prior to 1976. Near future current buying has been generally conducted since the oil industry sustained a huge loss of about 80 billion yen from the great collapse of the Chicago soybean market in 1975.	Three months forward buying is generally conducted. However, current buying may be practiced according to the grain market prices or movements in exchange rates. Recently, current buying has been increasing.	Six months forward buying is generally conducted, but up to one year forward buying can be conducted if the Chicago market prices are used. Recently, however, current buying has been increasing.
6. Hedging system	A direct interlink between domestic market prices and the Chicago market prices is dilute.	1) On the Rotterdam free market where dealing in warehouse certificate is chiefly conducted, and also on the Chicago market. The time lag between Chicago and	1) The Chicago market 2) Both the materials and the finished products are hedged at the Chicago futures market so as to earn a margin.

(cont'd.)

	Japan	EC	USA
(6. Hedge system)		the EC is as short as 6 hours, so that the Chicago market prices can be used in the EC. 2) Oil extractors sometimes resell the soybeans in accordance with the market prices, which are basically linked with the Chicago market prices.	
7. Market	Mainly domestic	Oils: EC, USSR, Eastern Europe, Africa, the Middle East Oil cakes: EC, USSR, Eastern Europe The markets in the Middle East have been encroached on by Malaysia and Singapore, while those in Africa have been overtaken by Brazil and Canada. The share of Brazilian oil cake has been increasing.	Domestic and worldwide Exports to the USSR have fallen steeply since the ex-president, Mr. Carter, prohibited the export of grains to the USSR.
8. Oil extraction profit margin	A hedge cannot be conducted against the oils and oil cakes produced from oil extraction, and it is difficult to adjust the manufacturing cost.	1) A profit margin from oil extraction can be secured by hedges against the products. 2) Operation is suspended down when a secure margin cannot be obtained. 3) Big enterprises such as Unilever contribute stabilization of the EC market.	1) A profit margin from oil extraction can be secured by hedges against the products. 2) Operation is closed when a secure margin cannot be obtained. 3) The oil industry is one of the industries in which a stable profit margin is usually obtained.

(cont'd.)

	Japan	EC	USA
9. Customs tariff			
1) Materials	Tax-free	Tax-free	Tax-free
2) Soybean oil	Crude oil : 17 yen/kg (14.0%) Refined oil: 20.70 yen/kg (17.2%) The percentages in parentheses indicate the ad valorem import duties between Jan. and Nov. 1982.	Crude oil : 10% (5%) Refined oil: 15% (8%) The figures in parentheses indicate the import tariff rate applicable to oils for industrial use.	22.5%
3) Soybean meal	Tax-free	Tax-free	0.3 ¢/pound
10. Factors how large-scale factories developed	1) The consumption of oils has increased with improvement in the diet. 2) The demand for soybean oil cake has increased steeply due to increased consumption of livestock products. 3) Oil is extracted mainly from imported rapeseed and soybean, because of decreased production of domestic rapeseed due to the free trade of rapeseed and of difficulty in obtaining cottonseed or copra. 4) The production of soybean in the USA and of rapeseed in Canada have increased and their supply is stable. 5) The prices on the soybean market in Chicago have become	1) The demand for oil cake, particularly soybean meal, has increased in the EC. 2) In order to compete against cheap Brazilian soybean meal, there is a need for rationalized large-scale factories. 3) For the reason shown in 2) above, small-scale factories have been amalgamated into large-scale factories. 4) Peanut, cottonseed, copra, etc. are difficult to obtain, while the import of soybean has increased. 5) The demand for soybean meal in the USSR and Eastern Europe has increased. 6) The demand for peanut oil, cottonseed oil, olive oil and sunflower seed oil has been replaced by the cheaper oils such	1) As the country is the largest producer of oilseeds such as soybean, cotton seed, sunflower and flax, large oil industry has developed aiming at both domestic and export markets. 2) Some major grain trading companies such as Cargill, Louis Dreyfuss, and A.D.M. (Archer Daniels Midland), have actively built factories for the production of both the materials and the products. 3) The USA is the largest consumer of livestock products in the world, and requires a large quantity of soybean oil cake for raising hogs, broilers and poultry, and for feedlots. 4) A significant amount of oil

(cont'd.)

Japan	EC	USA
stable, and transportation costs have been reduced by the development of larger vessels. 6) Oil extraction techniques have been improved. 7) Number of factories extracting more than 400 tons of oil per day: from 400 up to but not including 500 t/day: 3 factories from 500 " 1,000 t/day: 4 " from 1,000 " 2,000 t/day: 4 " 2,000 t/day or more : 2 " The largest capacity stands at 2,945 tons of oil/day.	as soybean oil and rapeseed oil. 7) Capacity of oil-extraction factories: Netherlands: Cargill (Amsterdam) 3,000 t/day Uni-Mill (a subsidiary of Unilever) (Rotterdam) 4,000 t/day Germany, FR: from 500 up to but not including 1,000 t/day: 4 factories from 1,000 up to but not including 2,000 t/day: 3 factories from 2,000 up to but not including 3,000 t/day: 2 factories 3,000 t/day or more: 3 factories Total : 12 " France: 100,000 t/year class: 2 factories 300,000 " : 2 " 400,000 " : 2 " 550,000 " : 2 " Total : 8 " The largest capacity is 4,000 t/day.	products is exported to the developing countries in accordance with PL 480, so that an excess of inventory can be controlled. 5) The reduced catch of anchovies in Peru has increased the demand for soybean meal as a protein feed. 6) The highest capacity of any oil extraction factory is 3,629 t/day (A.D.M.).

6. PRODUCTION AND EXPORT OF OILSEEDS

6.1 Production

Annual oilcrops are widely cultivated from the temperate zone to the tropical zone. Some oilcrops can be planted only in a very limited area, while others are cultivated over a wide area.

As shown by the average oilseed production figures for the past three years,[1] the production of soybean in the United States accounts for 63% of total world production. The sum of the shares held by the United States, Brazil and China reaches as much as 89%. The total production of cotton seed in the three main countries of Brazil, India and China amounts to 77.6% of overall production, while the production of other oilseeds such as peanut is dispersed more widely.

Coconut trees can be seen anywhere in the tropics, but most of the copra which is used as a material for oils is produced in only three countries; the Philippines, Indonesia and India. The total production of these three countries amounts to 80% of overall world production, with the Philippines holding a share of 50%.

Malaysia accounts for 56% of total world palm oil production, and three countries, Malaysia, Indonesia and Nigeria, together produce 80% of the world total.

The international market for these oilseeds is affected by natural forces such as the climate in the producing countries, and also by government control of production. The production of soybean in the United States exerts a great influence not only on the international soybean market but also on other oilcrop markets. The details will be explained in the following section.

Such concentrations of production are, needless to say, not fixed, and have gradually been changing. The significant changes in share of production over the past ten years are as follows:[2]

a. Soybean: The share held by the United States has slightly decreased, while Brazil's share has markedly increased from 13.7% to 16.4%. Argentina has also increased its production, to a level of 4.3% of the total.

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1) Yearly average for 1979/80 - 1981/82.
The yearly average for 1972/73 - 1974/75 is used for the purpose of comparison with the production figures of ten years ago.

2) Although palm oil is one of the important items, it is not mentioned here because the fruit of oil palm is not marketed as oilseed. It will be dealt with in the later section on vegetable oils.

b. The production of copra has increased by 23% over the past ten years. More than half of this increase is accounted for by the increase in the share held by the Philippines, which has grown from 45.7% to 50.3%.

c. Sunflower seed: The share held by the USSR has declined from 59% to 34%, while that held by the United States has increased to 16.8%.

d. Palm kernel: Total world production has increased from about 1 million tons to about 1.44 million tons. Most of this increase has been brought about by an increase in production in Malaysia, and the share held by Malaysia has risen from 18.3% to 36.3%. Nigeria's share, which ranked second ten years ago, has decreased from 26.1% to 18.5%, and Malaysia now ranks the first position.

6.2 Exports

Most of the production of oilseeds, or the entire amount of production for some types of oilseeds, are used as a material for oil extraction. The extraction of oil, however, is usually carried out in the producing country, and as a result, only a small quantity of oilseeds is exported.

The figures for the total world production and exports of oilseeds for the past three years indicate that the average level of exports stood at 29 million tons, which accounted for 19% of the average total production of 152 million tons.

The export ratios of the major oilseeds as to world total are shown in Table 3. As the Table shows, the export ratio of soybean is the highest (30.2%) while that of cottonseed is the lowest (0.7%). However, these figures are the ratios of world total exports to world total production, and there are great differences from country to country. For instance, although Brazil is a major soybean producing country, its export ratio of soybeans as an oilseed is only 8.4% because Brazil mainly exports the processed products, whereas Argentina exports 73% of its soybean production.

The production of oils has been increasing while exports of oilseeds have been significantly declining in the producing countries since the 1970s. The reason for this is that the producing countries have been aiming at exports of oil to gain the added value. The marked reduction in exports of copra from the Philippines is the typical example. The amounts of production and exports by countries are shown in Table 3 and Appendix Table 1.

Table 3 World Production and Exports of Major Oilseeds, 1979-82 average

(1,000 MT)

	Production	Exports	Export ratio (%)
Soybean	87,223	26,337	30.2
Cottonseed	26,223	200	0.7
Sunflower seed	14,397	1,983	13.8
Peanut	11,612	776	6.7
Rapeseed	11,433	764	6.7
Copra	4,922	444	9.0
Castor bean	863	66	7.6
Palm kernel	1,441	208	14.4

Source: Compiled from Oil World statistics

7. PRODUCTION AND EXPORT OF VEGETABLE OILS

As is known from Table 4, production of vegetable oils roughly corresponds to the production of oilseeds. Same as the production of soybean, the production of soybean oil holds by far the largest share among all vegetable oils. The order of the share of other oils, however, differs somewhat from that of oilseeds, because of the difference of oil yield (oil extraction ratio) among various oilseeds. Moreover, some oilseeds, such as peanut, are consumed as direct food, thus the production of such oils does not correspond to the production of the oilseeds.

As mentioned above, oil extraction is mostly carried out in the producing countries, so that the shares of oil production by countries are almost the same as those for oilseed production by countries. The major vegetable oil producing countries which are not major oilseed producers are the European countries and Japan.

The export ratios of the vegetable oils are generally higher than those for oilseeds. This indicates that vegetable oils are more in the nature of an international commodity.

As shown in Table 4 and Appendix Table 1, palm oil and palm kernel oil have the largest export ratios, since these oils are produced in a limited number of countries. Cottonseed oil and peanut oil have the smallest export ratios, the reason for this being that the major producers of cottonseed oil, i.e., the USSR, China and India, consume domestically almost all of their production. A similar reason can be attributed to the case of peanut oil.

The countries having comparatively large export ratios are Senegal, with an export ratio of 57% for peanut oil; Brazil, which has export ratios of 78% for castor bean oil and 40% for cottonseed oil, and the Philippines, with an export ratio of 74% for coconut oil.

Table 4 Production and Exports of Major Vegetable Oils, 1979-82 average

(1,000 MT)

	Production	Exports	Export ratio (%)
Soybean oil	12,915	3,303	25.5
Sunflower oil	4,903	1,024	20.9
Palm oil	4,479	3,402*	76.0*
Rapeseed oil	4,068	764	18.8
Cottonseed oil	3,002	426	14.2
Coconut oil	2,752	1,230	44.7
Peanut oil	2,576	450	17.5
Palm kernel oil	600	371	61.8
World total (including other vegetable oils)	33,671	9,526	28.3

* This includes Singapore's exports of 530,000 tons arising from its entrepot trade in palm oil from Malaysia and Indonesia. Singapore's imports in the same period were 550,000 tons. When Singapore's exports are deducted from the figures marked (*), the export ratio obtained is 64%.

Source: Compiled from Oil World statistics

8. IMPORTS AND CONSUMPTION OF VEGETABLE OILS

8.1 Imports

Most of the production of vegetable oils in the world is carried out in the oilseed producing countries, and a considerable portion of these oils is exported, as described above. Table 5 shows the quantity of imports and their share of total imports by main importing countries.

Table 5 Imports of Major Oilseeds and Oils, and Import Shares by Major Importing Countries, 1977-1980 average

	Imports (1,000 MT)	Major countries importing vegetable oils and percentage share of total imports					
Soybean	26,674	Japan (15.9)	Germany, FR (13.3)	Netherlands (12.2)	Spain (10.4)	Italy (5.5)	USSR (5.2)
Soybean oil	3,232	Indea (19.2)	Iran (8.3)	Pakistan (7.7)	Mexico (3.9)		
Palm oil	3,372	Singapore* (16.5)	India (13.9)	Pakistan (6.6)	Netherlands (5.3)	Germany, FR (5.0)	Japan (4.2)
Sun-flower seed	2,005	Germany, FR (36.0)	Portugal (13.2)	Mexico (11.6)	Italy (8.1)	France (5.7)	UK (5.0)
Sun-flower oil	1,009	France (13.1)	USSR (9.6)	Venezuela (8.3)	Argentina (7.8)	Cuba (7.7)	
Copra	447	Japan (14.5)	Germany, FR (12.8)	France (9.4)	Singapore* (9.2)	Netherlands (8.1)	
Coconut oil	1,263	USA (39.6)	Germany, FR (5.9)	UK (5.9)	France (4.7)		
Other vegetable oils	9,584						

* entrepot trade

Source: Oil World

As shown in Table 5, most of the oilseeds are imported by the developed countries, particularly the EC countries and Japan, while vegetable oils are imported by both the developing and developed countries. The main developing country which imports these oils is India. India is a major producer of peanut and cottonseed as well as a large producer of some vegetable oils. However, recently the demand for oilseeds has not been met by domestic production, since demand has increased while production has remained at the same level, with the result that imports have steeply increased.

As shown in Table 6, the trend of world imports in the 1970s indicates a significant increase in imports of oils by the developing countries. The annual increase in imports by India over the period from 1969/71 to 1978 was 28%. The annual increases for Nigeria and Mexico were as high as 44% and 34% respectively. Imports into the petroleum producing countries such as Iran and Saudi Arabia have also been increasing.

8.2 Consumption Level

It is difficult to accurately calculate the annual rate of consumption within individual countries. Generally, the disappearance of a product is calculated in accordance with the equation: (Initial stock) + (Production) + (Imports) - (Exports) - (Final stock). The term "disappearance" includes actual consumption plus loss in the country and the disappearing portions which have not been actually consumed. For oil consumption, some oils and fats contained in meats and grains are ingested together with the meats and grains themselves, but these oils and fats are not included in the consumption figures, and are known as invisible consumption. Only the oils and fats which are actually consumed in the form of an oil are known as visible consumption or apparent consumption.

It is very difficult to obtain the figures for consumption in each country because some countries do not have the necessary data.

Table 7 is one of the sets of data prepared by the World Bank for projecting future world prices of primary products (World Bank, Price Prospects for Major Primary Commodities, July 1982, Vol. II, Annex Table 3).

Table 7 shows that China consumed the largest amount of oilseeds, followed by the United States, India, the USSR and Brazil. These countries have large populations and produce large amounts of oilseeds and vegetable oils. Among the countries which do not produce oilseeds, i.e., the countries which import oilseeds and oils, the level of consumption in the EC countries and Japan is very high. Of course, the figures for consumption by countries do not indicate the actual

Table 6 Total Imports of Fats and Oils* into Developing Countries, by Regions

(1,000 MT)

	1969-71 average	1974-76 average	1977	1978	Annual Increase 1969/71 - 1978 (%)
Total World Imports	12,114	14,636	16,903	18,279	5.3
Total Developing Countries Imports	2,816	4,178	6,029	7,161	12.4
By regions and main countries					
Latin America	763	1,048	1,255	1,492	8.7
Cuba	166	179	180	173	0.5
Mexico	48	167	218	447	32.0
Colombia	68	84	106	111	6.3
Peru	49	79	94	98	8.0
Venezuela	59	124	201	204	16.8
Other countries	373	415	456	459	2.6
Africa	474	707	874	949	9.0
Algeria	113	203	213	237	9.7
Morocco	102	167	182	172	6.7
Nigeria	1	34	138	182	44.0
Other countries	258	303	341	358	4.2
Near East	630	1,141	1,121	1,458	11.0
Egypt	201	376	416	467	11.1
Iran	133	295	262	455	16.6
Iraq	87	87	113	146	6.7
Saudi Arabia	27	33	60	79	14.4
Turkey	29	128	36	39	3.8
Other countries	153	222	234	272	7.5
Asia and Pacific	949	1,282	2,779	3,262	16.7
Bangladesh	109	109	136	160	5.0
China	170	323	551	558	16.0
India	194	111	1,116	1,379	28.0
Korea Rep. of	86	157	207	239	13.6
Pakistan	117	261	345	388	16.2
Singapore	33	63	110	146	20.0
Other countries	240	258	314	392	6.3

* Including the oil equivalent of oilseed but excluding quantities subsequently re-exported.

Note : Totals computed from unrounded data.

Source: FAO, Expanding Trade in Fats and Oils among Developing Countries, CCP-80/4, Feb. 1980

Table 7 Oilseeds (Oil Equiv.) — Apparent Consumption, by Main Countries and Economic Regions

(1,000 MT)

Countries/ Economies	1961	1970	1975	1980
Developed	7,935	10,210	13,436	13,669
N. America	3,933	4,630	7,144	5,403
USA	3,732	4,054	6,504	4,860
EC-10	3,175	4,106	4,579	6,031
Italy	743	1,057	1,257	1,376
Germany, FR	713	942	1,014	1,476
Japan	507	984	1,151	1,539
Centrally planned	3,492	4,316	4,258	5,327
USSR	2,557	3,181	2,893	3,685
E. Europe	801	949	1,167	1,419
Developing	11,751	15,993	19,700	26,419
Asia	7,304	9,479	10,491	14,914
China	3,106	3,785	4,279	5,614
India	2,578	3,086	3,566	4,627
Africa	2,009	3,076	4,065	4,726
S. America	1,418	2,134	2,934	4,386
Brazil	421	782	1,275	2,069
S. Europe	1,015	1,286	2,159	2,287
World	23,178	30,519	37,394	45,416
Developed & Developing	19,686	26,203	33,136	40,089

Sources: FAO, Production & Trade Yearbook Tapes (Actual); and World Bank, Price Prospects for Major Primary Commodities, July 1982, Volume II, Annex Table 3

per capita consumption level for each country. The country with the highest quantity of consumption, China, possesses a large population of one billion people, so that the per capita consumption is much smaller than that of the EC countries.

Table 8 shows per capita consumption of vegetable oils and fats, which indicates the actual consumption level in these countries. There is a large gap between the developed and the developing countries in per capita consumption. Among the developing countries, the countries producing a large quantity of oilseeds have comparatively high levels of per capita consumption, such as the per capita consumption of palm oil in Malaysia, Indonesia and Nigeria, coconut oil in the Philippines and Indonesia, and soybean oil in Brazil. The USSR and China are large consuming countries, but the level of per capita consumption is small in both countries. Countries not listed in Table 7 are those whose per capita consumption is less than the lowest level of consumption shown in the Table.

Table 8 Per Capita Consumption of Vegetable Oils and Fats in Selected Developed and Developing Countries, 1977

(kg/year)

	Per capita consumption of Vegetable oils and fats
USA	20.2
Netherlands	18.4
Italy	17.3
Argentina	13.0
Germany, FR	12.8
France	12.7
UK	11.6
Japan	9.8
Nigeria	9.5
Ivory Coast	8.5
Malaysia	7.8
USSR	7.4
Mexico	7.1
Zaire	6.4
Indonesia	4.9
Pakistan	4.8
India	4.6
Brazil	4.5
China	3.0
Papua New Guinea	2.8
Sri Lanka	2.6

Source: FAO, Food Balance Sheets, 1975-1977

8.3 Type of Consumption

Oils and fats have various uses according to their chemical and physical properties. They can be classified into two groups: those for food puposes and those for industrial purposes, as listed in Section 3.1. Most of the vegetable oils can be used in either category, although some oils such as flax oil, castor oil and tung oil are only suitable for industrial applications. The ratio of the two applications varies from country to country. In Japan, for example, the ratio of edible uses to that of industrial uses was 88 : 12 in 1981.

Japan's oil consumption consists mainly of vegetable oils. The consumption of animal oils and fats is much smaller than that in the United States and the European countries. As a reference, the oil consumption and the uses of oils in Japan are shown in Table 9.

As shown in the Table 9, vegetable oils are classified according to their uses, i.e., household consumption, institutional consumption (restaurants, hotels, and other catering service), processing use and non-edible use. Household and institutional uses are mostly for cookery such as frying and salad dressing. Pre-blended frying oils and salad oils of various composition are sold widely and gaining popularity in recent years. For manufacturing of processed oils, such as margarine and shortening, various vegetable and animal oils are mixed, according to various uses.

A key feature of oils and fats is that different kinds of oils and fats can be substituted among them to a large extent. Margarine and shortening manufacturers change the blending ratio of the oils and fats according to price situation. Of course, each oil or fat has a particular taste and properties, so that complete substitution is not likely to be realized. Nevertheless, the extent of substitution between the different oils has recently become greater due to the development of manufacturing techniques, particularly the technique of fractionation described in Section 4.1.

9. PRICE OF VEGETABLE OILS

9.1 Economic Factors in Setting Prices

The prices of vegetable oils are basically formed according to the balance of supply and demand, as with other commodities, but the following characteristics of vegetable oil prices have to be noted.

The fluctuation in demand for vegetable oils is relatively moderate, while fluctuations in the production of oilseeds are sharp. Such fluctuations in production of annual oilcrops are caused not only by climatic and other natural influences but also by the reaction of the producers against the fluctuations in the prices. This is illustrated by the fact in the United States that the production of

Table 9 Consumption of Oils and Fats in Japan, 1981

(1,000 MT of raw oils)

Use	Total consumption/ demand		Consumption/demand for vegetable oils		Types of vegetable oils		Consumption/demand for vegetable oils by use			
Edible	Vegetable oils	1,539(110.0)	Edible oils	1,329	Soybean oil	656				
					Rapeseed oil	506	Household use	480	Margarine	127
	Animal oils	325 (98.5)	Other Vegetable oils	210	Cottonseed oil	52	Institutional use	442	Shortening	97
	Total	1,864(107.8)	Total	1,539	Safflower seed oil	11	Manufacturing use	617	Lard	9
Non-edible	Vegetable oils	201 (99.0)	Edible oils	86	Sesame seed oil	16	Non-edible use	201	Other products	96
					Corn oil	65	Total	1,740	Subtotal	329
	Animal oils	193 (92.8)	Other Vegetable oils	115	Sunflower seed oil	10			Mayonnaise and dressings	162
	Total	394 (95.9)	Total	201	Rice bran oil	97			Other products	126
					Other edible oils	2			Total	617
For export	Vegetable oils	14 (37.8)	Edible oils	7	Total edible oils	1,415				
	Animal oils	179(109.8)	Other Vegetable oils	7	Coconut oil	82				
	Total	193 (96.5)	Total	14	Palm kernel oil	16				
					Palm oil	141				
Total	Vegetable oils	1,754(107.0)	Edible oils	1,422	Linseed oil	34				
					Castor oil	16				
	Animal oils	697 (99.4)	Other Vegetable oils	332	Tung oil	10				
					Other oils	26				
	Total	2,451(104.7)	Total	1,754	Total other vegetable oils	325				
					Total	1,740				

Notes : Figures within parentheses show the ratio to the previous year's level of consumption/demand. Other edible oils include mustard oil, peanut oil, kapok oil.

Source: Data prepared by Japan Oils and Fats Association sunflower seed was doubled in 1979/80 due to the high price in 1978/79, while production in 1980/81 was reduced to the normal level of the previous years due to the increase in stocks and the fall in price. The details will be explained later in the section on sunflower seed.

The price of vegetable oils is sometimes influenced by the balance of supply and demand for the oil cake. About till 30 years ago, oil cake was considered to be a byproduct of oil, but recently it has increased in importance, with growing demand for oil cake as a protein-rich feed due to the development of the livestock industry. In particular, this trend is remarkable in the case of soybean [1). The extraction rate of soybean meal is about 80%, while that of soybean oil is about 18%. If these percentages are compared in terms of value, soybean oil stands at about 30 to 40% while soybean meal represents about 60 to 70% of the total value. Therefore, soybean meal can be considered as a main product, judging from both its volume and value. The prices of soybean and soybean oil are influenced by fluctuations in the price of soybean meal. However, such a relationship between other oils and their corresponding oil cakes is not so strong as in the case of soybean. For instance, there is almost no relationship between the price of sunflower oil and that of sunflower meal. The details will be explained later in the section on sunflower seed.

Vegetable oils can be substituted for each other and can also be substituted for certain animal oils to a large extent, and consequently the price of each oil depends not only on the supply and demand situation of that oil itself but also on those of other oils liable to be substituted.

Table 10 is a correlation matrix of the prices for selected oils and fats, as shown in the data prepared by the World Bank on Price Prospects for Major Primary Commodities, mentioned in Section 4.2. This Table shows that the strongest correlation (0.99) exists between soybean oil and rapeseed oil, while olive oil have a comparatively weak correlation with other oils. This may be due to the fact that people in the Latin countries, notably Italy and Spain, have stronger preference to olive oil than other countries and difficult to substitute with other oils. Among coconut oil, palm kernel oil and babassu oil there exist strong price correlation, because these three oils are similar in chemical property (lauric acid type) and can be substituted each other, but the prices of these oils are relatively independent from other oils of non-lauric type.

Industrial oils, such as castor oil and tung oil, have almost no correlation with other edible vegetable oils. The details will be explained later in the section on castor oil.

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1) As the oil content of soybean is lower than that of other oil seeds, larger amount of meal with high protein-content is obtained.

Table 10 Correlation Matrix of Prices for Selected Fats and Oils *

	Sunflower oil	Peanut oil	Cottonseed oil	Rapeseed oil	Olive oil	Palm oil	Coconut oil	Palm kernel oil	Fish oil	Butter	Tallow	Lard
Soybean oil	.99	.97	.98	.99	.93	.96	.86	.90	.96	.78	.93	.94
Sunflower oil		.96	.98	.98	.92	.93	.85	.88	.95	.75	.90	.92
Peanut oil			.95	.97	.95	.95	.83	.88	.95	.82	.93	.95
Cottonseed oil				.96	.92	.93	.88	.89	.93	.98	.91	.92
Rapeseed oil					.93	.97	.87	.91	.97	.80	.93	.96
Olive oil						.93	.78	.84	.91	.91	.95	.96
Palm oil							.90	.95	.96	.86	.97	.98
Coconut oil								.99	.86	.69	.89	.85
Palm kernel oil									.90	.75	.92	.91
Fish oil										.80	.94	.96
Butter											.90	.91
Tallow												.98

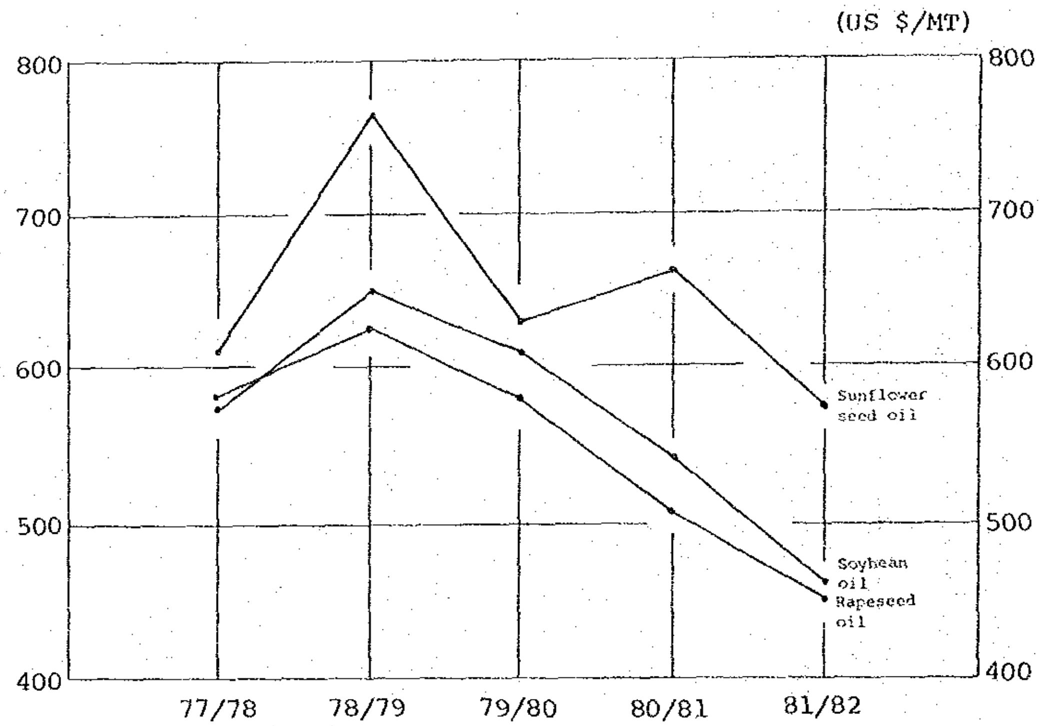
* Computed from Prices in the European Markets for the Period 1960-1980.

Source: Oil World, Hamburg

From the above, it can be seen that the price of vegetable oils depends on the overall supply and demand relationship of all oils, and particularly on the price of soybean, which holds a large share of the international market, rather than on the supply and demand relationship of each oil. In other words, the prices of soybean, soybean oil and soybean meal in the Chicago market lead the prices of all oilseeds and oils. The details will be provided in the section on soybean.

Fig. 3 illustrates the movements in the prices of soybean oil, rapeseed oil and sunflower seed oil over the past five years. These three oils have the highest degree of correlation in Table 10.

Fig. 3 Price of Vegetable Oils



This chart shows that the price of sunflower seed oil rose in 1978/79 and fell again in 1979/80, and the reason for this has already been explained. The degree of fluctuation of each of these three oils over the past ten years has been calculated and is shown in the following Table. It can be seen that soybean oil and rapeseed oil have fluctuated within almost the same range, whereas sunflower seed oil has a somewhat larger range of fluctuation than the other two oils. This is probably because sunflower seed oil has a particular form of consumption as a premium oil, such as a salad oil, so that demand is somewhat lacking in flexibility, while fluctuations in the production of sunflower seed are larger than those for soybean and rapeseed.

	Soybean oil (Netherlands, CIF es-godown)	Rapeseed oil (Netherlands, CIF ex-godown)	Sunflower seed oil (CIF Rotterdam)
Mean price from 1971/72 to 1981/82	$514.4/ton	$511.8/ton	$604.5/ton
Standard deviation	$135.8/ton	$130.2/ton	$179.0/ton
Coefficient of variation (%)	26.4	25.4	29.6

9.2 Outer-economic Factors affecting Oil Economy

Besides the economic factors affecting the vegetable oil prices as discussed in the preceding sections, there are many outer-economic factors which are also affect these prices.

In the planned economy countries almost all prices are controlled by the government. Even in the free economy countries, most of the oilseed producing countries have some price support system for the producers. The international markets for oilseeds, oils and oil cakes are, needless to say, greatly influenced by the agricultural policies of the United States and the EC, the details in this respect will be further examined in the part on soybeans.

Export taxes and other levies are the factors influencing the prices of oilseeds and oils in the world market. Similarly, import duties and import quotas are factors in the countries importing oilseeds and oils. Some oilseed producing countries tax other materials or other kinds of oils in order to protect both the domestic oilseed producers and domestic oil extractors, and some oilseed importing countries exempt oilseeds from duties but tax the oils in order to protect oil extractors. However, a marked tendency towards the reduction or abolition of import duties has been in evidence since the Tokyo Round (A Table of current taxes is attached to Appendix Table 4). The trend towards conversion from the export of oilseeds to the export of the oils can be seen in some oilseed producing countries, e.g., the export of copra now being banned or controlled in the Philippines, and likewise for castor bean in Thailand. Such conversion has exerted a strong impact on oil-extracting industries in the European countries and Japan, which depend on imported oilseeds. Thailand, which was virtually the only country exporting castor bean, has recently developed its own domestic oil extraction industry, so that Japanese oil extractors are now importing castor bean from the Philippines. As a result, the production of castor bean has markedly increased in the Philippines.

Market prices are also affected by trade conducted outside the regular route, including the so-called concessional term trading, in which developed countries such as the United States supply materials or products to developing countries without compensation or on a deferred payment basis, and bilateral trading on a bartering basis. Some irregular instances of large-scale buying, carried out by countries whose trading is under the control of the government or semi-governmental organizations, disturb the international market. Examples of these irregular occurrences of large-scale purchases include the large-scale buying of Malaysia's palm oil by the State Trading Corporation of India, and the large purchases of soybean from the United States by the Export Khleb of the USSR. Other political factors, such as the embargo placed by the United States on exports to the USSR, also affected the international market prices in the past.

On the other hand, long-term contracts between importing country and exporting country have recently become more common. Such contracts are conducted mainly for grains, but also sometimes for oilseeds such as soybean or for vegetable oils, as shown in Table 11.

10. CONCLUDING REMARKS

As described above, the economy of the oilseeds industry is influenced by a variety of factors, and therefore it is very difficult to forecast the future prospects. The FAO, the World Bank and other international organizations have prepared some long-term projections of oil demand and oil prices with econometric models based on past trends, prospective movements in production, and prospective increases in demand due to increases in population and income. Of course, these models are based on assumptions of various unknown factors. It is not possible for the present Study even to do full justice to these models, not to mention to undertake building a new similar economic models within the given time period. Instead, in this report, tentative forecasts are attempted on the basis of extrapolation of past trends, which are modified in the light of the analyses of the past trends and future prospects to be provided for each oilcrop in the following chapters.

The most significant trend of vegetable oil production since the 1960s has been the rapid and marked increase in soybean production due to an increase in the demand for soybean meal as a protein-rich feed,

Table 11 Contracts or Agreements on a Governmental Basis for the Supply of Oilseeds, Oils and Oil Cakes

Supplier	Recipient	Commodity items	Quantity traded (1,000 MT)	Shipping term
Argentina	China	Soybean	-	1981-1984
"	Mexico	Soybean	400	1981-1982
Brazil	Mexico	Soybean	200	1981
"	USSR	Soybean	410	1981
"	"	Soybean oil cake	270	1981
"	"	Soybean	500	1982-1986
"	"	Soybean oil cake	400	
"	"	Vegetable oils	40	
"	Japan, South-east Asia	Soybean and soybean oil cake	300	1981-1983
Canada	Mexico	Rapeseed	60	1981
"	"	"	100	1982
India	USSR	Sesame seed	10	1981
"	"	Peanut	20	
Malaysia	Iraq	Palm oil	94	Oct. 1981 to June 1983
Philippines	China	Coconut oil	25-50	1981-1984
"	India	Coconut oil	200	1982
Sweden	Norway	Rapeseed oil	10-30	1981/82-1983/84
USA	Mexico	Soybean	850-1,000	1981
"	"	Sunflower seed	200-300	
"	"	Cottonseed	100-180	
"	"	Soybean oil and sunflower oil	10-20	
"	"	Sunflower oil	10-20	
"	"	Animal fats	60-80	
"	"	Soybean oil cake	170-200	
"	"	Soybean	100	1982
"	"	Cottonseed	100	1982
"	"	Animal fats	45	1982

Source: FAO, Guidelines for International Cooperation in the Oilseeds, Oils and Oilmeal Sectors, CCP 82/5 and the great increase in palm oil production due to the rapid expansion of oil palm planting in Malaysia. The increase in the supply of these two vegetable oils has depressed the prices of these oils, and consequently, the overall consumption of vegetable oils has increased, as shown in Appendix Table 3.

One of the most important aspects of the future outlook is the question as to whether or not soybean production will increase and retain its predominant infuence on world oil economy. This will depend to a great extent on the future prospects of the world livestock industry. According to the study made in the chapters dealing with livestock and feedstuffs, soybean will maintain its predominant influence. The future prospects for each of the various oils will also be described in the following parts.

As also mentioned above, the per capita consumption of vegetable oils is comparatively large in the developed countries, but it has already reached or close to the saturation point.[1] Accordingly, an increase in the demand for edible oils due to future increases in income or decreases in the prices of the oils is hardly expected in these countries. The increase in demand may be merely proportionate to the increase in population. To a certain extent, however, the consumption shift between oils may take place. Shift from animal oils to vegetable oils for health reason (cholesterol precaution) may also be expected.

On the other hand, in many developing countries, per capita oil consumption is less than the minimum required level for the maintenance of health. Accordingly, any increase in demand for oils will depend on an increase in personal income in each country as well as an increase in population. Already, an increase in oil consumption in the petroleum producing countries in the Middle and Near East due to increased income levels is in evidence. These countries have been importing edible oils, but many developing countries which are short of foreign exchange will have to increase their domestic production of oils, rather than increasing their level of imports, in order to accomodate the prospective increase in demand for oils. China, which is a large oil-consuming country, has almost reached self-sufficiency in vegetable oils at present, and will enter the international oil market in the future, importing some kinds of oils in deficit and exporting other oils which are surplus in the domestic market.

From these trends in the production of and demand for oils, it can be considered that both the supply and demand of the vegetable oils overall will increase at a moderate rate, although this rate of increase will be slightly lower than that during the 1970s.

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1) The saturation level of per capita consumption of edible oils and fats, including animal oils and fats, is approximately 30 kg of oils and fats/year.

Appendix Table 1 World Production, Imports and Exports of Major Oilseeds and Oils
Yearly averages for 1977/78-1979/80 and 1972/73-1974/75

(1,000 MT)

Oilseed production	152,256 (100%)	Soybean 81,383 (53.5)	Cottonseed 24,367 (16.0)	Sunflower seed 13,807 (9.1)	Peanut 11,543 (7.6)	Rape-seed 9,577 (6.3)					Others	(77/78-79/80)
	119,187 (100%)	Soybean 55,261 (46.4)	Cottonseed 24,872 (20.9)	Sunflower seed 10,846 (9.1)	Peanut 10,848 (9.1)	Rape-seed 7,017 (5.9)					Others	(72/73-74/75)
Oilseed Exports	29,103 (100%)	Soybean 23,184 (79.7)	Rape-seed 1,736 (6.0)	Sun-flower seed 1,436 (4.9)							Others	(77 - 79)
	20,603 (100%)	Soybean 15,140 (73.5)	Rapeseed 1,494 (7.3)	Copra 980 (4.8)	Pea-nut 887 (4.3)						Others	(72 - 74)
Oilseed Imports	28,720 (100%)	Soybean 23,028 (80.2)	Rape-seed 1,545 (5.4)	Sun-flower seed 1,299 (4.5)							Others	(77 - 79)
	20,639 (100%)	Soybean 15,296 (74.1)	Copra 982 (4.8)	Rape-seed 968 (4.7)	Pea-nut 866 (4.2)						Others	(72 - 74)
Oil Production	33,671 (100%)	Soybean oil 10,992 (32.6)	Sunflower seed oil 4,259 (12.6)	Palm oil 3,340 (9.9)	Rapeseed oil 3,034 (9.0)	Cotton-seed oil 2,900 (8.6)	Coconut oil 2,720 (8.1)	Peanut oil 2,637 (7.8)	Olive oil 1,574 (4.7)		Others	(77 - 79)
	27,600 (100%)	Soybean oil 7,916 (28.7)	Sunflower seed oil 3,725 (13.5)	Cottonseed oil 2,843 (10.3)	Peanut oil 2,640 (9.6)	Rapeseed oil 2,439 (8.8)	Coconut oil 2,355 (8.5)	Palm oil 1,877 (6.8)	Olive oil 1,589 (5.8)		Others	(72 - 74)
Oil Exports	9,526 (100%)	Palm oil 2,618 (27.5)	Soybean oil 2,608 (27.4)	Coconut oil 1,184 (12.4)	Sunflower seed oil 786 (8.3)	Peanut oil 507 (5.3)	Rape-seed oil 482 (5.1)	Cotton-seed oil 380 (4.0)			Others	(77 - 79)
	5,060 (100%)	Palm oil 1,242 (24.5)	Soybean oil 671 (13.2)	Sunflower seed oil 628 (12.4)	Coconut oil 609 (12.0)	Peanut oil 405 (8.0)	Cotton-seed oil 328 (6.5)	Rape-seed oil 322 (6.3)	Olive oil 290 (5.7)		Others	(72 - 74)
Oil Imports	9,584 (100%)	Palm oil 2,615 (27.3)	Soybean oil 2,548 (26.6)	Coconut oil 1,179 (12.3)	Sunflower seed oil 752 (7.8)	Rape-seed oil 550 (5.7)	Peanut oil 506 (5.3)	Cotton-seed oil 385 (4.0)			Others	(77 - 79)
	6,425 (100%)	Palm oil 1,544 (24.0)	Soybean oil 1,248 (19.4)	Coconut oil 743 (11.6)	Sunflower seed oil 711 (11.1)	Peanut oil 483 (7.5)	Cotton seed oil 342 (5.3)	Olive oil 335 (5.2)	Rape-seed oil 330 (5.1)	Lin-seed oil 276 (4.3)	Others	(72 - 74)

Appendix Table 2 Oil and Meal Yields*

(%)

Oilseed crop	Oil yield	Meal yield
Soybean	18.0	79.5
Sunflower seed	42.0	55.0
Cottonseed	17.5	59.0
Peanut	44.5	55.0
Rapeseed	38.5	59.0
Copra	63.5	36.0
Palm kernel	46.5	52.5
Linseed	34.0	63.0

* The same oil and meal contents were used to convert oilseed supplies into their oil and meal equivalents. Thus, the figures for world fats and oils supplies are the totals of the oil equivalents of the various oilseeds and the world supplies of oils, such as palm oil or olive oil, which are extracted from a raw material that has no significant meal component.

Source: Oil World Weekly

Appendix Table 3 Prices of Selected Fats and Oils, CIF Europe, 1960 - 1980

(US$/MT)

	Soybean	Sunflower	Cottonseed	Peanut	Rapeseed	Olive	Palm	Coconut	Palm kernel	Fish	Lard	Butter	Tallow
1960	225	243	235	326	219	585	228	312	317	155	214	851	142
1961	287	311	305	331	280	561	232	254	263	139	225	706	158
1962	227	246	266	275	221	631	216	251	255	104	218	822	137
1963	223	236	243	268	215	871	222	286	287	160	216	900	141
1964	205	255	250	315	252	586	240	297	299	203	251	911	168
1965	270	294	278	324	263	663	273	348	353	217	293	910	200
1966	261	263	333	296	244	661	236	324	271	196	282	833	180
1967	216	212	378	283	206	690	224	328	249	127	205	817	144
1968	178	172	305	271	161	681	169	399	367	99	169	709	129
1969	228	213	291	332	200	666	181	361	306	150	216	709	166
1970	307	331	354	379	293	699	260	397	429	240	271	733	202
1971	323	375	392	441	295	727	261	371	335	221	262	1,048	176
1972	270	326	324	426	232	916	217	234	244	182	251	1,209	179
1973	465	480	500	546	395	1,399	378	513	491	342	373	975	356
1974	795	903	939	1,077	745	2,174	669	998	1,010	559	602	1,216	448
1975	619	739	726	857	551	2,436	434	393	439	344	479	1,669	340
1976	438	581	593	741	415	2,166	406	418	433	372	480	1,740	371
1977	576	639	622	852	584	2,234	530	578	620	472	618	2,247	421
1978	607	665	661	1,079	597	2,427	600	683	764	451	626	1,982	483
1979	662	772	798	889	621	2,701	654	985	992	450	693	2,698	612
1980	598	632	657	863	570	2,500	674	673	669	450	644	2,352	487

Descriptions:

Soybean oil : Crude, US, CIF Rotterdam
Sunflower oil : Any origin, ex-tank Rotterdam
Cottonseed oil: US, PBST, CIF Rotterdam
Peanut oil : Nigerian/Gambian/Any origin, CIF Europe
Rapeseed oil : Dutch, FOB ex-mill
Olive oil : Spanish, edible, 1% drums
Palm oil : Malaysian, 5%, CIF UK
Coconut oil : Philippine/Indonesian, bulk, CIF Rotterdam
For 1973, Dutch, 5% ex-mill; prior to 1973, White Ceylon, 1%, bulk ex-tank, Rotterdam
Palm kernel oil: West African, CIF UK
Fish oil : Any origin, crude, CIF Europe. Prior to March 1973, Peruvian, semi-rolled.
Lard : EEC refining quality, CIF UK. Prior to Feb. 1973, YS, Prime Steam, CIF UK.
Butter : Dutch, bulk, unsalted, UK markets
Tallow : US, bulk, bleachable fancy, CIF Rotterdam

Price Index weighted by current world exports (1974 = 100).

Source: Oil World Digest, and Public Ledger

Appendix Table 4 Customs Tariffs on Oilseeds and Oils

	Australia	New Zealand	Austria	Finland	Norway	Sweden	Switzerland
Soybean							
seed	MFN 0%	MFN 22¢/100kg	MFN 0%	MFN 19%	MFN 0%	MFN 0%	MFN SwF 0.10/100kg
oil crude refined	MFN $A 46.50/t	MFN 17.5%	MFN 15.6% (package 5kg or less) MFN 12% (package over 5kg)	T E MFN 10% MFN 16% as above	MFN NKr 0.16/kg	MFN 0% MFN 15%	MFN SwF 10/100kg MFN SwF 12/100kg
Palm							
nut, kernel	MFN 0%+2% a) GSP 0%	MFN 0%B QR	MFN 0%	MFN 19% QR	MFN 0%	MFN 0% IL	MFN SwF 0.001/kg (0.1%) IL
palm oil crude	MFN 0%+2% a) GSP 0%	MFN 0% B	MFN 0% (unfit for immediate consumption)	T E MFN 10% MFN 16%	MFN 0%	MFN 0% IL	T E MFN SwF0.01/kg MFN SwF0.10/kg (6.4%) GSP 0%
refined	as above	MFN 0%	MFN 12% B b)	as above	MFN 0%	T E MFN 8% MFN 15% GSP 0% h) GSP 0% h) IL	T E MFN SwF0.01/kg MFN SwF0.12/kg B IL GSP 0%
in small containers		MFN 0% B QR g)	MFN 15.6% B (5kg or less)				
palm kernel oil							
crude	MFN 0%	MFN 0% B	MFN 0% (unfit for immediate consumption)	T E MFN 10% MFN 16%	MFN NKr 0.16/kg (7.8%)	MFN 0% IL	T E (7.9%) MFN SwF0.01/kg SwF 0.10/kg GSP 0%
refined	MFN 0%	MFN 0% B	MFN 12% B b)	as above	as above	T E MFN 8% MFN 15% GSP 0% h) GSP 0% h) IL	T E (12.5%) MFN SwF0.01/kg MFN SwF0.30/kg IL GSP 0%
in small containers			T E MFN 0% MFN 15.6% (5kg or less)				
Castor bean							
seed	MFN 0%+2% a) GSP 0%	MFN 0% B	MFN 0%	MFN 19% QR GSP 0%	MFN 0% B	MFN 0% B	MFU SwF0.001/kg(0.01%) IL
oil	MFN GSP as above	MFN 0%	MFN 0%	MFN 0% B	MFN 0% B	MFN 0% B	MFN SwF0.01/kg GSP 0%
Peanut							
seed	MFN A$ 0.111/kg MFN 0% (from PNG) MFN A$ 0.07/kg (from Canada)	MFN 0% B (in retail packs)	MFN 0% B	MFN 10% B	MFN 0% B	MFN 0% IL	MFN SwF0.001/kg (0.1%) IL
oil crude	MFN 10%	MFN 0% B	MFN 0% B (Unfit for immediate consumption)	T E MFN 10% MFN 16% QR	MFN NKr 0.16/kg (4%)	MFN 0% IL	T E MFN SwF0.01/kg MFN SwF0.10/kg B (6.4%) IL GSP 0%
refined	MFN 10%	MFN 0% B	MFN 12% B b)	as above	as above	T E MFN 8% MFN 15% GSP 0% h) GSP 0% h) IL	T E MFN SwF0.01/kg MFN SwF0.12/kg B (6.3%) IL GSP 0%
in small containers			MFN 15% B (5kg or less)				

Appendix Table 4 (cont'd.)

	Australia	New Zealand	Austria	Finland	Norway	Sweden	Switzerland
Copra	MFN 0%+2% a) GSP 0%	MFN 0% B QR	MFN 0% B	MFN 19% QR	MFN 0% B	MFN 0% IL	MFN SwF0.001/kg (0.1%) IL
Coconut oil crude	MFN 0%	MFN 22.5% B QR GSP 10% Sparteca 0%	MFN 0% (unfit for immedi- ate consumption)	T: MFN 10% E: MFN 16% QR	MFN NKr 0.16/kg (7.9%)	MFN 0%	T MFN SwF0.01/kg B E MFN SwF0.10/kg (7.4%) IL GSP 0%
refined	MFN 0%	as above	MFN 12% b)	as above	as above	T: MFN 8%, GSP 0% h) E: MFN 15%, GSP 0% h) IL	T MFN SwF0.01/kg B E MFN SwF0.30/kg (12.50%) IL GSP 0%
in small containers			T: MFN 0% B E: MFN 15.6%B (5 kg or less)				
Cottonseed seed	MFN 0%	MFN 0%	MFN 0%	MFN 19%	MFN 0%	MFN 0%	MFN SwF0.10/100kg
oil crude	MFN A$70.13/t	MFN 15.6% (5kg or less)	MFN 17.5%	T: MFN 10% E: MFN 16%	MFN NKr 0.16/kg	MFN 0%	MFN SwF10.0/100kg
refined		MFN 12% (over 5kg)				MFN 15%	MFN SwF12/100kg
Sunflower seed	MFN 0%	MFN 0%	MFN 0%	MFN 19%	MFN 0%	MFN 0%	MFN SwF0.10/100kg
oil crude	MFN A$70.13/t	MFN 19.5% (5kg or less)	MFN 17.5%	T: MFN 10% E: MFN 16%	MFN NKr 0.16/kg	MFN 0%	MFN SwF10/100kg
refined		MFN 15% (over 5kg)				MFN 15%	MFN SwF12/100kg
Babassu nut	MFN 0%+2% a) GSP 0%	MFN 0%	MFN 0%	MFN 19% QR (not for human consumption)	MFN 0% B	MFN 0% IL	MFN SwF0.001/kg (0.1%) IL
crude	MFN 0%	MFN 0%	MFN 0% (unfit for immedi- ate consumption)	T: MFN 10% E: MFN 16%	MFN NKr 0.16/kg (3.8%)	MFN 0% IL	T MFN SwF0.01/kg B E MFN SwF0.10/kg GSP 0%
in small containers		MFN 5% MFN 0% (from AUS. CAN) GSP 0% (4 liter less)	MFN 19.5% (5kg or less)				
Pepper	MFN A$0.041/kg (ground) MFN 0% (unground)	unground MFN 30%(1kg less) MFN 20%(1kg over) ground MFN 52.5%(1kg less) MFN 35%(1kg over)	MFN 3.5% (unprocessed) MFN 32.5% (processed)	MFN 0%	MFN 0% (black & white)	MFN 0%	MFN SwF10/100kg (unprocessed) MFN SwF30/100kg (processed)
Soybean, Cotton- seed, Sunflower, Babassu, Pepper	1975	1975	1978	1978	1978	1978	1976

Appendix Table 4 (cont'd.)

	Japan	USA	EC	Canada	
Soybean					
seed	MFN 0% (temporary)	MFN 0%	MFN 0%	MFN 0%	EEC Palm oil In small continaers (In containers of 1kg or less) MFN 20% GSP 18% c) ACP/LLDC 0%
oil crude	MFN ¥17/kg	MFN 22.5%	MFN 10%	MFN 10%	
refined	MFN ¥21.56/kg	MFN 22.5%	MFN 15%	MFN — GSP 5%	
Palm					
nut, kernel	MFN 0%	MFN 0% b)	MFN 0%	MFN 0%	
palm oil crude	MFN 7.4% GSP 4.0% LLDC 0%	MFN 0%	T MFN 4.0% GSP 2.5% c) ACP/LLDC 0% E MFN 6% GSP 4% c) ACP/LLDC 0%	MFN 10% GSP 0%	
refined	same as crude oil	MFN 0%	T MFN 8% E MFN 14% GSP 12% ACP/LLDC 0%	MFN 17% GSP 12.5%	
palm kernel oil crude	MFN 8% B	T MFN 0%bound at 3¢/lb E MFN 0% B	T MFN 5% d) GSP 2.5% c) ACP/LLDC 0% E MFN 10% d) GSP 7% c) ACP/LLDC 0%	MFN 10% GSP 0%	
refined	same as crude oil	same as crude oil	T MFN 8% GSP 6.5% c) ACP/LLDC 0% E MFN 15% GSP 13% c) ACP/LLDC 0%	MFN 17.5% GSP 12.5%	
in small containers			MFN 20% GSP 18% c) ACP/LLDC 0%		
Castor bean					
seed	MFN 0%	MFN 0% B	MFN 0%	MFN 0%	
oil crude refined	MFN 9.4%	MFN 3% (20¢/lb or less) MFN 1.5¢/lb(1.8-4.8%) (over 20¢/lb) GSP 0%	MFN 5% GSP 6% ACP/LLDC 0%	MFN 0%	
Peanut					
seed	MFN 0% (for oil extraction) MFN 10% (others)	MFN 4.25¢/lb (36.1%) (not shelled) MFN 7¢/lb (10.4%) (shelled or etc.)	MFN 0%	MFN 0%	
oil crude	MFN ¥17/kg	MFN 4¢/lb (5.9%)	T MFN 5% B ACP 0% E MFN 10% ACP 0%	MFN 7.5% B GSP 0%	
refined	MFN ¥23/kg	MFN 4¢/lb (5.9%)	T MFN 8% ACP 0% E MFN 15% ACP 0%	MFN 15% GSP 12.5%	from Jan. 1, '83
in small containers			MFN 20% GSP 18% c) ACP/LLDC 0% (1kg or less)		
Copra	MFN 0%	MFN 0%	MFN 0%	MFN 0%	
coconut oil crude	MFN 9.4% (¥10/kg)	MFN 0%	MFN 5%	MFN 10% GSP 0%	
refined	MFN 9.4%	MFN 0%	MFN 10%	MFN 17.5% GSP 12.5%	

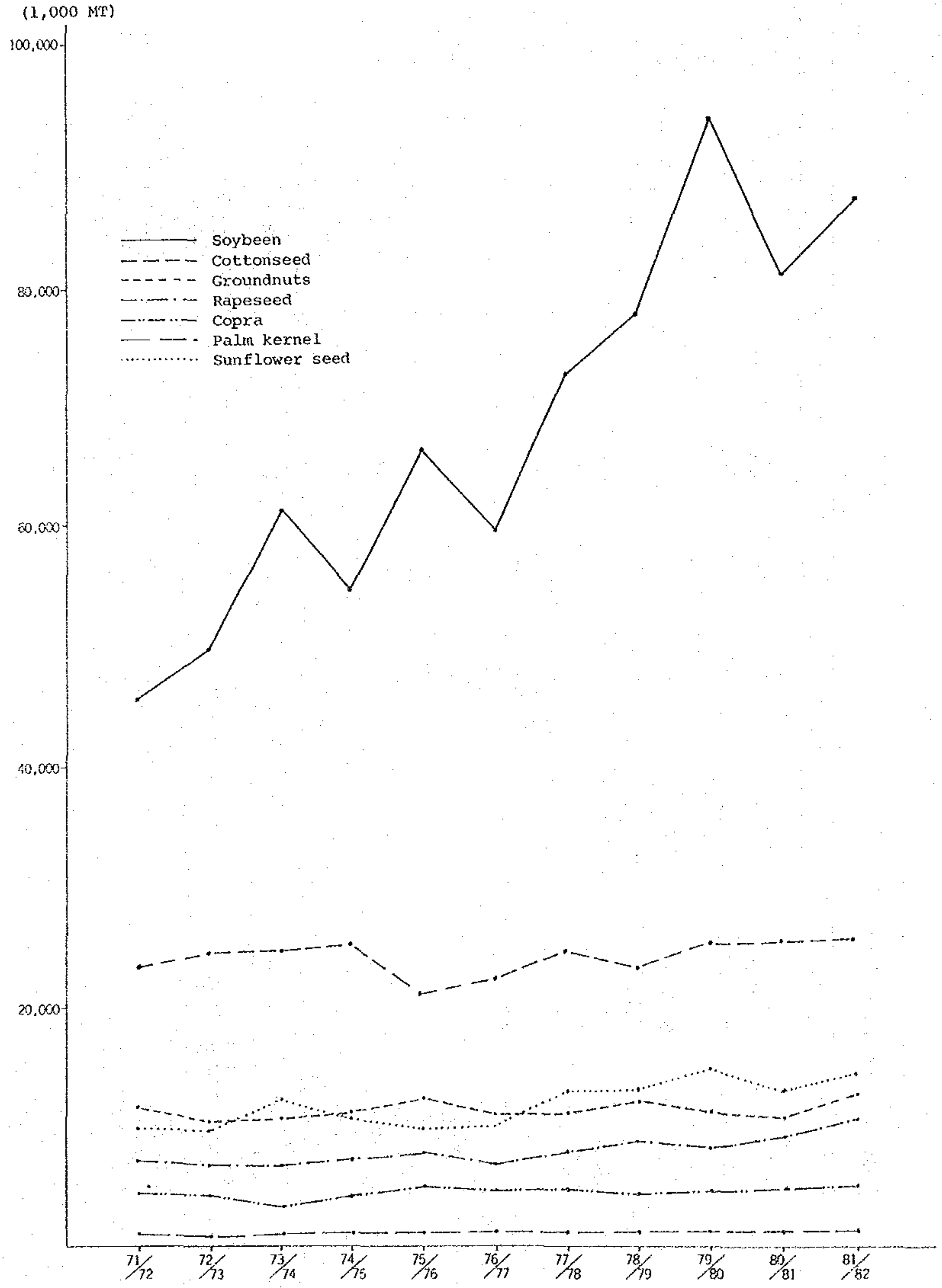
Appendix Table 4 (cont'd.)

	Japan	USA	EC	Canada
Cottonseed				
seed	MFN 0%	MFN 0%	MFN 0%	MFN 0%
oil crude	MFN ¥17/kg	MFN 3¢/lb	MFN 10%	MFN 10% GSP 0%
refined	MFN ¥18.13/kg	MFN 3¢/lb	MFN 15%	MFN 17.5% GSP 12.5%
Sunflower				
seed	MFN 0%	MFN 0%	MFN 0%	MFN 0%
oil crude	MFN ¥17/kg (canned of for export)	MFN 0.9¢/lb+4%	MFN 10%	MFN 10%
refined	MFN ¥23/kg	MFN 0.9¢/lb+4%	MFN 15%	MFN 17.5%
Babassu				
nut	MFN 0%	MFN 0%	MFN 0%	MFN 0%
oil crude	MFN ¥17/kg B (3.4%)	MFN 0%	T E MFN 5% MFN 10% GSP 2.5% ACP/LLDC 0% ACP/LLDC 0%	MFN 10%
refined	MFN ¥20.7/kg B (3.3%) (Acid value 0.6 or less)	MFN 0%	T E MFN 8% MFU 15% B ACP 0% ACP 0%	MFN 17.5%
in small containers			MFN 20% ACP/LLD 0% GSP 18% (1kg or less)	
Corn oil				
crude	MFN ¥12.63/kg	MFN 4%	MFN 10%	MFN 10%
refined			MFN 15%	MFN 17.5%
Pepper	MFN 0% (unprocessed) MFN 7.5% GSP 0% (processed)	MFN 0%	MFN 0% (for industrial) MFN 10% (others)	MFN 9.2% GSP 0%

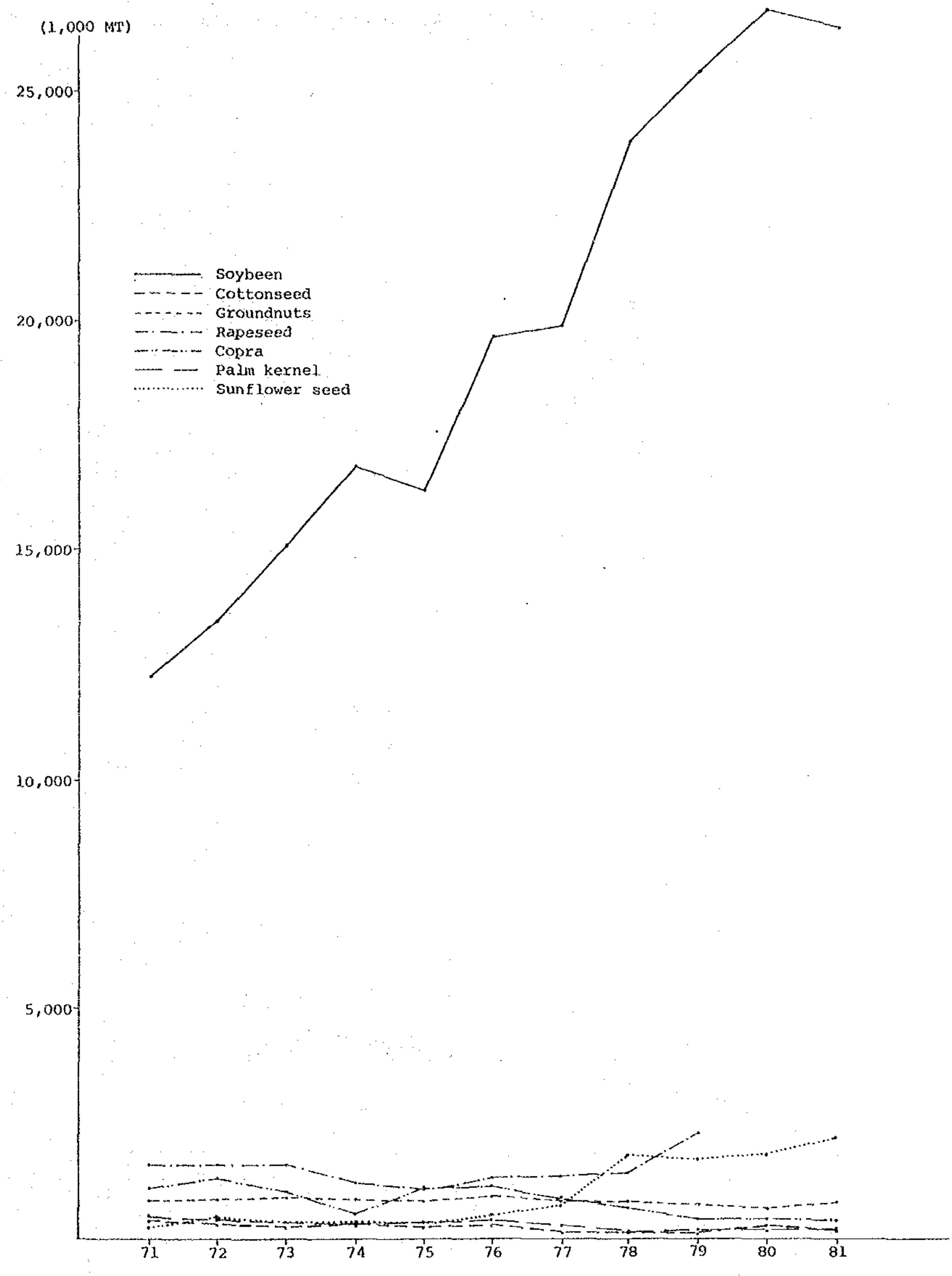
T: for technical or industrial uses; E: edible; QR: quantitative restrictions; IL: import levy and charge; B: Ad valoram rate, fully bound at prevailing rate; ( ): Ad valorem incidence of specific duties in 1976 or 1977
GSP: Generalized System of Preferences in favor of developing countries; MFN: Most favored nation tariff
ACP: African, Caribbean and Pacific Associables preferential tariff rate; LLDC: Least less-developed country preferential tariff rate

a) Temporary revenue duty
b) Oils for margarine factories for the manufacture of margarine under certificate of authorized use
c) Turkey is subject to duty rates equivalent to CSP rates
d) Bound for coconut oil
e) For the production of aminoundecanoic acid for use in the manufacture of synthetic textile fibres or of artificial plastic materials:
f) Bound for babassu oil
g) Imports are subject to quantitative restrictions if in containers of capacity less than 4 liters.
h) These GSP rates are not applicable to Bulgaria, China and Romania.
i) Bound rates (up-bindings) are as follows: copra 1.87 cents per lb.; palm nuts 0.35 cents per lb.; palm kernels 1.35 cents per lb.
j) GSP rate on castor oil having lovibond color values not greater than 6 yellow and 0.6 red did not apply to Brazil in 1976-78 and 1980-81 under the competitive.

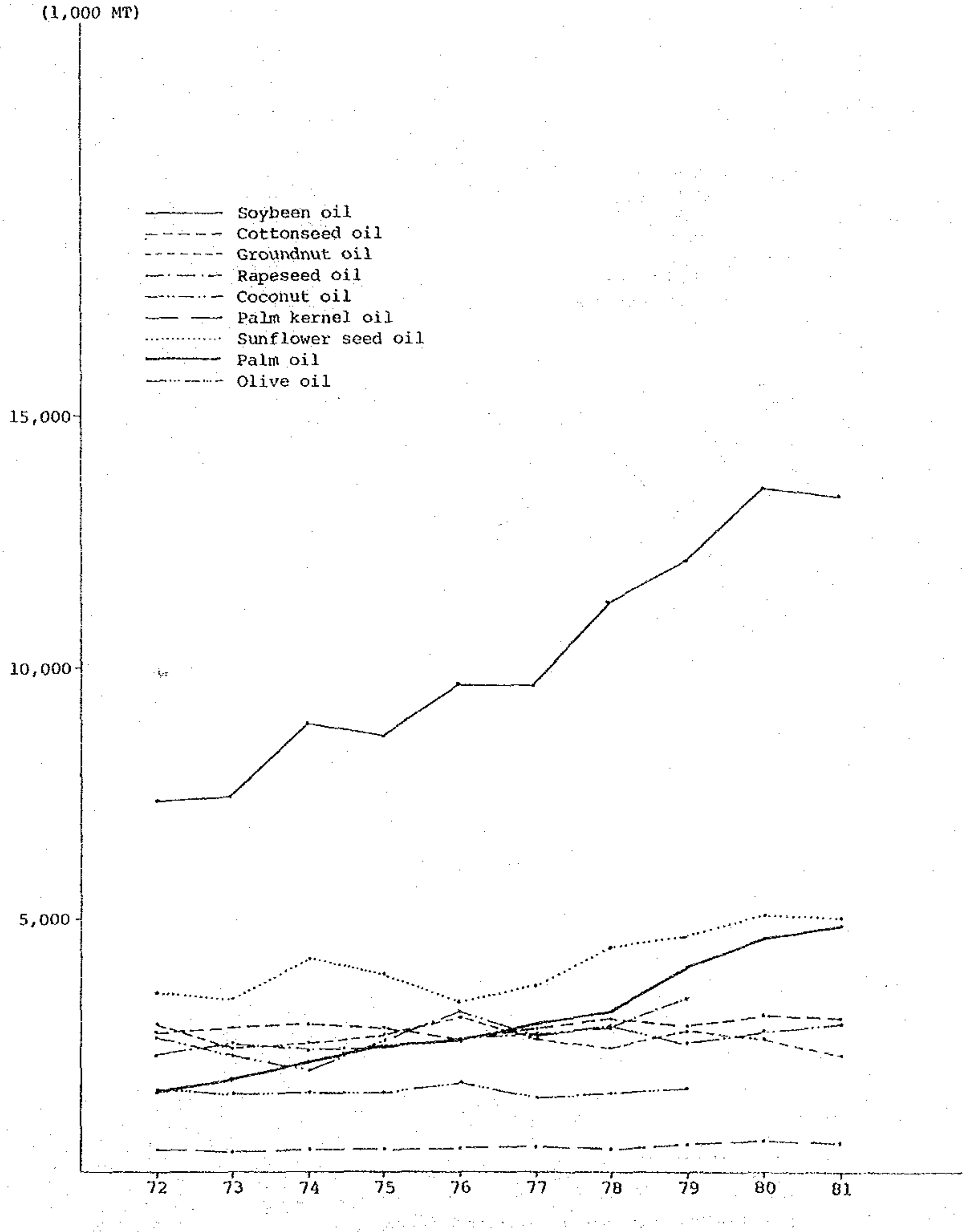
Appendix Fig. 1 World Oilseed Production



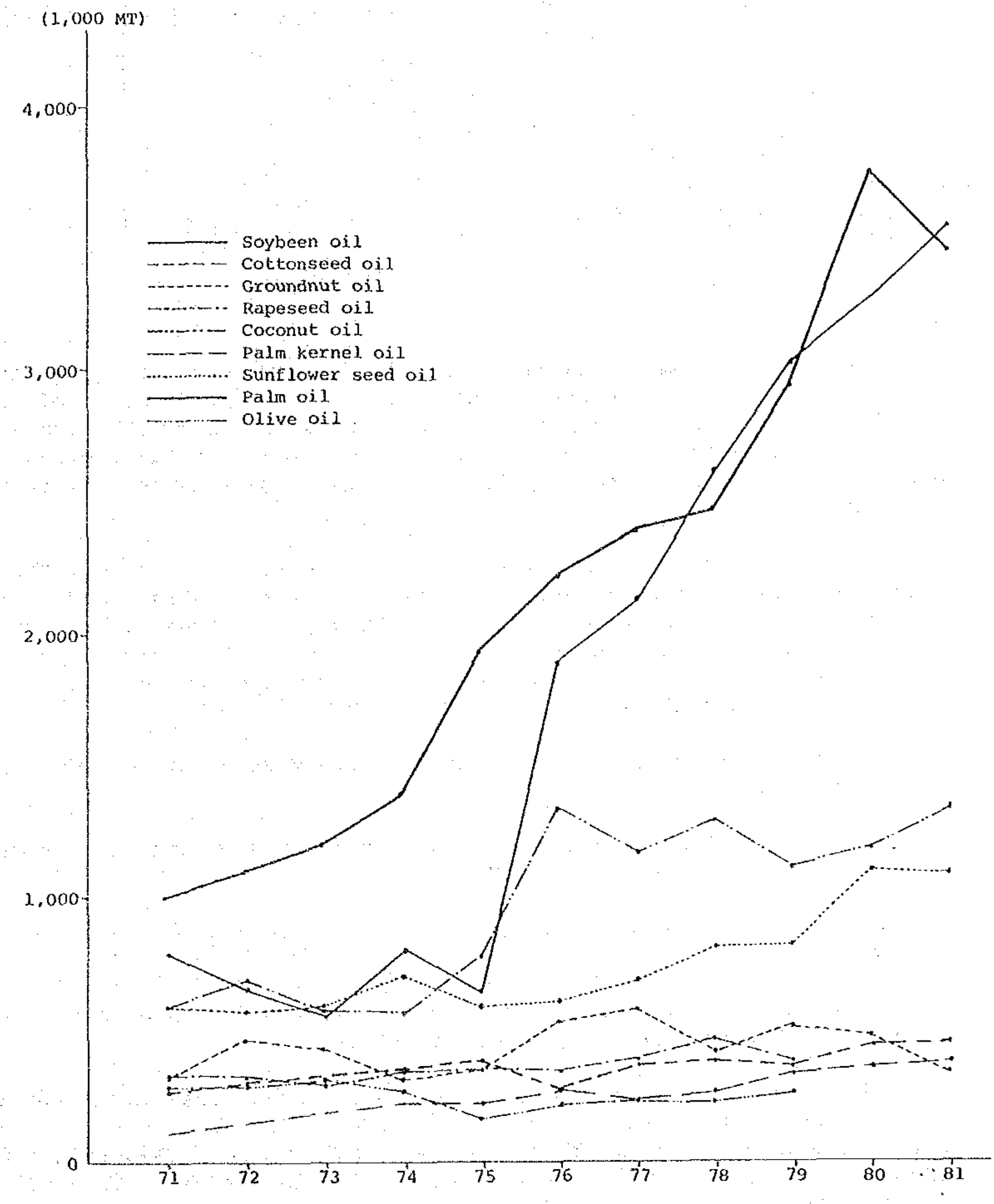
Appendix Fig. 2 World Oilseed Export



Appendix Fig. 3 World Oil Production



Appendix Fig. 4 World Oil Exports



[1-2] DETAILED DESCRIPTION BY COMMODITIES

[1-2-1] OIL PALM

A. OIL PALM PRODUCTS

Oil palm is a perennial oil crop cultivated widely throughout the wet tropical zone between approximately 10° north and 10° south of the equator. It is one of the most important crops, ranking with soybean and coconut in world trade as a source of supply of vegetable oil, its output of oil per area under cultivation being highest among all of the oil crops.

In and around Western Africa, where oil palm is originated, the palm grows wild or spreads naturally after initial planting, and it is said that it can be cultivated under relatively poor conditions. The yield, however, shows large variations according to the natural conditions such as the climate and soil. The optimal conditions are considered to be as follows:

a. no distinct dry season, and a regular monthly rainfall of 200 mm or more throughout the year;

b. an average maximum temperature of around 29 to 30°C and an average minimum temperature of 22 to 24°C;

c. an average of five hours of sunshine per day in each month of the year; and,

d. a sandy clay soil, or a soil with good drainage and water retentive properties with a soil depth of 1 m or more.

The fruit bunches of the oil palm contain about 20% oil on average, plus cellulose, fixed carbon and lignin (Fig. A-1), and the main products are palm oil obtained from the flesh, palm kernel oil obtained from the seed (kernel), and palm kernel meal, which is used as a feedstuff. The pulp (remnant of fruit flesh after oil extraction), mainly consisting of the fiber, is used as boiler fuel in palm oil extraction mills. Further, studies are being made for the development of more sophisticated applications (e.g., as a material for pulp) in Malaysia.

Fig. A-1 Weight Ratios of Palm Products to Bunches (Tenera)

- Fruit bunches* (100)
  - Stems (27)
    - Dry stems (8): cellulose (5), lignin (1.8), ash (0.4), other (0.5)
    - Water (19)
  - Fruit (63)
    - Flesh
      - Water (13)
      - Palm oil (20): saturated acids 47%, unsaturated " 53%
      - Fiber (10) : cellulose (6.4), lignin (2.1), ash (0.5), other (1.0)
    - Seeds
      - Shells (16) : fixed carbon (3.2), volatile matter (11.2), ash (0.6), water (0.8)
      - Kernels (4)
        - Kernel oil: (1.6) saturated acids 80%, unsaturated " 20%
        - Meal (1.6)
        - Water (0.8)
  - Water (10)

* Fresh fruit bunches are usually known as FFB.

This chapter will describe palm oil, the major oil product of the oil palm. Palm kernel oil is dealt with as one of the lauric oils in the chapter on coconut oil.

I. Properties and Uses

Palm oil, an oil extracted from the flesh of the palm fruit, is rich in vitamins, and is semi-solid in the normal temperature range of the temperate zones.

In terms of its fatty acid composition, saturated fatty acids such as palmitic acid and stearic acid account for 40 to 50%, while the remainder are unsaturated fatty acids (oleic acid: 40% and linoleic acid: 7 to 8%). The iodine value is between 50 and 54, and it travels and stores well because of its high stability. However, for shipping to hot regions such as India and Pakistan, an anti-oxidant (usually BHA) should be added to prevent oxidation. Since the oil is highly stable when heated, it is very suitable for cooking (Table A-1).

Table A-1 Composition of Palm Oil

Vitamins					
Carotene	(Vitamin A)				500-700 ppm
Tocopherols	(Vitamin E)				800-900 ppm
Fatty acids					
Saturated	Lauric acid	(C_{12})			Nil-0.1
	Myristic acid	(C_{14})			0.5-0.8
	Palmitic acid	(C_{16})			46-51
	Stearic acid	(C_{18})			1.5-3.5
Unsaturated	Oleic acid	$(C_{18:1})$			39.5-42
	Linoleic acid	$(C_{18:2})$			6-8.5
Iodine value					50-54
Composition of triglycerides					
3 saturated			9.2		55.8
2 saturated					
Oleo			38.8	46.6	
Linoleo			7.8		
1 saturated					
Dioleins			27.5	38.5	43.8
Oleolioleins			11.0		
3 unsaturated			5.3		
Melting point					35-38°C

Carotene, which is a precursor of vitamin A, and of which the oil contains as much as 600 i.u. per gram on the average, gives the palm oil its dark orange color. Carotene is eliminated through a refining process.

Palm oil is also rich in tocopherols, or vitamin E, which functions as anti-oxidants.

Palm oil has an unusual fatty acid composition and can be fractionated into low melting point and high melting point types in the ratio of 7:3 by refining, fractionation or ester exchange. Soft oil of low melting point is composed mainly of oleic acid, and hard oil of high melting point consists of palmitic, stearic and other acids. The former is primarily used for food, such as margarine, shortening, cooking oil, bread, cakes, etc. However, an extended range of uses may be obtained by means of sophisticated fractionation, such as fractional crystallization and solvent extraction. The latter type is used for industrial purposes - for making soaps, surface active agents, steel rolling fat, lubricants, etc. It is also employed as a raw material for higher alcohols, glycerin, and various kinds of synthesized chemicals.

Certain countries are considering the use of palm oil as a substitute for diesel fuel.

Some palm oil refineries are almost completely self-sufficient in heating energy through using the flesh fiber and shells as boiler fuel. However, large amounts of surpluses are thrown away. Empty bunches (the remains of bunches after the fruit has been removed) contain more than 60% of water and are usually burned in a slow combustion incinerator, but their water content is so high that they yield as little as 1,700 kcal of heat per kg, as compared with 4,000 kcal/kg from dried ones. Palm oil factories generate combustible waste of about 20% of the total amount of bunches, and 16% of kernel shells.

A kernel shell contains 70% of volatile matter, 20% of fixed carbon, 6% of water and 4% of ash. It can make good charcoal by dry distillation and activated charcoal by activation.

In Malaysia, research is under way in order to make paper or board, although not of high quality, and to make fuel and feed, from the waste liquid coming from palm oil mills.

II. Varieties and Qualities

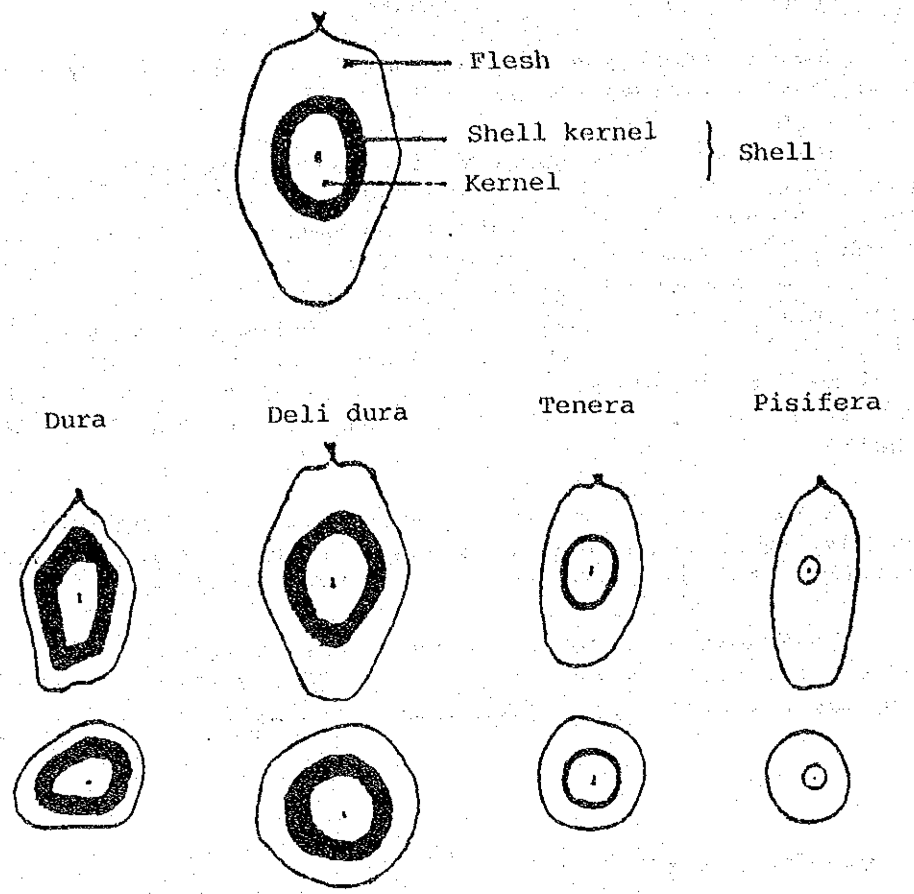
Oil palms are roughly divided into two varieties: Elaesis Guineensis, originated in Africa, and Elaesis Melanococca, originated in South America of which the former is planted widely at present.

E. Guineensis is further divided into three types according to size of shell.

a. Dura (thick shells, tall tree; Deli-dura is a type of dura.)
b. Tenera (hybrid of dura and pisifera)
c. Pisifera (almost no shells)

Since the dura has a large kernel, its oil yield is small. In addition, its height makes it difficult to harvest the fruit, and the fruit's quality suffers when it is dropped. The pisifera has the highest product yield since it is nearly shell-less, but it is not a practical proposition because of its low fertility. The tenera has a relatively large oil yield because of its thin shell, and its short stature gives the advantage of easy cropping. This type is considered

Fig. A-2 Fruits and Seeds



Note: Yampolsky has classified oil palm by type as follows:
1) Congo type (Var. macrocarpa)
2) Deli type (Var. dura)
3) Lisombe type (Var. tenera)
4) Pisifera type (Var. pisifera)
5) Diwakkawakka type (Var. diwakkawakka)
Var.: variety

to be the best today and is being newly planted or is replacing other types extensively in Malaysia, Indonesia, Brazil, etc.

The proportions of palm oil and kernel to fruit bunches are 17 to 18% and 6% in the dura, and 20 to 24% and 4% in the tenera, respectively.

The South American E. Melanococca has a different composition and contains abundant polyunsaturated acids. This type is not being developed because of its small oil yield.

III. Competitive Fats and Oils

Both palm oil and palm kernel oil can be replaced by other vegetable, animal and fish oils and fats and compete with those similar in properties and composition for food and industrial use. The main rivals of palm oil and palm kernel oil from the standpoint of properties are listed in Table A-2.

Table A-2 Some Technical Characteristics of Oils and Fats

Fat/Oil	Main fatty acids	Iodine value	Solidification point (centigrade)
Soybean oil	Linoleic/oleic	121-142	-18 to -8
Sunflower oil	Linoleic	115-135	-19 to -16
Peanut oil	Oleic	84-105	-2 to 3
Cottonseed oil	Linoleic	101-107	2 to 4
Rapeseed oil	Linoleic	94-105	0
Olive oil	Oleic	78-95	-9 to 0
Palm oil	Stearic/palmitic/oleic	44-56	24 to 30
Coconut oil	Lauric	7-10	14 to 25
Palm kernel oil	Lauric	16-23	19 to 30
Fish oil	Linoleic	110-180	-4 to 24
Tallow	Stearic/palmitic	45-55	30 to 38
Lard	Stearic/palmitic	58-77	22 to 32

Source: World Bank

Among competing oils and fats, what matters most is the main types of fatty acids and the melting points of the oil. As mentioned before, palm oil has an unusual fatty acid composition. Among soft oils with low melting points, which consist largely of oleic acid, palm oil competes with soybean, peanut and rapeseed oils. Among the hard oils with high melting points, which are composed of palmitic and stearic acids and others, the competitor is tallow. Owing to the recent advances in refining and fractionation technology, a wide range of products, from those that are liquid at room temperature to very hard solid fats, can be manufactured from palm oil. Through the fractionation and liquefaction of palm oil, the competition with soybean and rapeseed oils has intensified. For use as a food such as margarine and shortening, palm oil has the advantage of costing less to process than the principal oils such as soybean and rapeseed oils.

B. PRODUCTION

I. World Production

World palm oil production increased sharply in the 1970s, from 1.97 million tons in 1970 (about 5% of the total oil production) to 3.22 million tons in 1975 (7%), and to 5.05 million tons in 1980 (11%). The average growth rate during this period was a high 9.9% (Table B-1).

Meanwhile, the major producing countries, which until 1970 were African nations such as Nigeria, the Ivory Coast, Zaire and Dahomey (now Benin), are now Southeast Asian nations particularly Malaysia and Indonesia. One of the reasons for this shift was that a wave of independance among African nations prompted a withdrawal of European capital and technology for cultivation, processing and management, owing to concern over the nationalism in the region, and subsequent reinvestment in Malaysia and other countries.

Today, the major producers of palm oil are Malaysia and Indonesia, and their shares of the world total production were 48% and 13%, respectively, in 1979. Malaysia in particular showed a marked increase: it produced only 100,000 tons in the early 1960s, but now it accounts for nearly half of the total world production. Meanwhile in the traditional producing countries such as Nigeria, and Zaire, although they are still producing considerable amounts, the level of production is either decreasing or leveling off, and their respective shares are on the decline. Against the general background of production cuts in African nations, the Ivory Coast is one of the few to increase its output (Appendix Table 1). The figures of the periodical Oil World are listed in Appendix Table 2, since they are somewhat different from those of the FAO.

II. Situation in Major Producing Countries

Oil palm growing countries are located between about 10° North and 10° South of the equator, and total around 40 according to FAO. Among them, those major producing countries considered to have particularly strong influence on the international market today and in the future are discussed in this section.

Table B-1 Production Trends of Palm Oil

(MT)

	Malaysia	Indonesia	Nigeria	China	Ivory Coast	Zaire	Cameroon	Colombia	Sierra Leone	Guinea	World total
1966	189,674	174,400	713,000	60,000	17,000	124,600	50,000	2,800	47,100	35,000	1,591,009
1967	225,726	174,100	410,000	70,000	20,000	149,400	65,000	11,100	48,000	37,500	1,393,538
1968	282,914	188,200	370,000	85,000	22,000	242,200	56,000	13,400	49,000	41,300	1,546,395
1969	351,996	188,800	445,000	100,000	28,000	245,000	62,000	17,700	50,000	42,800	1,743,740
1970	430,958	216,500	540,000	115,000	50,000	231,700	64,500	26,900	50,700	43,800	1,973,693
1971	588,940	248,400	600,000	128,000	61,400	220,600	63,700	36,200	46,400	44,000	2,242,170
1972	728,679	269,464	590,000	148,000	93,400	208,000	64,600	41,400	43,500	30,000	2,447,756
1973	812,329	290,000	590,000	152,000	99,100	194,400	69,300	44,000	37,800	40,000	2,588,600
1974	1,031,000	351,100	600,000	156,000	145,900	184,400	72,200	50,800	39,000	37,000	2,946,484
1975	1,161,000	411,400	640,000	156,000	153,400	181,400	79,900	39,200	43,100	40,000	3,216,571
1976	1,380,000	433,880	655,000	160,000	150,600	175,400	80,000	38,940	48,000	35,000	3,475,379
1977	1,614,000	497,438	660,000	168,000	148,000	173,300	77,000	43,310	53,000	40,000	3,820,324
1978	1,786,000	524,956	670,000	176,000	145,500	170,900	80,000	49,080	45,000	40,000	3,989,826
1979	2,180,000	610,000	675,000	184,000	158,000	170,000	80,000	62,110	48,000	40,000	4,533,228
1980	2,573,000	676,800	675,000F	190,000F	170,000F	168,300*	79,000F	69,800	48,000F	42,000F	5,052,641
1981	2,821,700	722,000	675,000F	190,000F	190,000F	155,000F	80,000F	88,000*	50,000F	42,000F	5,383,960

* Unofficial figures
F: FAO estimates

Source: FAO, Production Yearbook

1. Malaysia

Malaysia, which produces the largest amount of palm oil now, increased its production dramatically at the beginning of the 1970s. Annual production was about 200,000 tons in the mid-1960s, but reached 730,000 tons in 1972, surpassing Nigeria, the biggest producer until that time. Furthermore, the production rose at an astonishing annual average of 16% to 2.82 million tons in 1981. Malaysia's share of the total world production of palm oil grew from 30% to 52% (Table B-1). Some of the reasons for this sharp rise are the following:

a. The Government offered various incentives to encourage the palm oil industry as well as rubber and tin industries to develop into an export industry.

b. Since the mid-1970s, the sharp demand increase for vegetable cooking oil in developing countries has absorbed production increase in Malaysia, and these countries or in South Asia, such as India and Pakistan, and in such Middle Eastern petroleum producing nations as Saudi Arabia, so Malaysia had the advantage of geographical propinquity.

c. The African nations' surpluses for export dropped sharply.

d. Since the Malaysian Government adopted the policy of levying export duties according to processing level (the more processed, the less the export duties), it was more profitable to export refined palm oil or palm olein. Consequently, improved processing techniques enabled the industry to export the oil to countries without refining facilities.

Palm oil production in the Peninsular Malaysia developed in three stages.[1] In the first stage, oil palm trees were transplanted into Singapore in 1875 and cultivated as foliage plants. In the second, estates were established in 1917 to expand commercial cultivation. In the third, post-World War II stage, the development of oil palm plantations for smallholders [2] has been promoted since 1958 by the Federal Government.

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1) Lim Chong-Yah, Economic Development of Modern Malaysia, Oxford University Press, 1967, pp. 128-143

2) Hectarage by form of management in Malaysia is listed in Appendix Table 3. The Federal Government has organized FELDA (Federal Land Development Authority) with loans from the World Bank and the Asian Development Bank (ADB), and began to promote a palm plantation development since 1966 to settle non-landowners and smallholders under the nucleus estate system. As a result, the production share of public agencies (FELDA and other public corporations) increased rapidly.

In East Malaysia, oil palm cultivation has been mainly in the state of Sabah. This started as a pilot project on the east coast in 1958, but has since not only been supplemented by small estates but has also been supported under the Major Settlements Plan by the State Agricultural Department and the Farmers' Land Development Co-op.

Malaysia's marked growth in palm oil production is due to the increases in hectarage and yield. First, hectarage has been steadily on the increase since 1957. It was 45,000 ha in 1955, but expanded eightfold to 359,000 ha in 1972, and it is estimated to have reached 924,000 ha in 1980 — an increase of more than 20 times (Table B-2). In particular, the annual increase of 30,000 to 40,000 ha during the late 1960s soared to 50,000 to 100,000 ha per year. However, with regard to the Peninsular Malaysia, it has been pointed out that the development of suitable land has reached the limit, so growth at this rate can no longer be expected.

In East Malaysia, full-scale planting started in the late 1960s in Sabah, and in the late 1970s in Sarawak. In 1980, the hectarage reached an estimated 82,000 ha in Sabah and an estimated 37,000 ha in Sarawak (Table B-2). There is a great deal of uncultivated land in the two States, and hectarage is expected to continue to expand.

Next, because of the spread of high-yield varieties, increased use of fertilizers, improvement of cultivation management, and especially the advances made in pest control and disease prevention, yield grew from 1.28 tons/ha in 1955 to 3.44 tons/ha in 1972, and to an estimated yield of 3.84 tons/ha in 1980 [1] (Table B-3).

The main reason for this dramatic growth of hectarage in the Peninsular Malaysia during the 1970s was that palm oil had an export price advantage over rubber, which had been the country's chief primary product for export until that time.[2] At the outset of the

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1) Malaysia is undertaking a trial experimental insect pollination system using weevils (Elaeidobius Kamerunicus) introduced from Cameroon in mid-1981. This method improves the pollination efficiency of female flowers, increasing the number of FFB per hectare. Since the number of fruits per FFB also increases, the yield of palm kernel grows from 4.5 tons to 6-6.5 tons per 100 tons of FFB. The yield of FFB per hectare is 10-20% greater than with artificial pollination. On the other hand, thicker shells and thinner flesh decrease the ratio of palm oil yield to FFB weight from the 21-22% to 14%. For more specific data, refer to Oil World, April 16, 1982, pp. 101-102.

2) International Development Center of Japan, Fuel Oil Production with Oil-bearing Plants - A Survey of the Feasibility of Producing Fuel Oil with Oil-bearing Plants Overseas (in Japanese), 1982, pp. 68-70.

Table B-2 Total Planted Area of Oil Palm in Malaysia, 1960-1980

(ha)

Year	Malaysia		Sabah		Sarawak		Total	
	Overall Total	Year's Total	Overall Total	Year's Total	Overall Total	Year's Total		
1955	45,000	n.a.	n.a.		n.a.		—	
1960	54,634		n.a.		n.a.		—	
1961	57,143	2,509	n.a.		n.a.		—	
1962	62,079	4,936	n.a.		n.a.		—	
1963	71,030	8,951	n.a.		n.a.		—	
1964	83,200	12,170	n.a.		n.a.		—	
1965	96,947	13,747	n.a.		n.a.		—	
1966	122,703	25,756	n.a.		n.a.		—	
1967	153,610	30,907	n.a.		n.a.		—	
1968	190,765	37,155	n.a.		n.a.		—	
1969	231,176	40,411	n.a.		n.a.		—	
1970	261,199	30,023	28,947		1,117		291,263	
1971	294,149	32,950	32,058	3,111	2,614	1,497	328,821	37,558
1972	348,741	54,592	35,769	3,711	5,241	2,627	389,751	60,930
1973	412,070	63,824	39,779	4,010	7,345	2,104	459,194	69,443
1974	500,244	88,174	49,405	9,626	8,197	852	557,846	98,652
1975	568,770	68,526	49,640	235	14,929	6,732	633,339	75,493
1976	637,617*	68,847	59,280	9,640	16,112	1,183	713,009	79,670
1977	712,002*	74,285	62,275	2,995	18,393	2,281	792,670	79,661
1978(e)	763,714	51,712	66,606	4,331	21,777	3,384	852,097	59,427
1979(e)	819,945*	56,231	74,021	7,415	30,072	8,295	924,038	71,941
1980(e)	924,029	104,084	81,929	7,909	36,750	6,678	1,012,708	118,670
1981(e)							1,130,000	87,292

n.a. : not available

(e) : estimated figure

* the reason for the difference of about 7,000-14,000 between this figure and that of Department of Statistics is not known.

Sources:
1. Department of Statistics, Malaysia
2. MOPGC (Malaysian Palm Oil Growers' Council)
3. PORLA (Palm Oil Registration and Licensing Authority)

Table B-3 Planted Area, Production, Export, Export Price and Comparison with Rubber, Peninsular Malaysia, 1955 - 1979

Year	Planted area (1,000 ha)	Hectarage in production (1,000 ha)	Production (1,000 MT)	Output per hectare (MT/ha)	Export price 1) (M$/long ton)	Yield 2) per hectare	Output per hectare of rubber (kg/ha)	Export price of rubber (M$/long ton)	Yield per hectare	Ratio of export price (1960 = 100)
1955	45		54	1.28	647	828	548			
1960	55		57	2.50	622	1,555	756	2,348	1,775	100
1964	83	52	122	2.36	649	1,531	915	1,499	1,371	163
1965	97	59	149	2.51	754	1,892	951	1,540	1,464	185
1966	123	66	186	2.81 (2.74)	642	1,804	1,005	1,441	1,448	168
1967	162	74	217	2.91 (2.87)	624	1,815	1,031	1,192	1,229	198
1968	201	85	265	3.11 (2.97)	447	1,390	1,103	1,171	1,292	144
1969	242	108	326	3.01 (3.06)	437	1,315	1,150	1,539	1,770	107
1970	261	134	402	3.01 (3.06)	641	1,929	1,189	1,244	1,479	194
1971	294	170	551	3.24 (3.18)	673	2,180	1,288	1,016	1,309	250
1972	349	191	657	3.44 (3.29)	482	1,658	1,323	935	1,237	190
1973	412	231	740	3.19 (3.40)	570	1,818	1,377	1,656	2,280	130
1974	500	269	942	3.49 (3.45)	1,153	4,024	1,389	1,794	2,492	243
1975	569	310	1,137	3.66 (3.47)	1,055	3,861	1,272	1,367	1,758	291
1976	630	362	1,261	3.48 (3.50)	882	3,069	1,460	1,990	2,905	167
1977	698	419	1,484	3.54 (3.53)	1,225	4,336	1,430	2,028	2,900	228
1978	761	495	1,640	3.31 (3.56)	1,178	3,899	1,439	2,300	3,312	193
1979	835	557	2,033	3.65	1,309	4,778	1,439	2,794	4,023	177

Notes: 1) Price is per long ton (1 long ton = 1.016 kg)
2) Yield is export price multiplied by output per hectare.

Sources: Department of Statistics, Oil Palm, Coconut and Tea Statistics, 1972/1979; Rubber Statistics Handbook Malaysia, 1972/1979

1970s, the export price of palm oil was at a constant high level relative to that of rubber while remained relatively low (Table B-3). This situation is considered to have given impetus to the conversion of rubber tree plantations to oil palm and to the increase in new planting of oil palm. In the case of conversion, the direct yard-stick for growers is the revenue per hectare (palm oil and palm kernel) (Table B-3. When palm kernel is included, the figures go up by 10%). In 1960, the revenue from palm oil was smaller than that of rubber, but since 1964 it has remained larger except in 1969. Although production costs per hectare of palm oil are higher,[1] its revenue per hectare is greater, so when rubber and oil palm plantations with the same areas under cultivation are compared, the growing of oil palm is seen to be more profitable. This is thought to have been the deciding factor in the conversion to oil palms.[2]

As of 1981, the number of palm oil mills approved by PORLA (Palm Oil Registration and Licensing Authority) is 148, and the processing capacity of FFB (fresh fruit bunches) reaches 4,100 tons per hour. Since around 1973 or 1974, the Malaysian Government has given encouragement not only to the production of crude palm oil but to refining and processing in order to raise the added value. Also, it has been aiming, under a variety of domestic policies including the introduction of foreign capital, to expand exports of highly processed goods. In 1977, the amount of refined oil exports exceeded that of crude, and refined oil now accounts for 90% of the total palm oil exports.[3]

In Malaysia, there are some 40 refineries in operation today, with a combined capacity of 3.2 million tons. Currently, however, this figure is well over the country's actual production amount of crude oil, and the refineries as a whole are said to be operating at an average of 60% of their capacity. In addition, there are reportedly about 10 government-approved factories awaiting construction, and the gap between them and the country's production level could cause competition among refineries for procurement of crude oil. Consequently, the refiners are passing through a very difficult period.

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1) Production costs per kg for rubber and palm oil estimated by USDA based on the Malaysian Government's data are listed in Appendix Table 4. If yield per hectare is taken into account, production costs per hectare for palm oil are slightly higher.
2) International Development Center of Japan, ibid. p. 70
3) For duty to raise added value and exports of refined oil, refer to Section D. International Trade and Prices.

Table B-4 Crude Palm Oil Mills in Malaysia (1981)

Location	Number of mills	Shipping port
Johore	34	Pasir Gudang/Singapore
Pahang	28	Kuantan
Perak	24	Butterworth
Selangor	23	Port Klang
W. Malaysia and others	24	Kuala Trengganu, etc.
Sabah	13	Sandakan, Tawau, Sipitang, etc.
Sarawak	2	Kuching
Total	148	

Source: JICA, Manual for Agricultural Development in Developing Countries, 1981, p.227

2. Indonesia

The palm oil industry in Indonesia, the second-largest palm oil producing country, has been less advanced than that of Malaysia during the past 15 years. Recently, however, attempts have been made to breed improved varieties, promote planting, help refiners, improve the ports and expand the domestic demand, and as a result, production is gradually increasing by about 8% annually, from 500,000 tons in 1977 to 720,000 tons in 1981.

With regard to exports, the country is adopting a policy of exporting coconut oil, whose price on the international market is higher, and is using palm oil to meet domestic demand. Exports have therefore been on the decline since about 1978.

In addition, the export market is rapidly becoming more centered on refined oil, and processing and refining plants are continuously being built in Indonesia, which has been exporting its crude oil, to satisfy the domestic demand as well as export. As of 1980, the number of refining mills is said to be 11, many of them small; and their combined capacity is estimated to be about 20,000 tons per month.

3. African Countries

As mentioned before, the palm oil output of the major African producing countries, such as Nigeria, the Ivory Coast, Zaire, and Sierra Leone, has been in a stagnant condition since the mid-1970s, staying at the 1 million ton level, and exports are declining.

Until the 1960s, Nigeria had been the world's biggest producer and exporter. However, the Marketing Board, which buys up the export products, kept the prices paid to the producers for FFB low, and the smallholders, who accounted for 90% of the total production, did not carry out replanting, so that the palm trees aged and the harvest decreased. In addition to that, Biafra, the main producing region, became the battlefield of civil strife. These causes brought about a decline in production from the early 1970s. Also, increased petroleum revenues caused an influx of the rural population into the cities, and as a result, the production of palm oil became sluggish, and the domestic demand for fats and oils increased, making the country an importer of palm oil.

The palm oil production of the Ivory Coast is moving relatively smoothly, compared with other African nations, where it is stagnant. 63% of its palm oil is produced on state-owned plantations; the rest is on private ones. Recently, since the Government set the purchase price of FFB very low, private production is reported to be on the downward path. However, the government-run plantations are reported to be proceeding with replanting and producing more oil.

The palm oil production of Zaire has been falling since it reached its peak of 245,000 tons in 1969. It has declined at the rate of 1.6% per year for the last five years to an estimated 155,000 tons for 1981. Although the Government is planning to newly plant an area of 5,000 ha per year with palm trees in an attempt to increase production, only 2,000 ha is newly planted per year. Thus exports also have been decreasing since their 1968 peak of 130,000 tons, and the Government took some measures to limit exports in 1979.

4. Pacific Islands

The Solomon Islands and Papua New Guinea, the major producers in the Pacific, have only recently become independent. Their Governments regard palm oil as an important export commodity and are endevoring to develop the industry.

In the Solomon Islands, oil palms are grown only by SIPL (Solomon Islands Plantations, Ltd.), which has been incorporated jointly by the CDC (Commonwealth Development Corporation) of the

United Kingdom, the Solomon Islands Government, and local land owners.

SIPL began growing oil palm in 1965, and has a cultivated area of 3,335 ha, producing 13,000 tons of palm oil and 2,258 tons of palm kernel in 1979. High-yielding variety introduced from Malaysia is planted. FFB of this variety yield 23.5% of palm oil and 3.5% of kernel, totaling 27% in weight, on the world highest level. The combined production of palm oil and kernel for 1985 is expected to be about 20,000 tons, but palm oil refining and palm kernel extraction are neither carried out nor planned.

Table B-5 Solomon Islands' Plantation Hectarage, Production and Exports

	Plantation hectarage		Production		Exports
	Yearly increase (ha)	Total (ha)	Palm oil (MT)	Palm kernels (MT)	(US$1,000)
1970	9				
1971	49	58			
1972	633	691			
1973	568	1,259			
1974	700	1,959			
1975	721	2,680			
1976	535	3,215	4,535	358	1,398
1977	120	3,335	7,044	1,435	3,646
1978	-	3,335	10,911	1,963	6,452
1979	-	3,335	13,000	2,258	8,836

Source: Statistical Yearbook 1979, Solomon Islands

Papua New Guinea started oil palm cultivation in the mid-1960s along with the agricultural diversification policy. And, European plantation enterprises were interested in this area as the new area for their business operations.

Today oil palms are grown by the New Britain Oil Palm Development Pty. Ltd., which was jointly established in 1967 by the British company Harrisons and Crossfield and the Papua New Guinea Government, together with two government-financed British plantations and by smallholders in the nuclear estate. As of 1980, the cultivated area reached about 13,000 ha and their production was estimated at 33,000 tons of palm oil and 13,800 tons of palm kernel.