[1-3-2] STRUCTURE OF PROJECTION MODEL BY THE STUDY TEAM

A number of projection models for oilseed fats have been constructed depending on objectives of the model builders. The World Bank and the USDA models are typical examples of these models, as described above.

We now intend to construct an independent model on a world-scale for fats and oils based on the purposes of the Study.

The objective of our projection is to estimate the future production and consumption of oilseeds and their products (fats and oils), i.e., fats and oils, and to investigate the potential of each product as an export commodity.

The scope of the projection model may be summarized as follows:

a. To incorporate all vegetable fats and oils.

b. To project regional production and consumption levels.

c. To gauge the regional consumption patterns of fats and oils.

d. To observe the long-range trend of each objective variable (production or consumption) for the period 1985-2000.

e. To assess the future production of oilseeds by examining the movements in production upto the present.

f. To assess future consumption of vegetable fats and oils by examining the movements in consumption upto the present. Together with such projections the potential for increased exports can be evaluated from the balance of production and consumption of all fats and oils, and by crop and by type of oil or fat.

g. Analysis must be made on the basis of the small number of variables due to the limit on the availability of data and the lack of consistency between data.

On the basis of the above considerations a projection model has been constructed with the following ideas in mind.

From the considerations given above, the projection model is constructed on the basis of the following assumptions and requirements.

a. The purpose of projection is to examine production possibilities of oil crops, and since oil extraction is not the only end use of

harvests (oilseeds), projection is made for oilseeds as converted into oil terms rather than for vegetable oils.

b. To deal separately with the production and the consumption of fats and oils.

c. The purpose of the model is not to examine detailed casual relations but to observe long-range trends, so that the structure of the model is simplified by reducing the kinds of variables. Past trends in various factors including production, consumption and trade in oilseeds and, in particular, existing price relationships between different kinds of fats and oils are assumed to continue in the future.

d. The demand functions and supply functions are estimated independently, i.e., the model is not simultaneous equations system. The data used are mainly based on the FAO data.

e. The projection is based on the extrapolation of the time-series data. Most of the equations estimated are logistic curves.[1] However, if logistic curves are inappropriate, straight lines[2] are used.

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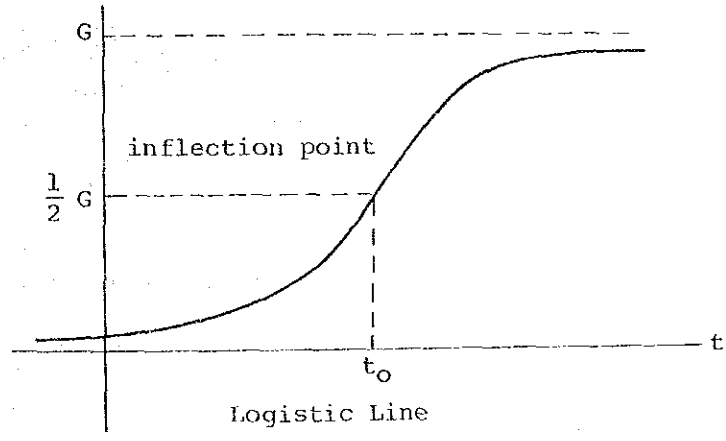
1) The general form of logistic curve is as follows:

$$y = \frac{G}{1 + a.e^{bt}}$$

where a, b and G are estimated parameters; G is the maximum value and the point of 1/2 G becomes an inflection point. With this point as a central point, the curve is symmetrical to the left and to the right (see the figure below).



Logistic Line

This curve was originally used to indicate population increase. Assuming a certain environmental situation, population cannot increase infinitely at the same rate but, in spite of increased growth, the growth rate will gradually decline until population reaches a certain level. If it is assumed that the size of population is inversely related to the rate of population increase then logistic curves fits quite well.

2) Values estimated using straight lines are indicated by * in Appendix Tables 6-1 to 6-13.

A. STRUCTURE OF PROJECTION MODEL

The structure of the projection model is outlined in Fig. A-1. It can be seen that the model is composed of a production-export block and a consumption-import block. For each fat and oil, if the production of the given fat or oil is larger than the consumption within the region, it will be regarded as being part of the production-export block. If not, it will be deemed as belonging to the consumption-import block.

In each block, the potential quantities of exports and the quantity of imports required are computed and the balance examined. Then, the export potentiality of various fats and oils, and the degree to which trade can be expanded will be evaluated.

Furthermore, the upper section of Fig. A-1 indicates the approach by which the trends in the consumption of vegetable fats and oils for cooking are projected based on changes in the per capita consumption of edible fats and oils. The consumption of edible oil is then compared with the consumption of vegetable fats and oils for cooking which is projected by the method shown in the lower section of Fig. A-1.

1. Oilseeds Examined

The following oil crops are examined in this Study.

Annual crops —— soybean, sunflower, rapeseed, cottonseed, castor bean, peanut, sesame, sufflower, linseed

Perennial crops —— coconut, oil palm, olive

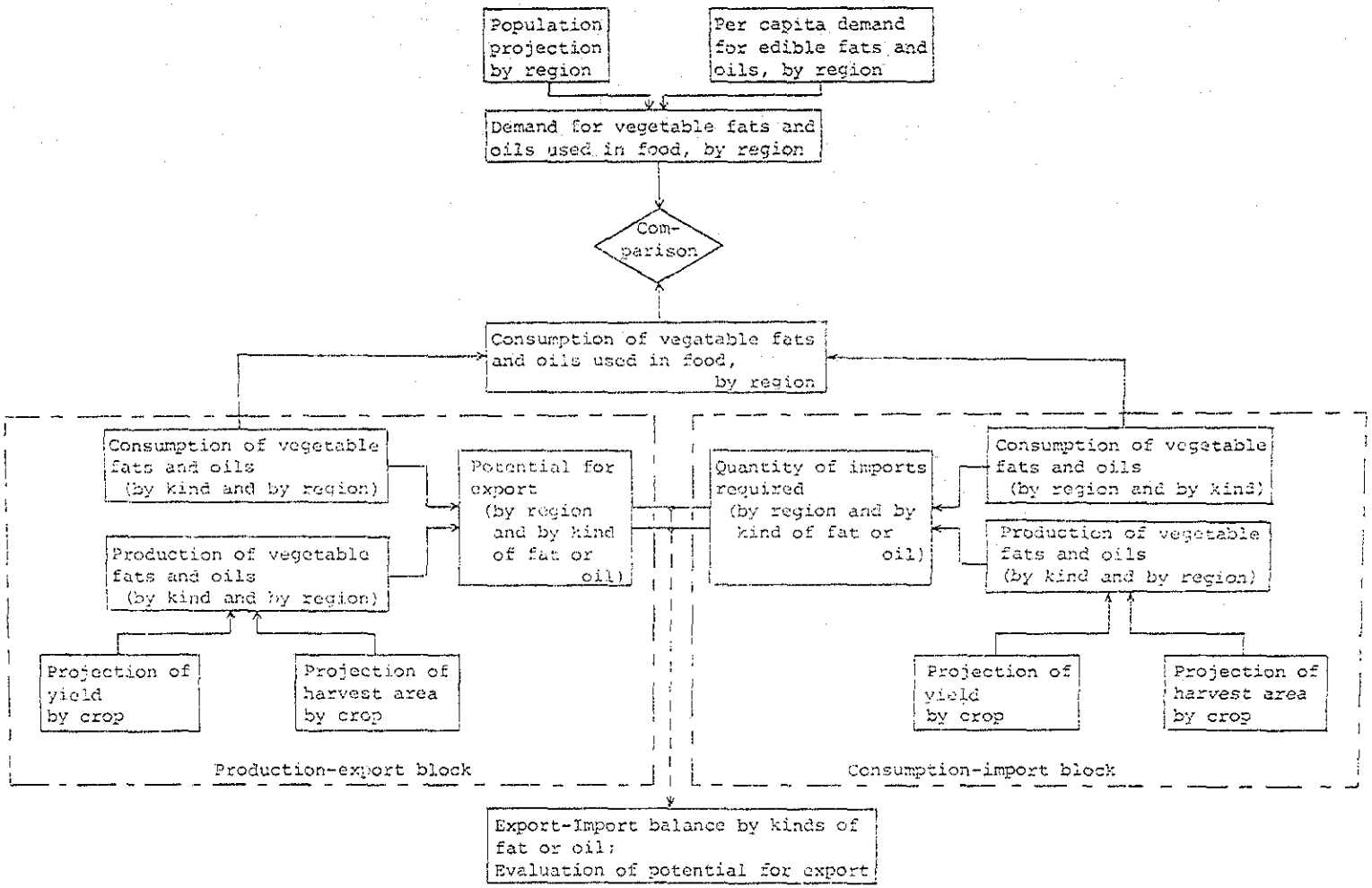
Production of oilseeds listed above is converted into oil terms. The only exception is palm oil, for which projection is done in terms of oil production, because oil palm bunches are processed near the groves to prevent the deterioration of oil contents.

Although rapeseed, sufflower, sesame, linseed and olive are outside the scope of the present Study, they are included in projection in order to obtain overall prospects for oilseeds.

2. Regional Blocs

According to the regional classification of FAO, the world is divided as follows (see Appendix Table 1 for details):

Fig. A-1 Structure of Projection Model



Developed countries:
- North America
- Western Europe
- Oceania
- Other developed countries

Developing countries:
- Africa
- Latin America
- Middle and Near East
- Asia
- Other developing countries

Countries with centrally planned economy:
- Asia (including China)
- Eastern Europe (including the USSR)

Among the oilseeds, five kinds, rapeseed, sesame, olive, linseed and castor bean, are dealt with by dividing the world into three regions; the developed countries, the developing countries and the countries with centrally planned economies.

3. Data

FAO data was used as a base of estimation to maintain consistency among different data sets.

a. Production — Production Yearbook, various issues
b. Trade — Trade Yearbook, various issues
c. Consumption pattern — Food Balance Sheet, various issues
d. Fats and oils intake — Food Balance Sheet, various issues

4. Projection Period

The projection period was extended to the year 2000 by using the 1966-1979 data and computing the projected values at five-year intervals.

B. PROJECTION METHOD

1. Oilcrop Production

The production of each oilcrop can be computed by multiplying its harvest area by unit yield. The projection was achieved to project the harvest area and unit yield separately and then to multiply these two projected numbers together.

When the demand for a certain crop is so large that producers are placed in a favorable position, its production will temporarily show a dramatic increase, i.e., the cultivated area of the crop increases radically. Furthermore, when the cultivated area can not be increased, it may be possible to increase yield by raising the unit yield. In such a situation, the growth in the harvest area and the unit yield is often represented by a growth curve.

2. Intra-region Consumption of Fats and Oils

Figures for the consumption of fats and oils within each region are not included in FAO statistics and it is therefore difficult to make assessments. To estimate the level of exports and imports by region, it is necessary to devise a method for estimating the consumption within the region. The method adopted here is to deduct total exports during a given year from the production of the same year and add total for imports of the region. This estimated quantity can be regarded as the total of consumption and stock within a region. Projections for consumption of fats and oils within a region are made by extrapolating the estimated consumption figures which are derived by the above method.

Consumption figures comprise fats and oils consumption and meal consumption. The conversion rates for oil and meal from oilseed are technical coefficient reflecting the level of technology and facilities within the given region. These factors are assumed to be fixed over the projection period. The conversion rates by region employed here are taken from FAO's Food Balance Sheet.

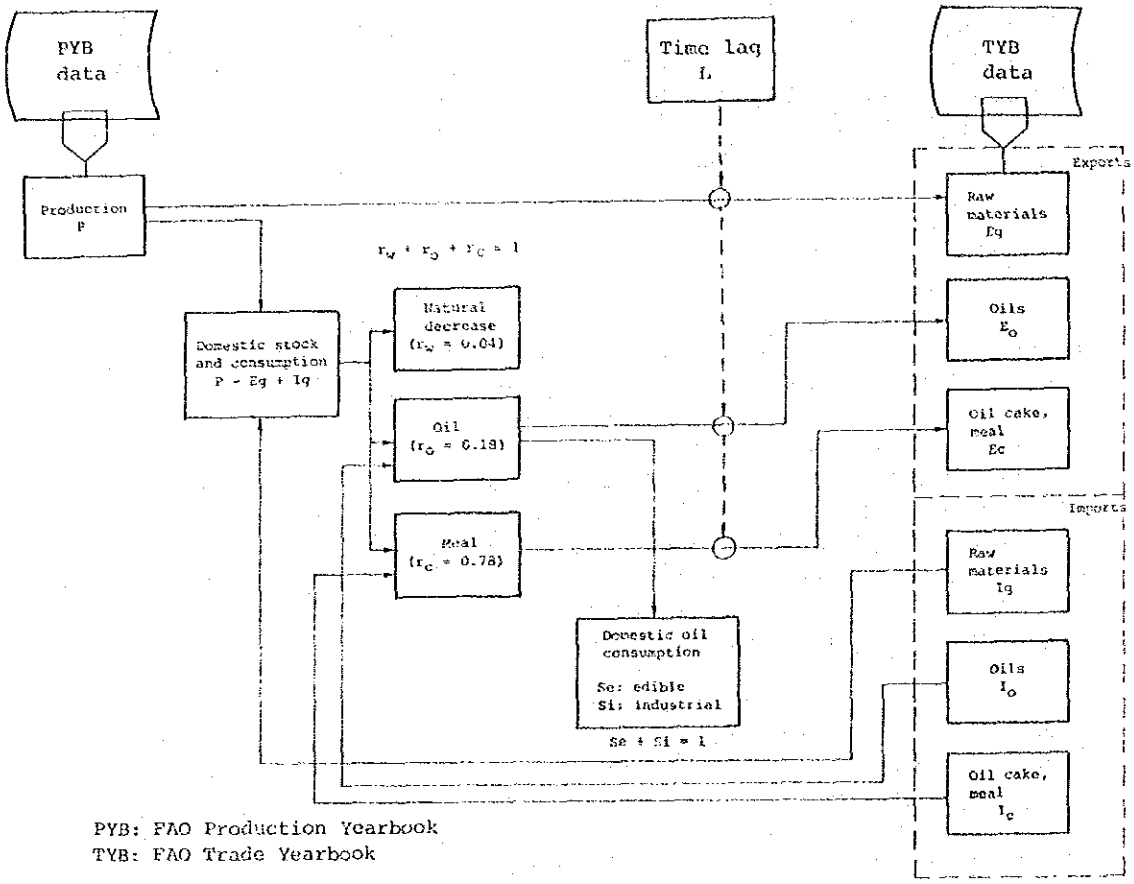
Consumption of oils is further classified by use - edible or inedible - calculated in the form of a ratio in each region, based on the FAO's Food Balance Sheet (1980 edition) (see Appendix Table 2).

3. Estimation of Export Volume and Import Volume

The potential volume of export is estimated by deducting regional fats and oils consumption from regional fats and oils production. When this is a minus, it is necessary to import.

As an example, the procedure used for the projection of soybean in the United States is shown in Fig. B-1.

Fig. B-1 Projection of Export and Import Volumes



PYB: FAO Production Yearbook
TYB: FAO Trade Yearbook

[1-3-3] PROJECTED RESULTS AND CONSIDERATIONS

The results of long-term projections are presented in this section and some considerations are made for the projected results based on the analysis of past trends and a short-range projection which were made separately from long-term projections.

As mentioned previously, the model extrapolates time-series data. Production and consumption, however, will not increase infinitely, and when they reach a certain level, their growth will level-off. Therefore, a growth curve is basically used although a linear regression is considered as an exceptional case.

Furthermore, the model projects production and consumption in eleven regions (economic blocs); determines the differences between production and consumption levels in each region; and, forecasts the world demand and supply by totalling the eleven regions. It can be used to gauge future imbalances of supply and demand by region, although the figures cannot be regarded as exact. Accordingly, the production-consumption gaps are indicated in the projected results as they were calculated, and no attempt has been made to compensate for such differences by changing projected results.

Thus, while developing our projections, no alteration has been made to any computed values. For some items, however, when a logistic curve is used, a value that is obviously incorrect is produced. For these items, a linear regression was adopted.

In short, the projection model is regarded to be just one means of projection. The projections in this Study, therefore, are derived by taking into consideration the information obtained from the trend analysis and the values derived from this model projection.

A. PROJECTED OILSEED PRODUCTION

Table A-1 indicates the projections for oilseed production as a whole in terms of oil. Production projections, together with consumptions by type are indicated in Appendix Table 6-1 to 6-13.

Table A-1 Projected Oilseed Production (in terms of oil)

(1,000 MT, %)

	Developed countries		Developing countries		Centrally planned economy countries		World	
	Production	Share of total quantity	Production	Share of total quantity	Production	Share of total quantity	Production	Share of total quantity
1980	15,448	34.1	20,782	45.9	9,065	20.0	45,295	100.0
1985	17,705	35.6	22,834	45.9	9,162	18.4	49,701	100.0
1990	19,692	37.1	24,071	45.4	9,307	17.5	53,070	100.0
1995	21,473	38.5	24,933	44.7	9,369	16.8	55,775	100.0
2000	23,072	39.7	25,641	44.1	9,423	16.2	58,136	100.0

By 1990, the total world production of oilseed is expected to be 53 million tons (in terms of oil). The ratios by region are 37% for the developed countries, 45% for the developing countries and 18% for countries with centrally planned economies. By the year 2000, total production will be 58 million tons, of which 23 million tons (39%) will be produced in the developed countries, 26 million tons (45%) in the developing countries and 9 million tons (16%) in the countries with centrally planned economies.

By type of oilseed, the share of soybean production will increase from 32.5% in 1980 to 38.8% in 2000 as shown in Table A-2. In detail, the annual average growth rate of soybean production will decrease from 2.7% in the 1980-90 period to 1.6% in the 1990-2000 period. Nevertheless, compared with other oilseed, the growth rate of soybean will remain very high relative to other oilseeds.

Palm oil production rapidly increased in the 1970s but the projected yearly average growth rate during the 1980s is 2.5%, which is less than that of the 1970s. Palm oil, as well as soybean and sunflower is likely to exhibit a high growth rate compared with other oilseed.

Table A-2 Projected Production by Oilseed Type (in terms of oil)

(Production, oil equivalent 1,000 MT; Ratio, %)

	1980		1985		1990		1995		2000	
	Prod.	Ratio	Prod.	Ratio	Prod.	Ratio	Prod.	Ratio	Prod.	Ratio
Soybean	14,734	32.5	17,159	34.5	19,182	36.1	20,970	37.6	22,561	38.8
Sunflower	5,015	11.1	5,354	10.8	5,525	10.4	5,615	10.1	5,667	9.7
Peanut	5,530	12.2	5,443	11.0	5,398	10.2	5,390	9.7	5,405	9.3
Rapeseed	3,442	7.6	3,638	7.3	3,782	7.1	3,908	7.0	4,026	6.9
Cottonseed	3,796	8.4	3,952	8.0	4,182	7.9	4,337	7.8	4,479	7.7
Safflower	342	0.8	389	0.8	434	0.8	479	0.9	526	0.9
Sesame	914	2.0	937	1.9	957	1.8	972	1.7	988	1.7
Castor bean	373	0.8	378	0.8	383	0.7	390	0.7	397	0.7
Linseed	883	1.9	920	1.9	967	1.8	1,019	1.8	1,076	1.9
Copra	2,917	6.4	3,139	6.3	3,366	6.3	3,594	6.4	3,824	6.6
Palm oil	4,796	10.6	5,709	11.5	6,134	11.6	6,296	11.3	6,352	10.9
Palm kernel	735	1.6	802	1.6	831	1.6	841	1.5	845	1.5
Olive oil	1,818	4.0	1,881	3.8	1,929	3.6	1,964	3.5	1,990	3.4
Total	45,295	100.0	49,701	100.0	53,070	100.0	55,775	100.0	58,136	100.0

During the 1990s, however, the growth rate will decrease rapidly to a level of 0.3%. Nevertheless, the production by 2000, will be second only to that of soybean with a share of 10.9% for all oilseed.[1)]

Copra shows a consistently high average annual growth (1.4%) until 2000, and will share 6.3-6.6% of total oil seeds throughout the period of projection.

With regards to sunflower, total production will increase but the annual growth rate of production will decrease gradually. The share of sunflower production in total oilseed production will drop from 11.1% in 1980 to 9.7% by 2000.

Cottonseed indicates a trend similar to that of sunflower: production increases consistently but annual production growth relative to other oilseed will decrease.

Peanut production has been declining and is expected to decline during the 1980s, but is expected to level off thereafter.

Castor bean production is expected to increase during the projection period at an annual average growth rate of 0.3%.

The annual increase in production of palm kernel is approximately half that of palm oil. The ratio of palm kernel (in terms of oil) to palm oil will decrease from 15.3% in 1980 to 14.0% in 1985; and from 13.5% in 1990, to 13.4% in 1995 and 9.0% by 2000. This trend will coincide with expansion in the cultivation of a high-yield variety (Tenera variety).[2)]

The production of other oilseed is likely to increase in the projection period.

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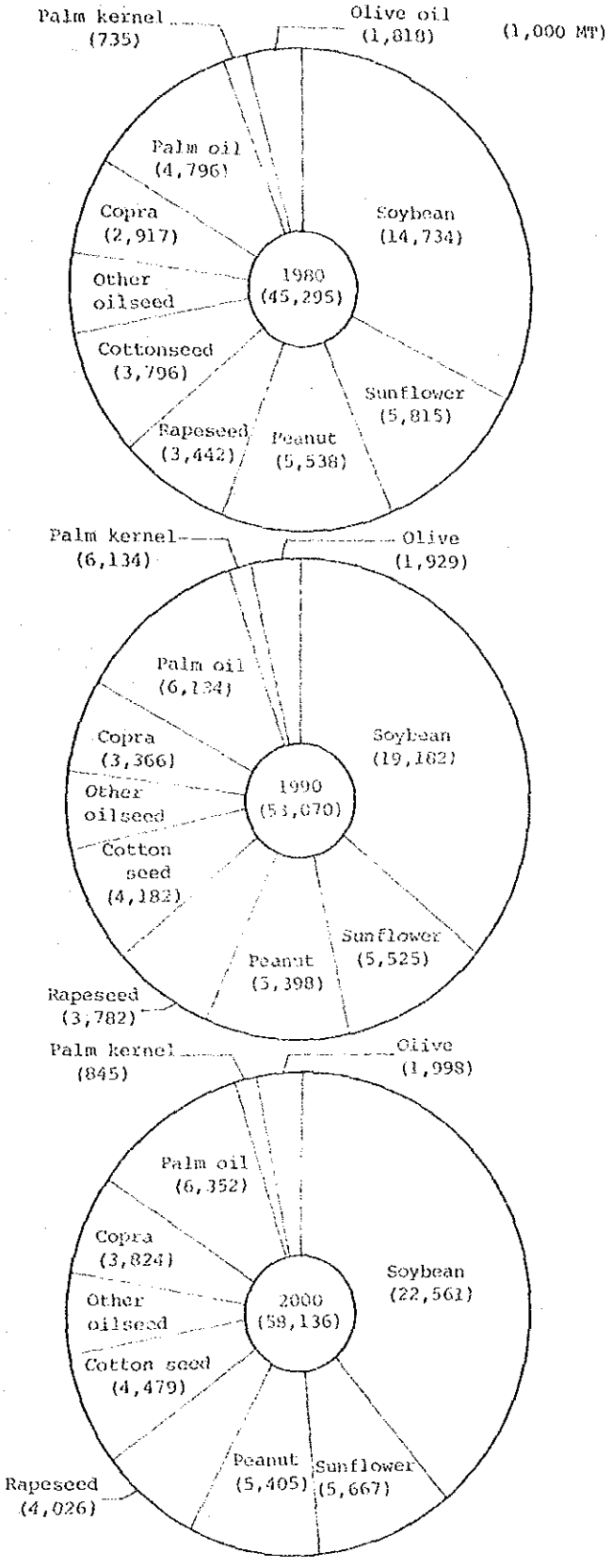
1) This is because, as described in detail in Section E, recent large extensions of newly planted areas has not been included in the estimations. Furthermore, the reduction in production due to the drought in Malaysia in the latter half of the 1970s is also incorporated in the variables to keep the projected value low.
2) Palm kernel oil of the Tenera variety: Production ratio of palm kernel oil to palm oil is approximately 8 to 100.

Fig. A-1 Oilseed Production (in term of oil)



B. PROJECTED OILSEED CONSUMPTION

Table B-1 indicates projections for total oilseed consumption calculated in terms of oil. The projected consumption by oilseed type is shown in Appendix Tables 6-1 to 6-13.

By 1990 it is expected that demand for oilseed (oil) will reach 51 million tons. For each economic bloc, the requirement will be 19 million tons, 21 million tons and 11 million tons for the developed countries, the developing countries and the countries with centrally planned economies, respectively. In percentage terms this represents 37%, and 22% respectively of total world consumption. By 2000, the total world consumption is expected to be 55 million tons, of which 20 million tons (37%), 22 million tons (41%) and 13 million tons (22%) will be consumed by the developed countries, the developing countries and the countries with centrally planned economies respectively.

The annual average consumption growth rate of soybean is 1.6% throughout the whole projection period and the percentage of soybean consumed in terms of total oilseed consumption will increase from 30.9% in 1980 to 34% by 2000.

Palm oil consumption has an annual average rate of 1.5% through the period and the proportion of palm oil consumed in overall oilseed consumption remains stable at around 12%.

Copra consumption increases annually at 1.2% during the period and its share in overall consumption remains steady at 6.3-6.5%.

Palm kernel consumption increases at an annual average rate of 0.9% through the period and its share in overall consumption remains constant at about 1.6%.

The annual average growth rate of sunflower consumption is small and its share in overall consumption is 10.2-10.7% throughout.

Peanut and cottonseed consumption fluctuates slightly during the period but exhibit no growth tendencies, suggesting a levelling-off in demand.

Castor bean consumption is symptomatic of the general downward trend in developed countries during the period 1966-1979 (This was the period from which basic data for the present projection was taken). Castor bean consumption is expected to fall from 345,000 tons in 1980 to 252,000 tons by 2000.

Table B-1 Projected Oilseed Consumption Required (in terms of oil)

(Consumption, 1,000 MT
Total production ratio, %)

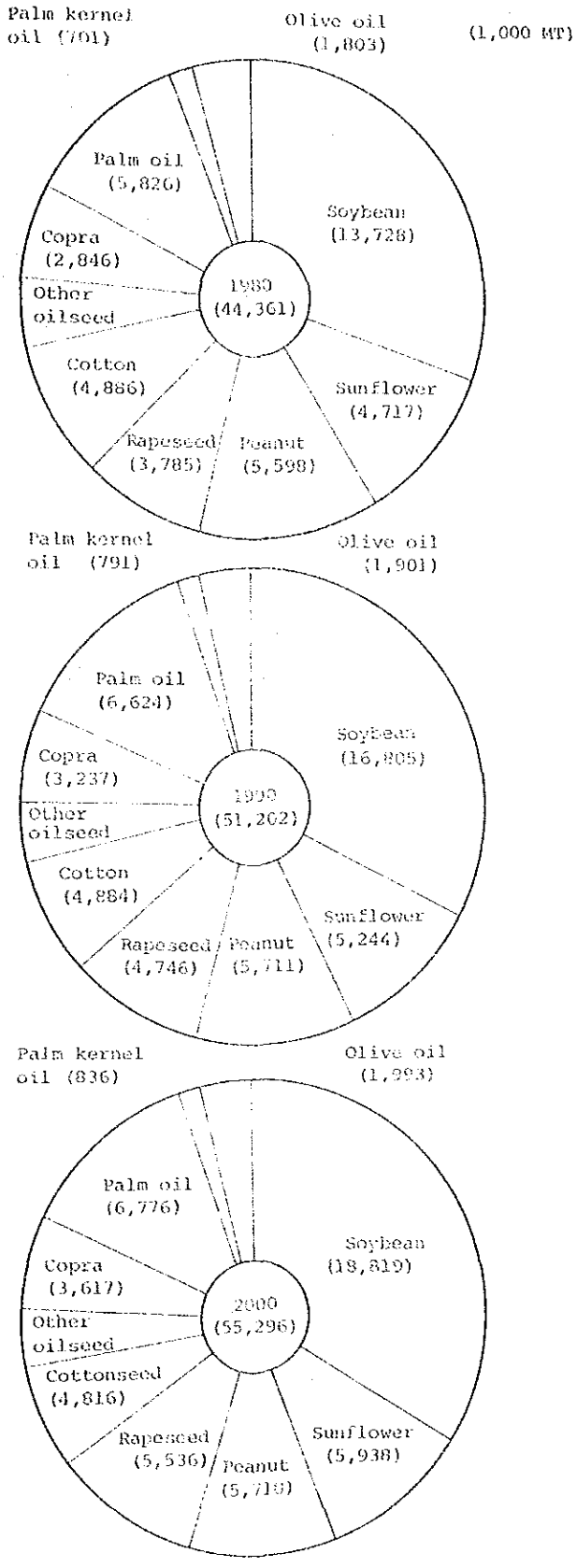
	Developed Countries		Developing Countries		Centrally Planned Economy Countries		World	
	Consumption	Share of Total Quantity	Consumption	Share of Total Quantity	Consumption	Share of Total Quantity	Consumption	Share of Total Quantity
1980	16,631	37.5	18,052	40.7	9,678	21.8	44,361	100.0
1985	17,718	36.5	20,390	42.0	10,404	21.4	48,512	100.0
1990	18,697	36.5	21,414	41.8	11,091	21.7	51,202	100.0
1995	19,621	36.8	22,011	41.2	11,735	22.0	53,367	100.0
2000	20,479	37.0	22,451	40.6	12,366	22.4	55,296	100.0

Table B-2 Projection of Consumption by Oilseed Kinds (in terms of oil)

(1,000 MT, %)

	1980		1985		1990		1995		2000	
	Consumption	Ratio	Consumption	Ratio	Consumption	Ratio	Consumption	Ratio	Consumption	Ratio
Soybean	13,728	30.9	15,503	32.0	16,805	32.8	17,882	33.5	18,819	34.0
Sunflower	4,717	10.6	4,972	10.2	5,244	10.2	5,559	10.4	5,930	10.7
Ground nut	5,598	12.6	5,677	11.7	5,711	11.2	5,718	10.7	5,710	10.3
Rape seed	3,705	8.4	4,255	8.8	4,746	9.3	5,172	9.7	5,536	10.0
Cotton seed	4,086	9.2	4,101	8.5	4,084	8.0	4,054	7.6	4,016	7.3
Safflower	342	0.8	389	0.8	434	0.8	479	0.9	526	1.0
Sesame	874	2.0	868	1.8	858	1.7	847	1.6	837	1.5
Castor bean	345	0.8	317	0.7	290	0.6	269	0.5	252	0.5
Lin seed	590	1.3	517	1.1	477	0.9	457	0.9	448	0.8
Copra	2,846	6.4	3,043	6.3	3,237	6.3	3,428	6.4	3,617	6.5
Palm oil	5,026	11.3	6,260	12.9	6,624	12.9	6,737	12.6	6,776	12.3
Palm kernel	701	1.6	756	1.6	791	1.5	817	1.5	836	1.5
Olive oil	1,803	4.1	1,854	3.8	1,901	3.7	1,948	3.7	1,993	3.6
Total	44,361	100.0	48,512	100.0	51,202	100.0	53,367	100.0	55,296	100.0

Fig. B-1 Oilseed Consumption (in terms of oil)



Furthermore, as a consumption form, the average consumption ratios (for edible and inedible oils) during the period 1975-1977 are taken for each of the eleven regional classifications, from FAO's Food Balance Sheet. Table B-3 shows the projected consumption by use.

Table B-3 Projected Oilseed (Oil) Consumption by Use

(consumption, 1,000 MT; ratio, %)

	World consumption	Edible use		Inedible use	
		Consumption	Ratio	Consumption	Ratio
1980	44,361	36,999	83.4	7,362	16.6
1985	48,512	40,504	83.5	8,008	16.5
1990	51,202	42,839	83.7	8,363	16.3
1995	53,367	44,731	83.8	8,636	16.2
2000	55,296	46,423	84.0	8,873	16.0

As the table indicates, there is a trend, even if it is only slight, towards an increase in the consumption of oilseed for edible use.

C. COMPARISON BETWEEN PROJECTED CONSUMPTION AND PRODUCTION

Table C-1 indicates the comparison between the production and consumption for all vegetable fats and oils by the world total and each economic bloc, that is, the developed countries, the developing countries and the countries with centrally planned economy.

In terms of the world total, projected production will always exceed projected consumption after 1980. Furthermore, the difference between them is expected to increase. Production is likely to exceed consumption by 3.5% in 1990 and 4.9% in 2000.

In the developed countries, demand will exceed production by 1.183

Table C-1 Projected Fat and Oil Production and Its Balance against Consumption

(1,000 MT, %)

Year	Developed countries			Developing countries			Centrally planned economies			World Total			
	Production	Consumption	Difference	Production	Consumption	Difference	Production	Consumption	Difference	Production	Consumption	Difference	Surplus rate
1980	15,448	16,631	-1,183	20,782	18,052	2,730	9,065	9,678	-613	45,295	44,361	934	2.1
1985	17,705	17,718	-13	22,834	20,390	2,444	9,162	10,404	-1,242	49,701	48,512	1,189	2.4
1990	19,692	18,697	995	24,071	21,414	2,657	9,307	11,091	-1,784	53,070	51,202	1,868	3.5
1995	21,473	19,621	1,852	24,933	22,011	2,922	9,369	11,735	-2,366	55,775	53,367	2,408	4.3
2000	23,072	20,479	2,593	25,641	22,451	3,190	9,423	12,366	-2,943	58,136	55,296	2,840	4.9

Difference = Production (potential) - consumption; surplus rate = $\frac{\text{difference}}{\text{production}} \times 100$

million tons in 1980 but, thereafter, the growth of production will always exceed that of consumption. Thus, overproduction will reach 995,000 tons in 1990 and 2.593 million tons by 2000 (In percentage terms, the surpluses will be 5% and 11% respectively). In the developing countries, production exceeds consumption throughout the projection period. Overproduction is 2.657 million tons in 1990 and 3.19 million tons in 2000 (surpluses of 11% and 12% respectively). In the countries with centrally planned economies, demand will exceed production throughout the period. Demand will be 1.784 million tons in 1990 and 2.943 million tons in 2000 (deficits of 19% and 31% respectively).

The graph in Fig. C-2 shows the relation between production and consumption by oilseed type on the basis of the figures in Tables B-1 and B-2. The closer to the 45° straight line an oilseed type is, the more balanced is the production and consumption of that type. The arrows indicate the direction of change over time.

On the basis of Fig. C-2, the following points can be made:

a. The production and consumption levels of most fats and oils more or less correspond. Exceptions are linseed oil and castor oil.

b. Most fats and oils indicate increasing levels of production and consumption (shown by arrows pointing to the upper right). Linseed, castor and sesame oil show decreasing consumption but increasing production. Peanut oil shows increasing consumption but decreasing production.

c. The equilibrium in demand and supply of the following oils: soybean, palm, coconut, olive, palm kernel and safflower remains stable, even when changes in demand or supply occur.

d. Increases in the production of rapeseed oil occur faster than increases in consumption.

Fig. C-1 Projected Production and Consumption of Oilseeds (in terms of oil)

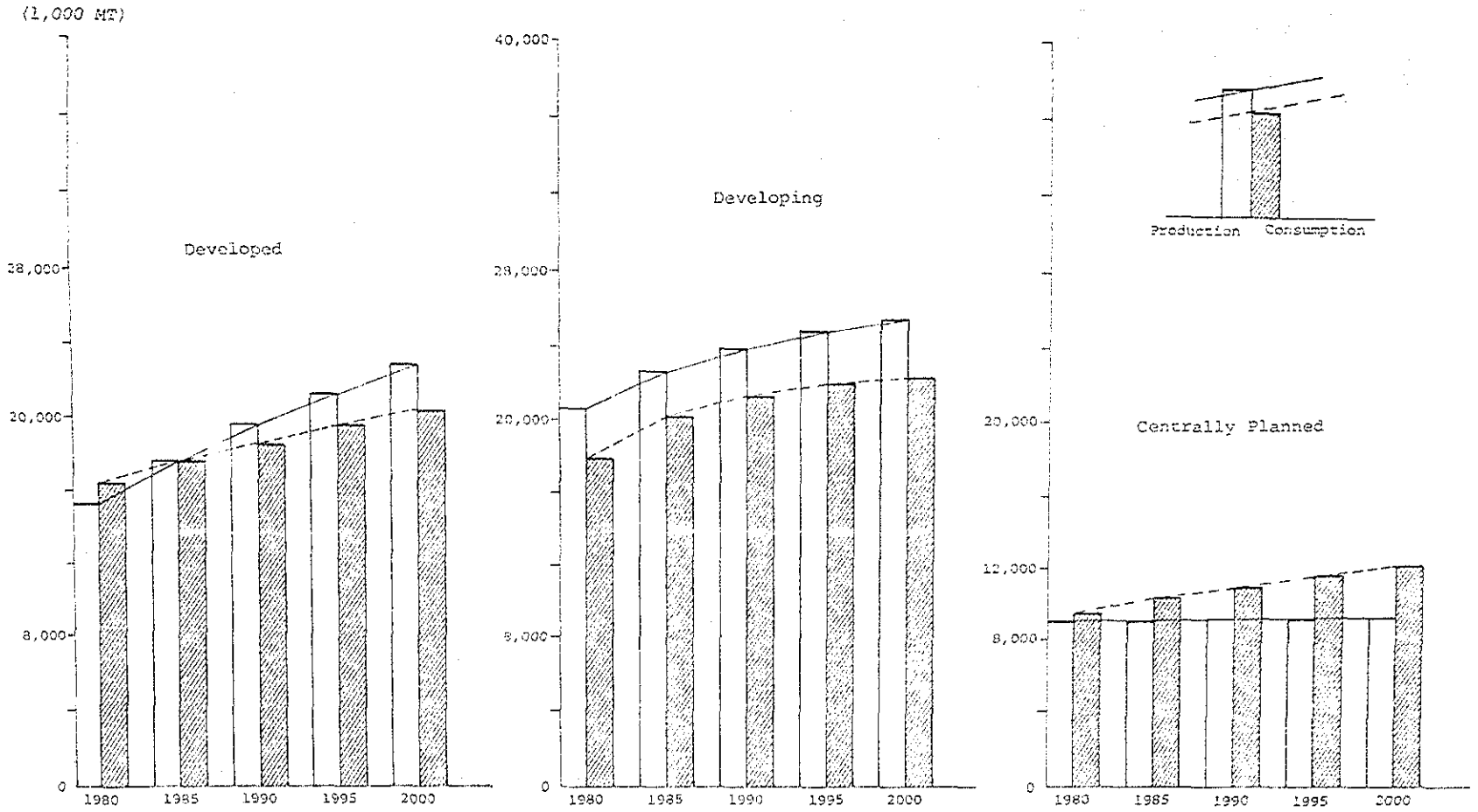
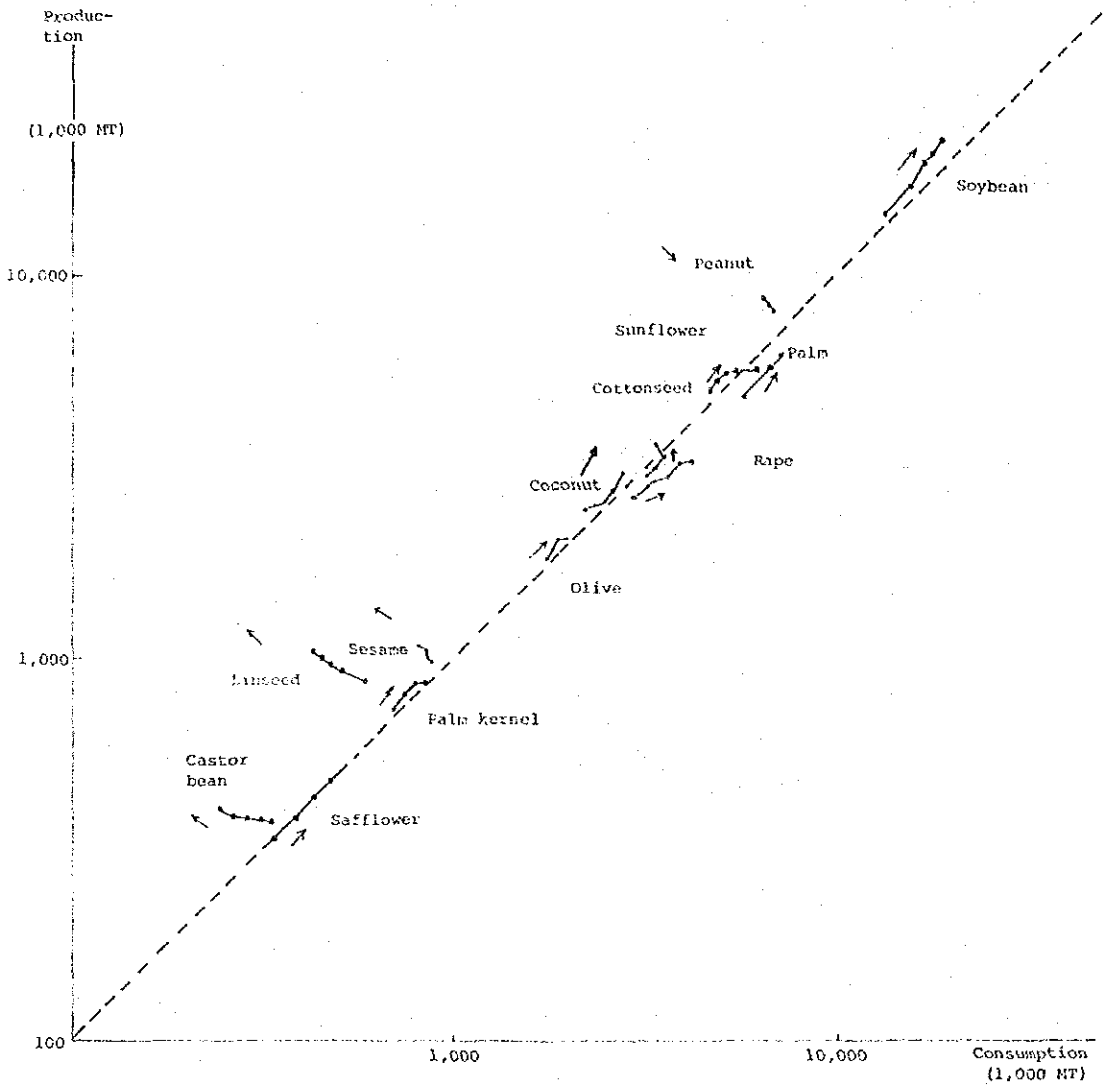


Fig. C-2 Relation between Production and Consumption by Oilseed Type (in terms of oil)



D. TRENDS IN PROJECTED EDIBLE OIL CONSUMPTION IN TERMS OF THE INTAKE OF VEGETABLE FATS AND OILS

Table D-1 indicates the projection in demand for vegetable fats and oils on the basis of caloric intake per capita (FAO, Food Balance Sheet, per capita food supplies). As for all fats and oils, the consumption will be 51.873 million tons in 1990 and 63.291 million tons by 2000. These values are, respectively, 1.22 times (average annual growth rate: 2.05%) and 1.49 times (average annual growth rate: 2.03%) higher than the 1980 levels.

In terms of overall oil consumption, the proportion of vegetable oils consumed will increase while that of animal fats and oils, will decrease. Rise in the consumption of vegetable fats and oils will be particularly large in the countries with centrally planned economies (61% in 1980 to 80% in 2000).

Large regional differences in daily consumption per capita of oils and fats were found. In 1980, for all fats and oils, the developed countries consumed 58.78g/capita per day, while the developing countries and the countries with centrally planned economies consumed respectively 19.45g/capita per day and 22.92g/capita per day. As compared to consumption in the developed countries, daily consumption per capita in the other two economic blocs were 34% and 40% respectively. This situation will not change even by 2000, although the growth in consumption in developing countries and countries with centrally planned economies is expected to exceed that of the developing countries.

Table D-2 shows the comparison between world consumption of vegetable fats and oils (found by multiplying per capita consumption of vegetable fats and oils (estimated) by estimated population) and the consumption of edible oilseed (in terms of oil) obtained from the projection in the model.

Estimated consumption of vegetable oils and fats (for food use) is lower in 1980 and 1990 but higher in 2000 than projected oilseed consumption. If the projected oilseed consumption is replaced with the projected vegetable oils and fats consumption, the projected oilseed production (in terms of oil) in 2000 would be 59.375 million tons exceeding by 1.239 million tons the projected oilseed production (in terms of oil) in the same year. This indicates an excess of demand.

Furthermore, the projected oilseed consumption includes some oilseed products which are directly used as food, such as peanut and soybean, whereas the estimated consumption for vegetable fats and oils does not. If this fact is taken into consideration then consumption would exceed production by a figure greater than the 1.239 million tons mentioned above.

Table D-1 Projection of Consumption of Fats and Oils

Year	Region		Population (1,000)	Per capita daily consumption of fats and oils (g/man·day)			Fats and oils consumption (1,000 MT)		
				Fats and oils	Vegetable fats and oils	Animal fats and oils	Fats and oils	Vegetable fats and oils	Animal fats and oils
1980	Developed countries	DD	788,655	57.74	40.96	16.21	16,621	11,791	4,830
	Developing countries	GG	2,274,450	18.11	14.69	3.47	15,034	12,195	2,839
	Centrally planned economies	PP	1,432,370	30.45	12.48	8.11	10,692	6,525	4,167
	World	WW	4,492,650	-	-	-	42,347	30,511	11,836
1985	Developed countries	DD	807,643	57.77	41.29	12.53	17,030	12,172	4,858
	Developing countries	GG	2,605,830	18.86	15.52	3.47	17,938	14,762	3,176
	Centrally planned economies	PP	1,510,000	21.73	13.74	8.47	11,976	7,573	4,403
	World	WW	4,903,630	-	-	-	46,944	34,507	12,437
1990	Developed countries	DD	822,214	57.78	41.59	9.79	17,340	12,421	4,919
	Developing countries	GG	3,002,266	19.45	16.19	3.47	21,314	17,741	3,573
	Centrally planned economies	PP	1,580,110	22.92	15.31	8.75	13,219	8,830	4,389
	World	WW	5,339,370	-	-	-	51,873	38,992	12,881
1995	Developed countries	DD	833,281	57.78	41.42	7.37	17,574	12,598	4,976
	Developing countries	GG	3,482,400	19.69	16.73	3.47	25,282	21,252	4,030
	Centrally planned economies	PP	1,643,530	24.61	17.29	8.96	14,874	10,366	4,508
	World	WW	5,799,110	-	-	-	57,730	44,216	13,514
2000	Developed countries	DD	841,620	57.78	41.43	5.16	17,750	12,727	5,023
	Developing countries	GG	4,072,700	20.22	17.13	3.47	30,058	25,464	4,594
	Centrally planned economies	PP	1,697,420	24.99	15.87	9.12	15,463	12,311	3,172
	World	WW	6,281,620	-	-	-	63,291	50,502	12,789

Note: Daily per capita consumption of oils and fats is projected on the basis of the figures of per capita food supplies in Food Balance Sheet by FAO. Population projections are done according to broad economic classification of the countries.

The projected consumption of edible fats and oils is calculated on the assumption that the average ratio of use, - either edible or inedible - found in the period 1975-1977 which was obtained from FAO's Food Balance Sheet would remain unchanged in the future. It is important to note, however, that the production-consumption relationship in 2000 for the estimated consumption of vegetable fats and oils shows consumption exceeding production, a situation opposite to that in the projection model which showed production exceeding consumption by 2.89 million tons.

Table D-2 Vegetable Fats and Oils Intake and Consumption Required

(1,000 MT)

	Oilseed required for food (oil equivalent)	Vegetable fats and oils intake	Difference
1980	36,999	30,511	6,488
1985	40,504	34,507	5,997
1990	42,839	38,992	3,847
1995	44,731	44,216	515
2000	46,423	50,502	-4,079

E. SOME CONSIDERATIONS OF THE PROJECTION DESCRIBED ABOVE

1. Consideration of Vegetable Fats and Oils

To summarize the projections mentioned above concerning vegetable fats and oils, production exceeds consumption throughout the projection period and, in fact, the gap expands gradually after 1985 so that production exceeds consumption by approximately 5% in 2000.

Needless to say, should over-production continue for a certain time, the equilibrium would be restored either by a decrease in production due to the price mechanism and political-motivated production cutbacks, or by an increase in demand caused by lower prices (or due

to both). It is an inevitable result when projecting production and consumption separately that projection contains a continuous imbalance, even though it is not large.

The World Bank projection for fats and oils introduced at the beginning of this part incorporates price variables. In its model, the Bank regards changes in production and consumption (mainly consumption) being due to price fluctuations. Consequently, in the results of projection, production equals consumption.

Thus, by comparing the results of our projections with those of the World Bank the following points can be made:

1.1 Production

Comparative production values are shown in Table E-1.

Table E-1 Projected Production

(oil-base million tons)

	1980	1985	1990	1995	2000
This Study	45.3	49.7	53.0	55.8	58.1
World Bank	45.7	53.0	62.6	73.5	-

When projecting production levels, it is almost impossible to calculate econometrically the response of production to price. Therefore, the World Bank projection also does not use price factors to estimate production, but rather bases its estimations on trends and other factors. Concerning tree crops, revisions are made according to data on existing planted hectarage and tree age. Consequently, our projection does not differ significantly from that of the World Bank with regard to production. A significant difference in the values of the two projections could conceivably be caused by the differences in base year, and the type of estimation method adopted.

1.2 Consumption

Regarding the projections of consumption, our model looks at

trends, while the World Bank projection centers around price forecasts based on price elasticities, and income growth (called the income-forecasting approach). Comparison of two projections is shown in Table E-2.

Table E-2 Projection of Consumption

(oil-base million tons)

	1980	1985	1990	1995	2000
This Study	44.3	48.5	51.2	53.4	55.3
World Bank projection	45.4	53.0	62.6	73.5	-

As seen in the above table, the projections of the two models differ considerably. This difference is larger than that between the two production projections seen in the previous table.

In the World Bank projection, large increases in consumption are caused mainly by the increase in consumption in the developing countries (Through 1995, the Bank sets the annual growth rate of the world consumption as 3.7%, and 4.2% in the developing countries).

The World Bank projection, an equilibrium model with price as the major factor, is highly detailed. However, in view of our findings from trend analysis, it is somewhat doubtful whether the increase in consumption in the developing countries can be expected to be as high as the Bank would suggest.

In the low-income countries, income elasticity of demand for edible fats and oils is undisputably large (The Bank takes the income elasticity value as 0.8 for the period 1980-85, declining to 0.6 in the period 1990-1995). In our estimation, however, the developing countries whose consumption increases due to increases in income are those with a strong propensity to consume oil, because they are oil producing countries or were in the past. In the developing countries which are not oil producers, as long as the propensity to consume remains unchanged, the income elastisity of demand is unlikely to increase. However, it is also difficult to explain why our model projection indicates that growth in consumption is approximately the same in both developed and developing countries; and, that in the developed countries the growth is almost constant

while in the developing countries the growth is higher and then decreases gradually.[1)]

We feel that the results projected in our production-consumption model may be slightly underestimated for both production and consumption while those of the World Bank projection seems to be somewhat too high. In our opinion, a point somewhere between the two projections may be appropriate.

2. Projected Results by Commodity Type

2.1 Palm Oil

The projected results for world palm oil production are 6.13 million tons in 1990, 6.35 million tons in 2000, while the consumption is set at 6.62 million tons in 1990 and 6.78 million tons in 2000. An excess of demand over supply will cause the market for palm oil to tighten. The annual average growth rates from 1980 to 2000 are 1.4% and 1.5% in production and consumption respectively.

This projection of future production seems to be rather too low, if we consider the recent situation in Malaysia and Indonesia, the two most important producers. In fact, the palm trees planted in the latter part of 1970s in these countries will reach the maximum production level before 1985 and continue production through to the year 2000. Also in Malaysia, replanting of aged trees are extensively carried out since about 1980 and the replanted trees will start production after 3 years and then increase yield. It is very likely that the production in these two countries together will reach 5 million tons by 1985, then the world total would be higher than the above projection. Since projected values are computed by extrapolating the trends in the period 1966-1979, recent movements mentioned above are not taken into consideration. Regarding the expansion of cultivated area, the absence of much data in FAO production statistics further inhibited the validity of the projections.

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1) 1. See Table B-1.
2. The slackening growth in the developing countries (it is expected to slacken off around 1985), is assessed by the big increase in consumption in those countries in the latter half of the base year (1980).
3. Apart from the model projection, the estimation is made on the basis of the per capita consumption data of FAO Food Balance Sheet which shows the growth rate of consumption in the developing contries as being higher than that in the developed countries (see Table D-1).

Furthermore, in Malaysia, which leads the world in palm oil production, unit yield is expected to increase by new techniques such as insect pollination and seedling culture using tissue culture. Accordingly, the Malaysian Government is forecasting palm oil production in 1990 to be as high as 6 million tons. Therefore, in view of the trends in extension of cultivated area, increases in unit yield and other factors, these projected values must be said to be quite low (The World Bank predicts that world palm oil production will be 7.66 million tons and 9.66 million tons in 1990 and 1995 respectively,[1] while the magazine, Oil World estimates 10.4 million tons by the 1991/92 fiscal year [2]).

Since stagnancy in fats and oils consumption will probably continue in the developed countries of Europe and North America, increased palm oil production in the future will be consumed in the developing countries of Asia and Africa where population is expected to grow. The main factors, however, will be foreign currency holdings needed to import palm oil, and the growth in earnings to make it possible to increase per capita consumption of fats and oils.

2.2 Copra

The projected results indicate that the world coconut oil production will reach 3.366 million tons and 3.824 million tons in 1990 and 2000 respectively at annual average rate of 1.4% (throughout the projection period) while consumption reaches 3.237 million tons and 3.617 million tons in 1990 and 2000 respectively at annual average rate of 1.2%. Production will exceed consumption by 129,000 tons and 207,000 tons, in 1990 and 2000 respectively.

In production by region, the major producing countries of Asia, such as the Philippines, Indonesia and India, show annual production growth rates of 1.5% (throughout the projection period) with its share of world production increasing steadily from 84.7% in 1985 to 86.5% in 2000.

Consumption increases at the annual average rate of 1.4% (throughout the projection period) in North America, while the expectation in Western Europe, Oceania and other developed countries is of slight increases or a levelling-off. In Asia including the traditional major consuming countries, consumption grows at an annual average rate as high as 1.8% resulting in consumption levels of 1.438 million tons in 1985 to 1.848 million tons in 2000. It increases its share in the world consumption from 47.2% in 1985 to 51.1% in 2000.

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1) World Bank, Price Prospects for Major Primary Commodities, 1982
2) Oil World, June 18, 1982

Throughout the projection period, the three regions, the Far East, Africa and the bloc of non-Asian developing countries, are likely to export 1.54 million tons and 1.739 million tons in 1990 and 2000 respectively. Of these, the Far East accounts for 1.299 million tons and 1.459 million tons in 1990 and 2000 respectively. In the Far East, throughout the projection period, the annual average increase in production (1.8%) exceeds that of consumption (1.5%) providing for an increase in export capacity, the growth rate of which, however, will remain at 1.2%.

At present, the main producing countries are promoting the development and spread of a high-yield variety of coconut hybrid. As mentioned previously, however, any influence on production levels will not appear before the 1990s. Therefore, this projection does not take into account likely production increases brought about by planting of hybrids. Should the development and spread of hybrid hereafter go smoothly, the production in the 1990s might exceed the projected figures. Price stagnancy in and after 1979 caused reductions in new planting. So, through the middle of 1980s to the beginning of the 1990s when new tree crops planted before 1979 can be harvested, stagnant production may be seen.

Coconut oil consumption involves both edible and inedible oils. Coconut oil competes to some extent with soybean oil and other vegetable fats and oils in the edible field and with petroleum products in the industrial field. Thus, its substitution by these competitive products depends on price. If the price of soybean oil falls due to excess supply, it may be used as a substitute for coconut oil if the price is competitive enough. In that case, the consumption of coconut oil would fall. Furthermore, regarding petroleum goods, although petroleum reserves are limited, petroleum prices are levelling off and its supply is more stable than that of coconut oil. In the areas in which coconut oil competes strongly with petroleum goods, therefore, it it not in a favorable position.

Furthermore, this projected result is rather lower for both production and consumption than the results obtained by the World Bank and Oil World magazine (The World Bank: production and consumption is taken as 3.605 million tons and 4.103 million tons in 1990 and 1995 respectively. Oil World: production; 3.9 million tons in harvest year 1991/92).

2.3 Palm Kernel

The projected results show world palm kernel production (in terms of oil) rising from 735,000 tons in 1980 to 845,000 tons in 2000 at an annual average rate of 0.7%, while world consumption (in terms of oil) increases from 701,000 tons in 1980 to 836,000 tons in

2000. The gap between production and consumption indicates over-production throughout the projection period but in terms of oil, it falls from 34,000 tons in 1980 to 9,000 tons in 2000. This reflects a tightening of supply and demand. Consequently, the projection shows only the Far East contributing to an increase in world production and that the Far East's share of world production increases from 37.3% in 1980 to 46.0% in 2000.

In regards exports from the producing countries, the Latin American region shows a slight increase from the level of 3,000 tons in the 1980s but exports from other regions fall or level-off reflecting a situation similar to that of production. Thus, only the Far East countries are likely to increase their exports in the future.

Regarding consumption increase throughout the projection period, North America and Africa exhibit high annual growth rates - 2.4% and 1.9% respectively. In other regions, however, consumption flattens out or, even if increases, the absolute quantity is small. The largest consumption region, Africa, is expected to experience stagnant consumption at levels of about 200,000 tons.

Production of palm kernel oil is likely to be influenced by trends in palm oil production because it is a byproduct of palm oil. Palm kernel production has tended to stagnate compared with the growth in palm oil production because replanting switched from using the Dura variety with high kernel content in its fruit bunches to the Tenera variety low in kernal content. In Malaysia and India, however, where the extension of palm planting has been conspicuous in recent years, most palms are now of the Tenera variety. Therefore, with palm oil production increasing, palm kernel oil production is also expected to increase in the future. Furthermore, should insect pollination, which aims at raising kernel content be introduced on a large-scale into palm tree production increases in palm kernel production seem possible. Consequently, in view of the expected trend of production increases in palm oil, the projected figure may be somewhat low.

Consumption of palm kernel oil, will inevitably be influenced by the supply and demand of coconut oil because the former is regarded as a substitute for the latter. In terms of its industrial uses, however, its potential demand is considered to be fairly strong. Should an increase in production lead to a low price relative to coconut oil, growth in consumption might be expected.

2.4 Soybean

The projected results show that in terms of the world total (in terms of oil), the annual average growth rate of production (2.2%) exceeds that of consumption (1.6%) throughout the projection period so that the gap between production and consumption should widen resulting in over-production of 2.377 million tons and 3.742 million tons in 1990 and 2000 respectively.

By region, at any point of time until 2000, only two regions, North America and Latin America, will have surplus production (export capacity). Thus, the basic international supply structure will remain unchanged.

Regarding increases in production in the two major producing regions, in the case of North America, the increases will be implemented by the expansion of cultivated area (annual average growth rate throughout the projection period: 1.5%) and the increase of unit yield (1.1%). The rate of expansion in cultivated area will be far below the annual average growth rate of 5.9% seen in the 1970s. The area, however, will expand by 9,158,000 ha from 25,796,000 ha in 1980 to 34,954,000 ha in 2000. Thus, the area expanded over the 20 years is equal to 3.9% the cultivated land of annual crops as of 1978 (233,620,000 ha: FAO data). In the case of North America, when it is taken into consideration that the main contributer to production is the United States which can utilize its land specially set aside for future use (government policy) and switch cultivation from other crops, this expansion is not altogether impossible, although in a comparison of profitability with other crops, particularly maize in the Mid West and cottonseed in the South, it may lose some of its attraction.

The unit yield in North America is expected to increase to 2.53 ton/ha in 2000. This harvest level is equivalent to the existing level of the main producing states such as Illinois and Iowa. Although the development and spread of plant breeding and techniques to increase profitability will continue through 2000, it will probably meet with considerable difficulties in raising the unit yield to 2.53 ton/ha.

Production will increase in Latin America due to extension in cultivated land (annual average growth rate 2.5% for the whole period) and increase in unit-yield (1%). The projection for this region sets the area extension (1.069 million ha during the projection period) rather low but the unit yield increase of 2.21 tons by 2000 is regarded as too high.

Production projected by multiplying area by unit yield gives the annual average growth rate of 1.5%. However, since this region has producing areas where production fluctuates greatly due to

droughts and other factors, steady increase in production cannot be expected. Nevertheless, some areas have large tracts of cultivable land and if current stable price and export markets are incorporated into the calculations, the projected production level would not be impossible.

The annual average growth rate of consumption (throughout the projection period) is as high as 2.7%, 2.1% and 1.7% for North America, the USSR and Eastern Europe, and the Near East respectively but the other regions do not show such a large growth rate. Western Europe, however, shows a slight increase.

Soybean oil consumption is grealy influenced by the price level because of the competition with other fats and oils. The over-production situation as projected is not likely to continue. Using the production projection as a guide, however, it may be considered that since soybean oil production will exceed projected consumption, the price level of soybean oil will decline so that the consumption of soybean oil will increase unexpectedly.

This projection sets low levels for both production and consumption relative to the World Bank projection (Production and consumption indicated by the quantity of soybean [1] (in terms of oil) are 21.269 million tons in 1990 and 26.888 million tons in 2000) and the Oil World projection (oil production: 22 million tons in 1991/92).

This projection has producion exceeding consumption by 3.742 million tons in 2000 and, compared with the World Bank projection, is conspicuous for the particularly low consumption figure. This is, as mentioned already, due to the methodology of this project. In fact, consumption is expected to actually move at a level higher than that of the projection.

At any rate, regarding the balance between production and consumption, the projected result shows no particular tightening (i.e., relative equilibrium). This indicates difficulties for a new producing region (or country) to participate in the soybean export market. Furthermore, it is supposed that production extension aiming at the exports is difficult in the region (country) where the costs of exporting are high or the export products are low in quality.

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1) This projection, similar to the World Bank projection, shows soybean production and consumption by quantity, in terms of oil. This quantity includes edible soybeans not converted into oil, whose current total consumption in the main consuming countries, China and Japan, is less than 5 million tons (900,000 tons in terms of oil).

In the demand projection for soybean cake shown in another chapter,[1] soybean cake (oil) consumption greatly exceeds the soybean (oil) consumption from the present projection. In contrast with this projecton, a considerable supply shortage is expected by 1990 throughout the world. This is because the projection of soybean cake consumption was computed by using a linear regression formula on the basis that the consumption trends in the period 1966-79 will continue hereafter. Should demand for soybean cake indicate such a high growth, it is very likely that consumption of soybean oil, a byproduct of soybean cake, and soybean production could grow relative to the elasticity of the demand.

2.5 Peanut

The projected results show that production will reduce slightly, consumption increase slightly and supply and demand tighten.

As for trade, Western Europe will continue to be a major importer and the United States a major exporter. Supply levels (export capacity) of the developing countries, however, will change from a situation of oversupply to that of undersupply caused by a conspicuous reduction in production in Brazil and Argentina which have been the main exporting countries of the developing economies bloc.

The export capacity of centrally planned economies in Asia is projected to increase steadily. This projection is derived from the expectation that production increases in China will absorb the excess demand.

China, the most populous country in the world, does not seem to have much room for expanding its arable land. Accordingly, a future increase in peanut production, if any, will largely depend on the improvement in yield per hectare. At any rate, when rises in the income level and changes in eating habits in China are taken into consideration, increasing production is thought likely to be accompanied by increases in consumption.[2] The export capacity is therefore unlikely to increase significantly. Such being the case, the world supply and demand is expected to become tighter than predicted in projection.

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1) Projection of soybean oil cake production is calculated by multiplying the projected value of soybean production, found when projecting the demand for soybean oil, by the rate of conversion (yield rate of processed oil), for each region.
2) Although not incorporated into this projection, in the latter half of the 1970s, Chinese peanut oil consumption (disappearance) increased dramatically.

2.6 Sunflower

The projected results show that both production and consumption will increase gradually and supply and demand will be in relative equilibrium. By region, the centrally planned economy bloc is facing a shortage and the free world (both the developed countries and the developing countries) a supply surplus.

This is the result of continuous production decreases in the world's largest producing country, the USSR, and the parallel increases in consumption.

In this case, whether the USSR overcomes the shortage of sunflower oil by importing sunflower oil, or substitutes other fats and oils (or soybeans) for it, depends on the USSR's policy.

In the first instance, the world market for sunflower would be in equilibrium while in the latter case, a supply surplus can be expected.

As mentioned in the trend analysis, however, the USSR treats increases in the production of soybeans and sunflowers as one of the important elements of its agricultural policy-making and it is planning to raise sunflower production from 5 million tons in 1980 to 7.2 - 7.5 million tons (approximately 3.2 million tons in terms of oil) by 1986-1990. If this plan is realized, supply and demand would be in equilibrium in the centrally planned economies bloc while the world, as a whole, would probably experience surpluses.

2.7 Cottonseed

The projected results show that production increases somewhat, consumption decreases slightly early in the period but levels off. In terms of supply and demand, production exceeds consumption but only to a small degree.

Cottonseed, as described in the trend analysis, is a byproduct of cotton. Cottonseed production is, therefore, related to the production of cotton.

The long-range projection of cotton made in the chapter on cotton in this report shows an increasing rate of cotton production which is slightly higher than the rate of cottonseeds (oil) projected here.

Should cotton production outstrip cottonseed production (as projected here), the production of cottonseed as a byproduct would also increase, although not necessarily in direct proportion (Depending on oil prices, the ratio of cottonseed used as foodstuff

(without oil extraction) may increase). As a result, a world-wide surplus is likely. If, however, increases in production of cotton and cottonseed occur in the self-sufficient countries such as the USSR and China, the world trade might not be influenced as much.

2.8 Castor Oil

The projected results show that production increases slightly, consumption decreases considerably and there is an oversupply.

As described earlier, castor oil is consumed exclusively for industrial use, of which there are many. Therefore, demand for castor oil depends upon the demand for the industrial products it is used in, as well as its competitiveness with the chemical synthetic oils. As a result, it is difficult to project future demand.

World-wide demand is stable (with slight increases). In the developed countries, demand decreases but in India, Brazil and China, the main producing countries, consumption is expected to increase. If industrialization is further promoted in these three countries, it is probable that castor oil consumption would also increase, and thus the world market would not reflect conditions of oversupply as large as predicted in this projection.

[1-3-4] SOME COMMENTS ON POSSIBILITIES FOR BRAZILIAN EXPORTS

In order to consider the possibilities for Brazilian exports, both the world trade and the domestic production conditions in Brazil must necessarily be examined at the same time. Some comments are made here only on a part of these conditions, i.e., those relating to the export of Brazilian products derived from our investigation of external conditions for Brazil to which the purpose of this Study is primarily limited. In other words, some aspects are discussed below relating to crop selection, making use of the results of the above projections and trend analyses as a reference for the selection of suitable oilseed crops for the Great Carajas Program.

(a) According to the projections made, the world supply of vegetable oils as a whole will slightly exceed demand under normal circumstances. However, such projections do not preclude the possibilities for Brazilian exports of oilseed crops and vegetable oils. Despite the global surplus, some regions or countries have an excess of supply while others suffer shortages, with trade being conducted between these respective regions or countries. Thus, it is important to pay attention to supply and demand on a regional basis (i.e., groups of countries) in using these projections.

(b) Since world trade in surplus products is carried out on a competitive basis among the exporting countries, the key point for crop selection is the competitive power of the products destined for export.

Needless to say, price and quality are the two major considerations with regard to competitive export power. This is indicated in the case of the remarkable growth of Brazil's exports of pepper, which have overwhelmed other exporting countries in terms of price.

An overall judgment as to which oil crops possess strong price competitiveness must be made by scrutinizing various economic and social factors involved, together with a judgment on whether they are suited to the natural and agronomic conditions in Carajas region and can utilize these conditions to the maximum advantage.

No less important than price is quality in the sales competition of any commodity, especially when it is sold in a buyers' market. "Better quality at a lower price" is the motto for winning sales competition.

The governments of exporting countries and producers' organizations take various types of measures such as the establishment of standards and inspection procedures in order to maintain and improve the reputation of their exports, and the easiness of such quality control must be taken as one of the criteria for crop selection. Also in respect of quality, attention should be paid to the fact that importing countries are becoming increasingly severe for sanitary aspects of importing food and feed, such as the safety from afratoxin contamination.

(c) In addition to the above-mentioned price and quality factors, stable supply is an essential element of competitive power. This is particularly true in the case of exports (with reference to oil crops or oils here) which are used as materials for industry. In the case of the use of an oil as an ingredient for margarine, for example, stability of material supply and price is required by margarine producers from the standpoint of management, and any changes in the ingredients used due to temporary difficulties in their procurement or price fluctuations are unfavorable for the maintenance of the standard of the product.

The supply and price of agricultural products are inevitably unstable due to the influence of natural conditions, and various measures have been taken and many proposals have been made in this area. Although such measures and proposals are not referred to here, it can be mentioned that bilateral agreements on exports and imports over a given term (usually 1 to 3 years) as described at the beginning of this chapter in [1-1] General Description on Oilseeds and Oils, are one of the measures to ensure stability of supply.[1)]

(d) The projections mentioned above indicate that the countries which will show the highest rate of growth of consumption will be the developing countries. An investigation of Brazil's competitiveness in the markets of developing countries which are potential customers for Brazilian products may be required. According to the projection, supply will exceed demand in the developing countries as a whole which include large producing countries like Brazil and Malaysia, but the non-producing developing countries may appear as a new markets as their income level go up.

Since the centrally planned economies are one of the regional blocs in which a shortage of oil is anticipated in the future in the projections, these countries may be regarded as a prospective market. For oils other than soybean oil, an examination of competitive power in such markets will become more important.

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1) OECD evaluates such bilateral agreements as being conducive to the stability of the world market, but at the same time, points out that there is a problem of increased instability outside the scope of these agreements (OECD, Study of Trends in World Supply and Demand of Major Agricultural Commodities, 1976).

(e) Although the outlook for the Brazilian domestic market is not included in this Study, Brazilian domestic demand also may be expected to considerably increase in the future, judging from the fact that the growth in consumption of vegetable oils in the developing countries is large in the producing countries (e.g., Malaysia, Nigeria and Indonesia).

The annual per capita consumption of vegetable oils in Brazil, at 4.5 kg, is not only lower than that in the developed countries (10 kg or more), but also lower than that in Nigeria, Malaysia, Mexico, Zaire and Indonesia (see [1-1] General Description on Oilseeds and Oils, Table 8). Increased national income and population of Brazil in the future can be expected to bring about a significant increase in domestic demand.

The advance of industrialization in Brazil will be accompanied by an increase in demand for vegetable oils in industry and in order to expand industrial development, efforts should be made to encourage the oil industries to use more of the cheaper domestic oils. In this case, not only conventional products such as soaps but also the development of sophisticated products such as higher alcohols deserve consideration in terms of the industrial applications of oils. If the application of vegetable oils as a substitute for diesel oil being studied in Brazil and Malaysia is feasible, the increase in demand will be vast. It is emphasized again that domestic demand should be fully examined in selecting oil crops for the Carajas development.

Next, some remarks are made on a product basis.

(1) Palm Oil

Palm oil is an international commodity second only to soybean oil among the vegetable oils, and its competitive power in international market prices may be a fundamental factor in considering its production for export. In terms of markets, entry into markets which are located geographically close to Brazil and consequently entail lower transportation costs compared to the existing exporting countries such as Malaysia should be taken into consideration.

It goes without saying that palm oil production requires capital investment in project sites such as farm development, plant construction and the relevant infrastructure, the provision and improvement of export ports, transportation and warehouses. Some areas to be developed will require the transfer of labor.

It is reported that widespread areas blessed with natural conditions suitable for oil palm cultivation exist in Carajas, but in order to develop projects which will be competitive with the leading exporting countries such as Malaysia, it will be necessary to select areas in

which the investment made can be expected to be the most efficient not only in view of the natural but also social and economic conditions, as well as to conduct detailed surveys on the scale and form of the projects. Preferential treatments may be required for the optimum development of the projects and for the encouragement of the participation of private enterprises.

It would appear to be advisable to direct such investigations toward the selection of the few most suitable sites rather than an extensive examination for the time being.

(2) Lauric Oils

The future consumption of coconut oil, palm kernel oil and babassu oil has higher possibilities for growth in the field of industry rather than in the food category, although this will depend on price differences among other oils and petroleum products. Since there is the problem of environmental pollution caused by synthetic detergents manufactured from alcohols derived from petroleum, especially in recent years, an increase in demand for the above-mentioned oils may be expected, provided that efforts are made for the stabilization of supply and price.

Thus, stable supply and price competitiveness in the international market will be key factors in the development of lauric oils. Looking at babassu from this point of view, despite many problems to be tackled including the provision of infrastructure such as roads for harvesting and collection, the mechanization of shell removal and the development of new uses for parts other than the kernel, various favorable aspects may be noted, namely that it is a plant which grows naturally in areas which are not greatly affected by tropical cyclones, and also that its constituent parts other than the kernel are potentially valuable as a commodity.

Since the cultivation of coconut as a single crop is not profitable in terms of cost-benefit ratio, the adoption of other profitable crops to be cultivated between coconut trees may be considered at the same time. The cultivation of field crops in the early period of coconut tree planting, and of such crops as cacao which require shade will improve the overall profitability of the farm operations and increase export competitiveness.

Palm kernel, the byproduct of palm oil production, should be considered as a part of the palm oil industry.

(3) Soybean

Brazilian exports now concentrate on soybean products such as the

oil and the meal, and soybean and its products have already become fully established as international commodities. Therefore, if Brazil continues to aim at an expansion of exports of soybean products or soybeans in the future, the competitive power of such exports will remain the most important factor. In fact, it is considered that the high competitive power of Brazilian soybean products in terms of price compared with other countries' products was the main force behind the strong growth of Brazilian exports of these commodities in the latter half of the 19'0s, in addition to factors such as international political circumstances. It is said that price differences between the United States and Brazil contributed to the rise in the share held by Brazil and the sharp fall of U.S. share in the Indian market for soybean oil in 1981.

It is also important here that sufficient attention be given not only to price competitiveness but also to problems of quality in securing the future growth of exports.

(4) Other Oilseeds

This Study covers peanut, sunflower, cottonseed, corn oil and castor bean, and all of these oil crops except for castor bean provide edible oils. These edible oils each have their particular flavor and each country or region has its own propensities of their consumption. Further, cottonseed oil and corn oil are, by their nature, byproducts. All of the above facts must be taken into account in order to increase the production of these edible oils. Some further comments are made below on a product basis.

(a) Peanut

Considering the possibilities for Brazilian exports of peanut oil, Brazil is expected to keep its position as one of the major exporting countries in the future, provided that price competitiveness is maintained. Although Brazil holds a 3 - 4% share of world peanut production, this country ranks first in world exports of peanut oil. The problem is, however, that Brazilian peanut production is decreasing.

The decrease in peanut production in the 1970s is thought to be mainly due to conversion from peanut to soybean cultivation. If the production of peanut is to increase in the future, its cultivation in semi-arid regions with insufficient rainfall for soybean and grains should be considered, because of peanut's resistance to dry conditions. However, the productivity (yield) and production stability in such regions may be a problem. For an increase in production to take place, it will be necessary to sell peanut at a competitive price in the international market. Such competitiveness may result from the overall profitability of farm management that might be attained by

taking advantage of peanut's ability to maintain fertile soil through rotation or intercropping with other crops.

(b) Sunflower

Although Brazilian sunflower production and exports have increased over the past few years, the level of exports stands at less than 10,000 tons, representing a very small portion of the world total exports of more than 1 million tons, and is outweighed by the exports of neighboring Argentina, at 330,000 tons.

Although the current producing areas in Brazil are concentrated in the States of Parana, Sao Paulo and Rio Grande do Sul, sunflower is considered to be a crop suitable for the development of the semi-arid zone in north-eastern region which is suitable for few other crops, because of its resistance to dry conditions. In this case, measures for rational cultivation in combination with other crops, and studies on the introduction of high-yield varieties will be required, as in the case of peanut mentioned above, in order to meet the international competition in prices, especially with Argentina.

(c) Cottonseed

Brazil ranks fifth in the world production of cottonseed, and its exports of cottonseed oil are second after the United States, holding a share of about 14% of total world exports. If the recent tendency for strong domestic demand for cottonseed oil continues, a significant increase in exports of cottonseed oil is unlikely.

(d) Corn Oil

Although Brazil is a major producing country of maize, the production of corn oil remains low. Exports of corn oil have begun only in recent years, and are a little less than 10,000 tons compared with the total world exports of about 200,000 tons. The future production of corn oil in Brazil will depend on trends in cornstarch production, and there are possibilities for the production and export of corn oil as a byproduct of cornstarch with international competitive power if the demand for cornstarch becomes strong in the future.

(e) Castor Beans

Brazil ranks with India as one of the major exporting countries of castor oil, but the level of exports has levelled off in recent years owing to an increase in domestic demand.

Since castor oil has diverse applications as an industrial oil, as previously stated, domestic demand can be expected to continue

growing in the future as a result of the development of Brazilian domestic industry, and there appears to be potential for increasing production in the future to meet both domestic and export demand.

Bahia State, which accounts for the majority of domestic production, has the problem of low yield compared with that of castor bean cultivation in southern Brazil, and efforts are therefore necessary for the improvement of productivity in Bahia and other regions in northeastern Brazil.

Appendix Table 1 Countries by Region

Economic Classes and Regions

Class I : Developed Market Economies

North America : Canada, United States.

Western Europe : Austria, Belgium-Luxembourg, Denmark, Faeroe Islands, Finland, France, Federal Republic of Germany, Greece, Iceland, Ireland, Italy, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, Yugoslavia.

Oceania : Australia, New Zealand.

Other Developed Market Economies : Israel, Japan, South Africa.

Calss II : Developing Market Economies

Africa : Algeria, Angola, Benin, Botswana, Burundi, Cameroon, Cape Verde, Central Africa Republic, Chad, Comoros, Congo, Ethiopia, Gabon, Gambia, Ghana, Guinia, Guinia-Bissau, Ivory Coast, Kenya, Lesoto, Liberia, Madagascar, Malawi, Mali, Mouritania, Manritius, Morocco, Mozambique, Nambia, Niger, Nigeria, Ramion, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Somalia, Swaziland, Tanzania, Togo, Tunisia, Uganda, Upper Volta, Zaire, Zambia, Zimbabwe.

Latin America : Antigua, Argentina, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Domonica, Dominican Republic, Equador, El Salvador, French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Saint Lucia, St. Kitts-Nevis-Anguilla, St. Vincent, Suriname, Trinidad and Tobago, Uruguay, Venezuela.

Near East : Afghanistan, Cyprus, Egypt, Iran, Iraqu, Jordan, Libya, Saudi Arabia, Sudan, Syria, Turkey, Yemen Arab Republic, Cemocratic Yemen.

Far East : Bangladesh, Bhutan, Brunei, Burma, Hong Kong, India, Indonesia, Republic of Korea, Lao, Macau, Malaysia, Maldives, Nepal, Pakistan, Phillippines, Singapore, Sri Lanka, Thailand.

Other Developing Market Economies : Fiji, French Polynesia, New Caledonia, Papua New Guinea, Samoa, Solomon Island, Tonga, Vanuatu.

Class III : Centrally Planned Economies

Asia : China, Democratic Kampuchea, Democratic People's Republic of Korea, Mongolia, Viet Nam.

Eastern Europe and USSR : Albania, Bulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, Romania, USSR.

All Developed Countries : Includes Developed Market Economies and Eastern Europe and USSR of Class III "Centrally Planned Economies".

All Developing Countries : Includes Developing Market Economies and Asia of Class III "Centrally Planned Economies".

(FAO Classification)

Appendix Table 2 Conversion and Utilization Rates of Fats and Oils

1. Soybean

(%)

Region	Conversion rate of oil	Utilization rate of oil		
		Edible	Food processing	Other processing
North America	17.90	41.99	51.33	6.65
Western Europe	17.23	56.05	32.13	11.76
Oceania	18.18	100.00	0	0
Other developed countries	18.18	76.48	11.15	2.44
Africa	17.65	98.00	0	0
Latin America	17.16	41.39	0	58.61
Middle East	17.65	94.62	0	9.87
Asia	17.86	100.00	0	0
Other developing countries	20.00	100.00	0	0
Asian centrally planned economies	18.00	97.01	0	3.08
East European centrally planned economies	17.05	41.11	12.22	46.67
World	17.65	47.29	17.80	8.65

2. Sunflower

(%)

Region	Conversion rate of oil	Utilization rate of oil		
		Edible	Food processing	Other processing
North America	40.00	98.03	0	1.97
Western Europe	37.61	99.29	0.71	0
Oceania	17.14	66.66	0	33.33
Other developed countries	50.00	100.00	0	0
Africa	30.00	100.00	0	0
Latin America	33.25	100.00	0	0
Middle East	34.95	77.22	0	22.22
Asia	30.00	100.00	0	0
Other developing countries	30.00	100.00	0	0
Asian centrally planned economies	34.34	100.00	0	0
East European centrally planned economies	44.13	31.45	59.04	9.56
World	41.15	52.19	39.66	8.15

Appendix Table 2 (cont'd.)

3. Rapeseed

(%)

Region	Conversion rate of oil	Utilization rate of oil		
		Edible	Food processing	Other processing
North America	40.78	36.29	45.16	18.55
Western Europe	41.38	47.14	22.47	0
Oceania	50.00	88.89	0	11.11
Other developed countries	40.52	85.08	15.25	0
Africa	37.33	81.82	0	18.18
Latin America	33.33	100.00	0	0
Middle East	33.33	100.00	0	0
Asia	33.18	99.61	0	0.39
Other developing countries	33.33	100.00	0	0
Asian centrally planned economies	38.01	89.74	0	10.26
East European centrally planned economies	37.98	25.15	60.23	15.20
World	37.50	79.53	11.86	8.60

Appendix Table 2 (cont'd.)

4. Peanut

(%)

Region	Conversion rate of oil	Utilization rate of oil		
		Edible	Food processing	Other processing
North America	43.48 (32.60)	76.48	18.63	4.90
Western Europe	45.58 (32.28)	97.05	2.32	0.63
Oceania	38.10 (23.81)	100.00	0	0
Other developed countries	45.58 (32.28)	100.00	0	0
Africa	46.00 (33.12)	100.00	0	0
Latin America	38.04 (26.69)	100.00	0	0
Middle East	46.00 (33.12)	100.00	0	0
Asia	40.01 (28.01)	97.73	0	2.27
Other developing countries	41.99 (29.39)	100.00	0	0
Asian centrally planned economies	41.99 (29.39)	100.00	0	0
East European centrally planned economies	42.86 (30.36)	16.67	83.33	0
World	45.51	98.69	0.57	0.58

Note: The figures within parentheses indicate shelled peanuts.

Appendix Table 2 (cont'd.)

5. Palm kernel - Palm oil

(%)

Region	Conversion rate of oil	Utilization rate of oil		
		Edible	Food processing	Other processing
North America	46.22	77.46	15.49	7.04
		(10.06)	(86.03)	(4.19)
Western Europe	46.22	2.28	33.79	63.93
		(35.93)	(30.50)	(33.56)
Oceania	46.22	0	0	100.00
		(0)	(100.00)	(0)
Other developed countries	50.00	0	87.50	12.5
		(14.71)	(22.79)	(61.76)
Africa	45.00	30.89	0.18	68.89
		(96.16)	(0)	(3.79)
Latin America	46.11	0	0	100.00
		(39.10)	(15.24)	(45.64)
Middle East	45.00	100.00	0	0
		(100.00)	(0)	(0)
Asia	45.35	76.19	0	23.81
		(38.24)	(24.79)	(36.55)
Other developing countries	45.00	58.56	0	41.43
		(38.87)	(0)	(61.13)
Asian centrally planned economies	49.09	14.81	85.19	0
		(15.10)	(0)	(85.42)
East European centrally planned economies	33.33	0	0	100.00
		(0)	(0)	(100.00)
World		22.01	1.40	76.59
		(68.28)	(6.07)	(25.65)

Appendix Table 2 (cont'd.)

6. Copra

(%)

Region	Conversion rate of oil	Utilization rate of oil		
		Edible	Food processing	Other processing
North America	63.91EE	31.48	10.49	58.03
Western Europe	63.91	0.19	67.18	26.68
Oceania	54.54	85.00	0	15.00
Other developed countries	65.00	73.00	14.00	13.00
Africa	63.95	98.73	0	1.27
Latin America	64.00	85.71	0	14.29
Middle East	60.00	0	0	100.00
Asia	63.45	94.85	0	5.15
Other developing countries	64.99	48.40	0	51.60
Asian centrally planned economies	65.21	100.00	0	0
East European centrally planned economies	60.00	0	100.00	0
World	64.90	52.37	9.34	38.29

7. Cottonseed oil

(%)

Region	Conversion rate of oil	Utilization rate of oil		
		Edible	Food processing	Other processing
North America	16.29	60.46	28.76	10.78
Western Europe	16.29	100.00	0	0
Oceania	16.29	100.00	0	0
Other developed countries	18.75	75.76	24.24	0
Africa	15.68	100.00	0	0
Latin America	15.68	100.00	0	0
Middle East	15.68	62.96	37.04	0
Asia	15.68	100.00	0	0
Other developing countries	15.68	100.00	0	0
Asian centrally planned economies	13.99	74.73	0	25.09
East European centrally planned economies	17.41	45.22	0	54.78
World	15.92	59.38	9.69	30.88

Appendix Table 3 Projected Production by Types of Fats and Oils

(oil base 1,000 MT)

	Region	Soybean	Sun-flower	Peanut	Rape-seed	Cotton-seed	Saf-flower	Sesame	Caster bean	Lin-seed	Coconut	Palm oil	Palm kernel	Olive	Total
1980	Developed countries	9,454	1,383	700	1,416	854	83	1	2	296	-	-	-	1,259	15,448
	Developing countries	3,694	611	3,899	837	1,220	258	734	315	438	2,894	4,620	713	549	20,782
	Centrally planned economies	1,586	3,021	931	1,189	1,722	1	179	56	149	23	176	22	10	9,065
	World	14,734	5,015	5,530	3,442	3,796	342	914	373	883	2,917	4,796	735	1,818	45,295
1990	Developed countries	12,888	1,973	682	1,487	1,003	77	1	2	316	-	-	-	1,263	19,692
	Developing countries	4,641	696	3,718	970	1,301	357	777	331	518	3,341	5,956	809	656	24,071
	Centrally planned economies	1,653	2,856	998	1,325	1,878	0	179	50	133	25	178	22	10	9,307
	World	19,182	5,525	5,398	3,782	4,182	434	957	383	967	3,366	6,134	831	1,929	53,070
2000	Developed countries	15,883	2,125	682	1,538	1,154	73	0	2	352	-	-	-	1,263	23,072
	Developing countries	4,973	781	3,675	1,106	1,380	453	811	349	601	3,798	6,174	823	717	25,641
	Centrally planned economies	1,705	2,761	1,048	1,382	1,945	0	177	46	123	26	178	22	10	9,423
	World	22,561	5,667	5,405	4,026	4,479	526	988	397	1,076	3,824	6,352	845	1,990	58,136

Appendix Table 4 Projected Consumption by Types of Fats and Oils

(oil base 1,000 MT)

	Region	Soybean	Sun-flower	Peanut	Rape-seed	Cotton-seed	Saf-flower	Sesame	Caster bean	Lin-seed	Coconut	Palm oil	Palm kernel	Olive	Total
1980	Developed countries	8,212	1,062	1,113	1,092	547	83	59	135	160	1,141	1,328	353	1,346	16,631
	Developing countries	3,385	664	3,611	1,498	1,869	258	624	115	281	1,578	3,418	314	437	18,052
	Centrally planned economies	2,131	2,991	874	1,115	1,670	1	191	95	149	127	280	34	20	9,678
	World	13,728	4,717	5,598	3,705	4,086	392	874	345	590	2,846	5,026	701	1,803	44,361
1990	Developed countries	10,303	1,182	1,077	1,105	414	77	42	81	36	1,221	1,424	381	1,354	18,697
	Developing countries	4,088	671	3,769	2,081	1,949	357	624	114	284	1,859	4,717	374	527	21,414
	Centrally planned economies	2,414	3,391	865	1,560	1,721	0	192	95	157	157	483	36	20	11,091
	World	16,805	5,244	5,711	4,746	4,084	434	858	290	427	3,237	6,624	791	1,901	51,202
2000	Developed countries	12,118	1,285	1,044	1,106	282	73	21	43	7	1,300	1,435	410	1,355	20,479
	Developing countries	4,157	678	3,809	2,425	2,004	453	624	114	284	2,130	4,766	389	618	22,451
	Centrally planned economies	2,544	3,967	857	2,005	1,730	0	192	75	157	187	575	37	20	12,366
	World	18,819	5,930	5,710	5,536	4,016	526	837	252	448	3,617	6,776	836	1,993	55,296

Appendix Table 5 Projected Consumption by Types of Fats and Oils

(oil base 1,000 MT)

		Utilization rate	Utilization rate of oil	1980	1990	2000
Soybean oil	Edible	47.29	0.6413	9,577	11,983	13,766
	Food process.	17.80	0.2414	3,605	4,511	5,182
	Inedible	8.65	0.1173	1,752	2,192	2,518
	Total	73.74	1.0000	14,935	18,685	21,466
Sunflower oil	Edible	52.19	0.5219	2,462	2,737	3,095
	Food process.	39.66	0.3966	1,871	2,080	2,352
	Inedible	8.15	0.0815	384	427	483
	Total	100.00	1.0000	4,717	5,244	5,930
Peanut oil	Edible	98.69	0.9885	5,534	5,645	5,644
	Food process.	0.57	0.0057	32	33	33
	Inedible	0.58	0.0058	32	33	33
	Total	99.84	1.0000	5,598	5,711	5,710
Rapeseed oil	Edible	79.53	0.7953	2,945	3,774	4,403
	Food process.	11.86	0.1186	439	563	657
	Inedible	8.60	0.0860	318	408	476
	Total	99.99	0.9999	3,703	4,746	5,536
Cottonseed oil	Edible	59.38	0.5941	2,427	2,426	2,386
	Food process.	9.69	0.0969	396	396	389
	Inedible	30.88	0.3089	1,262	1,262	1,241
	Total	99.95	0.9999	4,086	4,084	4,016
Safflower oil	Edible	85.23	0.8523	291	370	448
	Food process.	2.11	0.0211	7	9	11
	Inedible	12.66	0.1266	43	55	67
	Total	100.00	1.0000	342	434	526
Sesame oil	Edible	97.46	0.9754	857	837	816
	Food process.	0.16	0.0016	1	1	1
	Inedible	2.30	0.0230	20	20	19
	Total	99.92	1.0000	879	858	837
Castor oil	Edible	0	0	0	0	0
	Food process.	0	0	0	0	0
	Inedible	0.9838	1.0000	345	290	252
	Total	0.9838	1.0000	345	290	252
Linseed oil	Edible	9.92	0.0992	59	47	44
	Food process.	18.65	0.1865	110	89	84
	Inedible	71.23	0.7123	420	340	319
	Total	100.00	1.0000	590	477	448

Appendix Table 5 (cont'd.)

		Utilization rate	Utilization rate of oil	(oil base 1,000 MT) 1980	1990	2000
Coconut oil	Edible	52.37	0.5237	1,490	1,695	1,894
	Food process.	9.34	0.0934	266	302	338
	Inedible	38.29	0.3829	1,090	1,239	1,385
	Total	100.00	1.0000	2,846	3,237	3,617
Palm oil	Edible	68.28	0.6828	3,432	4,523	4,627
	Food process.	6.07	0.0607	305	402	411
	Inedible	25.65	0.2565	1,289	1,699	1,738
	Total	100.00	1.0000	5,026	6,624	6,776
Palm kernel oil	Edible	22.01	0.2201	154	174	184
	Food process.	1.40	0.0140	10	11	12
	Inedible	76.59	0.7659	537	606	640
	Total	100.00	1.0000	701	791	836
Olive oil	Edible	97.92	0.9933	1,791	1,888	1,980
	Food process.	0	0	0	0	0
	Inedible	0.66	0.0067	12	13	13
	Total	98.58	1.0000	1,803	1,901	1,993
Total	Edible			38,062	44,498	48,759
	Inedible			9,504	8,584	9,184
	Total			45,566	53,082	57,943

Appendix Table 6-1 Projected Production and Consumption of Soybean

	USA	Western Europe	Oce-ania	Others	Developed countries total	Africa	Latin America	Middle East	Asia	Others	Developing countries total	Asia	Eastern Europe	Centrally planned economies	World total
Consumption (oil base 1,000 MT)															
1980	5,168	2,007	50	987	8,212	278	2,157	491	459	0	3,385	1,663	468	2,131	13,728
1990	7,074	2,137	50	1,042	10,303	351	2,613	660	464	0	4,088	1,770	644	2,414	16,805
2000	8,870	2,149	50	1,049	12,118	362	2,645	685	465	0	4,157	1,838	706	2,544	18,819
Area (1,000 ha)															
1980	25,796	50	38	97	25,981	222*	11,016	135*	1,373	0	12,746	7,349	1,131	8,480	47,207
1990	31,406	50	38	97	31,591	267*	12,059	213*	1,408	0	13,947	7,349	1,159	8,508	54,046
2000	34,954	50	38	97	35,139	312*	12,085	291*	1,412	0	14,100	7,349	1,165	8,514	57,753
Unit yield (MT/ha)															
1980	2.035*	1.911	1.690	1.594		0.421	1.800	1.869	0.940	0		1.065*	0.924*		
1990	2.282*	1.929	1.691	1.721		0.445	2.071	1.957	1.033	0		1.074*	1.176*		
2000	2.529*	1.929	1.691	1.762		0.469	2.206	1.964	1.076	0		1.075*	1.427*		
Production (crop base, 1,000 MT)															
1980	52,495	96	64	155	52,810	93	19,829	252	1,291	0	21,465	7,827	1,045	8,872	83,147
1990	71,668	96	64	167	71,995	119	24,974	417	1,454	0	26,964	7,893	1,363	9,256	108,215
2000	88,399	96	64	171	88,730	146	26,660	572	1,519	0	28,897	7,900	1,662	9,562	127,189
Production (oil base)															
1980	9,397	17	12	28	9,454	16	3,403	44	231	0	3,694	1,408	178	1,586	14,734
1990	12,829	17	12	30	12,888	21	4,286	74	260	0	4,641	1,421	232	1,653	19,182
2000	15,823	17	12	31	15,883	26	4,575	101	271	0	4,973	1,422	283	1,705	22,561
Potential volume of exports/imports (oil base 1,000 MT)															
1980	4,229	-1,990	-38	-959	1,242	-262	1,246	-447	-228	0	309	-255	-290	-545	1,006
1990	5,755	-2,120	-38	-1,012	2,585	-330	1,673	-586	-204	0	553	-349	-412	-761	2,377
2000	6,953	-2,132	-38	-1,018	3,765	-336	1,930	-584	-194	0	816	-416	-423	-889	3,742

* Projected using linear regressions

Appendix Table 6-2 Projected Production and Consumption of Sunflower

	USA	Western Europe	Oce-ania	Others	Developed countries total	Africa	Latin America	Middle East	Asia	Others	Developing countries total	Asia	Eastern Europe	Centrally planned economies	World total
Consumption (oil base 1,000 MT)															
1980	113	737	19	193*	1,062	74*	354	234	2	0	664	90*	2,901	2,991	4,717
1990	119	752	19	292*	1,182	81*	354	234	2	0	671	145*	3,746	3,391	5,244
2000	120	754	19	392*	1,285	88*	354	234	2	0	678	201*	3,766	3,967	5,930
Area (1,000 ha)															
1980	1,306	1,018	167	481	2,972	117	1,409	594*	28*	0	2,148	245*	5,195	5,440	10,560
1990	1,986	1,058	167	787	3,998	117	1,409	801*	54*	0	2,381	403*	4,948	5,351	11,730
2000	2,046	1,059	167	916	4,188	117	1,409	1,014*	81*	0	2,621	561*	4,783	5,344	12,153
Unit yield (MT/ha)															
1980	1.161*	1.265*	0.659*	1.140	4.225	0.787	0.771*	1.056	0.371*	0	2.985	0.865*	1.286	2.15	
1990	1.161*	1.265*	0.766*	1.336	4.528	0.941	0.771*	1.059	0.371*	0	3.142	0.865*	1.253	2.118	
2000	1.161*	1.265*	0.873*	1.410	4.709	1.029	0.771*	1.059	0.371*	0	3.230	0.865*	1.229	2.094	
Production (crop base, 1,000 MT)															
1980	1,516	1,288	110	548	3,462	92	1,086	627	10	0	1,815	212	6,681	6,893	11,402
1990	2,306	1,338	128	1,051	4,823	110	1,086	848	20	0	2,064	349	6,200	6,549	11,813
2000	2,375	1,340	146	1,292	5,153	120	1,086	1,074	30	0	2,310	485	5,878	6,363	11,938
Production (oil base)															
1980	606	484	19	274	1,383	28	361	219	3	0	611	73	2,948	3,021	5,015
1990	922	503	22	526	1,973	33	361	296	6	0	696	120	2,736	2,856	5,525
2000	950	504	25	646	2,125	36	361	375	9	0	781	167	2,594	2,761	5,667
Potential volume of exports/imports (oil base 1,000 MT)															
1980	493	-253	0	81	321	-46	7	-15	1	0	-53	-17	47	30	298
1990	803	-249	3	234	791	-48	7	62	4	0	25	-25	-510	-535	281
2000	830	-250	6	254	840	-52	7	141	7	0	103	-34	-1,172	-1,206	-263

* Projected using linear regressions

Appendix Table 6-3 Projected Production and Consumption of Peanut

	USA	Western Europe	Oce-ania	Others	Developed countries total	Africa	Latin America	Middle East	Asia	Others	Developing countries total	Asia	Eastern Europe	Centrally planned economies	World total
Consumption (oil base 1,000 MT)															
1980	441	560	13	99*	1,113	1,056	189	304	2,060	2	3,611	851	23*	874	5,598
1990	441	555	13	68*	1,077	1,071	181	397	2,118	2	3,769	851	14*	865	5,711
2000	441	554	13	36*	1,044	1,073	180	422	2,132	2	3,809	851	6*	857	5,710
Area (1,000 ha)															
1980	623*	7	32*	152	814	4,943	650	1,060	8,469	2	15,124	2,496	5*	2,501	18,439
1990	641*	6	34*	33	714	4,597	104	1,086	8,508	1	14,296	2,674	7*	2,681	17,691
2000	651*	5	37*	6	699	4,458	9	1,087	8,546	0	14,100	2,805	10*	2,815	17,614
Unit yield (MT/ha)															
1980	3.007	2.562	1.287	1.503		0.746*	1.288*	1.055	0.879	0.731*		1.266	1.290*		
1990	3.111	2.742	1.287	1.573		0.746*	1.397*	1.059	0.907	0.731*		1.266	1.257*		
2000	3.125	2.800	1.287	1.589		0.746*	1.505*	1.059	0.914	0.731*		1.266	1.224*		
Production (shelled attached; crop base, 1,000 MT)															
1980	1,873	18	41	228	2,160	3,687	837	1,118	7,444	1	13,087	3,160	6	3,166	18,413
1990	1,994	16	44	52	2,106	2,429	145	1,150	7,717	1	12,442	3,385	9	3,394	17,942
2000	2,034	14	48	10	2,106	3,326	14	1,151	7,811	0	12,302	3,551	12	3,563	17,971
Production (oil base)															
	0.3260	0.3228	0.2381	0.9228		0.3912	0.2669	0.3312	0.2801	0.2939	0.2939	0.3036			
1980	610	6	10	74	700	1,221	223	370	2,085	0	3,899	929	2	931	5,530
1990	650	5	10	17	682	1,136	39	381	2,162	0	3,718	995	3	998	5,398
2000	663	5	11	3	682	1,102	4	381	2,188	0	3,675	1,044	4	1,048	5,405
Potential volume of exports/imports (oil base 1,000 MT)															
1980	169	-554	-3	-25	-413	165	34	66	25	-2	288	78	-21	57	-68
1990	209	-550	-3	-51	-395	65	-142	-16	44	-2	-51	144	-11	133	-313
2000	222	-549	-2	-33	-362	29	-176	-41	56	-2	-134	193	-2	191	-305

* Projected using linear regressions

Appendix Table 6-4 Projected Production and Consumption of Coconut

	USA	Western Europe	Oce-ania	Others	Developed countries total	Africa	Latin America	Middle East	Asia	Others	Developing countries total	Asia	Eastern Europe	Centrally planned economies	World total
Coconut consumption (1,000 MT)															
1980	497	517	23	104	1,141	84	170*	10*	1,302*	12*	1,578	52	75*	127	2,846
1990	574	517	26	104	1,221	99	162*	12*	1,575*	11*	1,859	52	105*	157	3,237
2000	651	517	28	104	1,300	105	154*	13*	1,848*	10*	2,130	52	135*	187	3,617
Copla production (1,000 MT)															
1980	-	-	-	-	-	176	211*	-	3,848*	314*	4,549	35	-	35	4,584
1990	-	-	-	-	-	203	181*	-	4,530*	340*	5,254	38	-	38	5,292
2000	-	-	-	-	-	246	150*	-	5,212*	366*	5,974	40	-	40	6,014
Coconut oil production (oil base)															
1980	-	-	-	-	-	113	135	-	2,442	204	2,894	23	-	23	2,917
1990	-	-	-	-	-	130	116	-	2,874	221	3,341	25	-	25	3,366
2000	-	-	-	-	-	157	96	-	3,307	238	3,798	26	-	26	3,824
Potential volume of coconut oil exports/imports (oil base 1,000 MT)															
1980	-497	-517	-23	-104	-1,141	29	-35	-10	1,140	192	1,316	-29	-75	-104	71
1990	-574	-517	-26	-104	-1,221	31	-46	-12	1,299	210	1,482	-27	-105	-132	129
2000	-651	-517	-28	-104	-1,300	52	-58	-13	1,459	228	1,668	-26	-135	-161	207

* Projected using linear regressions

Appendix Table 6-5 Projected Production and Consumption of Palm Kernel

	USA	Western Europe	Oce-ania	Others	Developed countries total	Africa	Latin America	Middle East	Asia	Others	Developing countries total	Asia	Eastern Europe	Centrally planned economies	World total
Consumption (oil base 1,000 MT)															
1980	81*	255	2*	15*	353	167	121	0	24	2	314	33	1	34	701
1990	105*	256	3*	17*	381	227	121	0	24	2	374	35	1	36	791
2000	130*	256	5*	19*	410	242	121	0	24	2	389	36	1	37	836
Production (crop base, 1,000 MT)															
1980	-	-	-	-	-	657	306	-	604	5*	1,572	44	-	44	1,616
1990	-	-	-	-	-	645	312	-	823	5*	1,785	45	-	45	1,830
2000	-	-	-	-	-	639	313	-	858	5*	1,815	45	-	45	1,860
Production (oil base)						0.4500	0.4611		0.4535	0.4500		0.4909			
1980	-	-	-	-	-	296	141	-	274	2	713	22	-	22	735
1990	-	-	-	-	-	290	144	-	373	2	809	22	-	22	831
2000	-	-	-	-	-	288	144	-	389	2	823	22	-	22	845
Potential volume of exports/imports (oil base 1,000 MT)															
1980	-81	-255	-2	-15	-353	129	20	0	250	0	399	-11	-1	-12	34
1990	-105	256	-3	-17	-381	63	23	0	349	0	435	-13	-1	-14	40
2000	-130	256	-5	-19	-410	46	23	0	365	0	434	-14	-1	-15	9

* Projected using linear regressions

Appendix Table 6-6 Projected Production and Consumption of Palm Oil

	USA	Western Europe	Oce-ania	Others	Developed countries total	Africa	Latin America	Middle East	Asia	Others	Developing countries total	Asia	Eastern Europe	Centrally planned economies	World total
Consumption (oil base 1,000 MT)															
1980	335	766	38	189	1,328	1,326	149	129	1,785	29	3,418	201	79	280	5,026
1990	344	788	74	218	1,424	1,388	155	154	2,991	29	4,717	204	279	483	6,624
2000	344	790	81	220	1,435	1,397	155	163	3,022	29	4,766	205	370	575	6,776
Production (oil base)															
1980	-	-	-	-	-	1,360	140	-	3,068	52	4,620	176	-	176	4,796
1990	-	-	-	-	-	1,401	146	-	4,357	52	5,956	178	-	178	6,134
2000	-	-	-	-	-	1,408	147	-	4,567	52	6,174	178	-	178	6,352
Potential volume of exports/imports (oil base 1,000 MT)															
1980	-335	-766	-38	-189	-1,328	34	-9	-129	1,283	23	1,202	-25	-79	-104	-230
1990	-344	-788	-74	-218	-1,424	13	-9	-154	1,366	23	1,239	-26	-279	-305	-490
2000	-344	-790	-81	-220	-1,435	11	-10	-163	1,545	23	1,406	-27	-370	-397	-424

Appendix Table 6-7 Projected Production and Consumption of Cottonseed

	USA	Western Europe	Oce-ania	Others	Developed countries total	Africa	Latin America	Middle East	Asia	Others	Developing countries total	Asia	Eastern Europe	Centrally planned economies	World total
Consumption (oil base 1,000 MT)															
1980	378*	83*	14	72*	542	136	484	656	593*	-	1,869	628	1,042	1,670	4,086
1990	268*	47*	15	84*	414	137	484	684	644*	-	1,949	628	1,093	1,721	4,084
2000	158*	11*	16	97*	282	137	484	688	695*	-	2,004	628	1,102	1,730	4,016
Production (crop base, 1,000 MT)															
1980	4,618*	323*	47	216*	5,204	950*	3,030*	25*	3,773*	-	7,778	4,512	6,265	10,777	23,759
1990	5,416*	315*	47	333*	6,111	968*	3,188*	30*	4,104*	-	8,290	4,512	7,164	11,676	26,077
2000	6,214*	307*	47	449*	7,017	985*	3,347*	36*	4,434*	-	8,802	4,512	7,548	12,060	27,879
Production (oil base)															
	0.1629	0.1629	0.1629	0.1875		0.1568	0.1568	0.1568	0.1568			0.1399	0.1741		
1980	752	53	8	41	854	149	475	4	592	-	1,220	631	1,091	1,722	3,796
1990	882	51	8	62	1,003	152	500	5	644	-	1,301	631	1,247	1,878	4,182
2000	1,012	50	8	84	1,154	154	525	6	695	-	1,380	631	1,314	1,945	4,479
Potential volume of exports/imports (oil base 1,000 MT)															
1980	374	-30	-6	-31	307	13	-9	-652	-1	-	-649	3	49	52	-290
1990	614	4	-7	-22	589	15	16	-679	0	-	-648	3	154	157	98
2000	854	39	-8	-13	872	17	41	-682	0	-	-624	3	212	215	463

* Projected using linear regressions

Appendix Table 6-8 Projected Production and Consumption of Rapeseed Oil

	Developed countries	Developing countries	Centrally planned economies	World total
Area (1,000 ha)				
1980	2,461	4,212	3,825*	10,498
1990	2,497	4,212	4,133*	10,842
2000	2,499	4,212	4,187*	10,898
Unit yield (MT/ha)				
1980	1.40325*	0.5965	0.82072*	
1990	1.45175*	0.6910	0.84592*	
2000	1.50025*	0.7876	0.87112*	
Production (crop base 1,000 MT)				
1980	3,453	2,512	3,139	9,107
1990	3,625	2,910	3,496	10,031
2000	3,749	3,317	3,647	10,713
Consumption (oil base 1,000 MT)				
1980	1,092	1,498	1,115	3,703
1990	1,105	2,081	1,560	4,746
2000	1,106	2,425	2,005	5,536
Production (oil base 1,000 MT)				
1980	1,416	837	1,189	3,442
1990	1,487	970	1,325	3,782
2000	1,538	1,106	1,382	4,026
Potential volume of exports/imports (oil base 1,000 MT)				
1980	324	-661	74	-263
1990	382	-1,111	-235	-964
2000	932	-1,319	-623	-1,510

* Projected using linear regressions

Appendix Table 6-9 Projected Production and Consumption of Castor Bean

	Developed countries	Developing countries	Centrally planned economies	World total
Area (1,000 ha)				
1980	8	1,064*	371*	1,443
1990	8	1,075*	339*	1,422
2000	8	1,087*	308*	1,403
Unit yield (MT/ha)				
1980	0.613	0.666	0.350	
1990	0.606	0.693	0.346	
2000	0.606	0.721	0.346	
Production (crop base 1,000 MT)				
1980	5	709	130	844
1990	5	745	117	867
2000	5	784	107	896
Consumption (oil base 1,000 MT)				
1980	135	115*	95	345
1990	81	114*	95	290
2000	43	114*	95	252
Production (oil base 1,000 MT)				
	0.4400	0.4448	0.4286	
1980	2	315	56	373
1990	2	331	50	383
2000	2	349	46	397
Potential volume of exports/imports (oil base 1,000 MT)				
1980	-133	200	-39	28
1990	-79	217	-45	73
2000	-41	235	-49	145

* Projected using linear regressions

Appendix Table 6-10 Projected Production and Consumption of Safflower

	Developed countries	Developing countries	Centrally planned economies	World total
Area (1,000 ha)				
1980	194	1,236*	6	1,436*
1990	197	1,683*	2	1,882*
2000	197	2,131*	0	2,328*
Unit yield (MT/ha)				
1980	1.2126	0.6604	0.4306	
1990	1.1047	0.6718	0.4287	
2000	1.0434	0.6726	0.4285	
Production (crop base 1,000 MT)				
1980	235	816	3	1,054
1990	218	1,131	1	1,350
2000	206	1,433	0	1,639
Production (oil base 1,000 MT)				
	0.3526	0.3159	0.3333	
1980	83	258	1	342
1990	77	357	0	434
2000	73	453	0	526

* Projected using linear regressions

Appendix Table 6-11 Projected Production and Consumption of Sesame

	Developed countries	Developing countries	Centrally planned economies	World total
Area (1,000 ha)				
1980	3	5,647	1,005*	6,655
1990	1	5,743	1,080*	6,824
2000	0	5,769	1,156*	6,925
Unit yield (MT/ha)				
1980	0.469	0.293*	0.379*	
1990	0.469	0.305*	0.352*	
2000	0.469	0.317*	0.325*	
Production (crop base 1,000 MT)				
1980	1	1,655	381	2,037
1990	1	1,752	380	2,133
2000	0	1,829	376	2,205
Consumption (oil base 1,000 MT)				
	0.5417	0.4436	0.4702	
1980	1	734	179	914
1990	1	777	179	957
2000	0	811	177	988
Production (oil base 1,000 MT)				
1980	59	624	191	874
1990	42	624	192	858
2000	21	624	192	837
Potential volume of exports/imports (oil base 1,000 MT)				
1980	-58	110	-12	40
1990	-41	153	-13	99
2000	-21	187	-15	151

* Projected using linear regressions

Appendix Table 6-12 Projected Production and Consumption of Olive

	Developed countries	Developing countries	Centrally planned economies	World total
Production (crop base 1,000 MT)				
1980	6,294	2,670	51	9,015
1990	6,312	3,191	52	9,555
2000	6,313	3,487	52	9,852
Production (oil base 1,000 MT)				
	0.2001	0.2055	0.2001	
1980	1,259	549	10	1,818
1990	1,263	656	10	1,929
2000	1,263	717	10	1,990
Consumption (oil base 1,000 MT)				
1980	1,346	437*	20	1,803
1990	1,354	527*	20	1,901
2000	1,355	618*	20	1,993
Potential volume of exports/imports (oil base 1,000 MT)				
1980	-87	112	-10	15
1990	-91	129	-10	28
2000	-92	99	-10	-3

* Projected using linear regressions

Appendix Table 6-13 Projected Production and Consumption of Linseed

	Developed countries	Developing countries	Centrally planned economies	World total
Area (1,000 ha)				
1980	993	3,079*	1,562	5,634
1990	923	3,336*	1,406	5,665
2000	909	3,593*	1,301	5,803
Unit yield (MT/ha)				
1980	0.856*	0.429*	0.278	
1990	0.982*	0.468*	0.275	
2000	1.108*	0.504*	0.275	
Production (crop base 1,000 MT)				
	0.3492	0.3319	0.3443	
1980	849	1,321	434	2,604
1990	906	1,561	387	2,854
2000	1,007	1 811	358	3,176
Consumption (oil base 1,000 MT)				
1980	160	281	149	590
1990	36	284	157	477
1995	16	284	157	457
2000	7	284	157	448
Production (oil base 1,000 MT)				
1980	296	438	149	883
1990	316	518	133	967
2000	352	601	123	1,076
Potential volume of exports/imports (oil base 1,000 MT)				
1980	136	157	0	293
1990	280	234	-24	490
2000	745	317	-34	628

* Projected using linear regressions

[1]-APPENDIX 1

OCEAN TRANSPORTATION OF OILSEEDS AND VEGETABLE OIL

[1]-APPENDIX 1

OCEAN TRANSPORTATION OF OILSEEDS AND VEGETABLE OIL

A. OUTLINE

Oilseeds are chiefly transported by bulk carriers except for small lots of consignment carried by liners (container ships in the main). Soybeans, maize, palm and copra are usually transported by bulk carriers but sometimes by liners according to the use for which they are consumed. Sesame and peanut are mainly carried by liners. As for sunflower seed, cottonseed and castor beans, liners are also used for some lots of them, depending on the conditions (their use and level of consumption) at their places of consumption.

Vegetable oil is transported mainly by small tankers (clean and chemical tankers) of 20,000-30,000 dead weight tons (Clean and chemical tankers are primarily used to carry refined oil such as naphtha, but vegetable oil is also transported by these tankers. Even tankers for refined oil are used also to transport vegetable oil provided that the inside of the tanks can be cleaned easily).

Soybean, palm, coconut and corn oils are transported chiefly by the tankers mentioned above but where the lot consigned is small, or depending on the kind of product (castor bean oil, for example), a liner may be used.

Some vegetable oil such as coconut oil, for example, is fluid in the tropical condition but becomes solid with the lowering of temperature and for such a case a heating tanker is used.

In actual transportation, crude oil and refined oil are occasionally loaded mix due to the availability of tanks. Shippers dislike such a mixed loading since the quality of refined oil may differ somewhat among refineries. The loading method of refined oil is usually determined between the shipping company and the shipper at the time of contracting carriage.

The vital factors in transporting vegetable oil are, in addition to

the availability of a tanker to be charted, the availability of the oil storage facilities and storage capacity at the places of production and consumption.

However, factors determining the actual cargo rates are even more diversified and not any one of them seems decisive. The circumstances and mechanism of pricing are outlined below.

B. OCEAN FREIGHT RATES

Similar to rail, road and airway rates, ocean rates are the payment which a shipping company receives for the services of carrying passengers and cargo by ship.

1. Types of Rates

a. Passenger fares and freight rates classified by what is actually carried.

b. Domestic and international rates classified on the basis of areas served.

c. Advance payment freight and deferred payment freight to be settled on a fixed date.

d. Agreed rates which are determined beforehand by negotiation among shipping companies and free rates which are fixed for each contract of carriage.

2. Classification of Rates by the Method of Calculation

2.1 Rates by Weight

Rate per unit weight of cargo. They are used usually to

calculate charges for heavy cargo such as iron ore and coal. The units of weight are metric ton (1 ton= 2,204 pounds), and long ton (1 ton = 2,240 pounds).

2.2 Rates by Measurement

Rates per unit measurement of cargo. They are used to compute charges for light and bulky cargo such as cotton. Although the units of measurement differ somewhat among countires, 40 cubic feet (about 1.1 m^3) is taken as 1 measurement ton (In North European countries, 1 m^3 is taken as 1 measurement ton).

2.3 Ad Valorem Rates

Rates based on the value of cargo. They are used to calculate charges for valuables including gold, silver and jewelry for which special care is required in their transportation.

2.4 Item Rates

Rates per item of cargo. They are used to calculate charges for cargo such as raw cotton and raw silk of which packing is standardized and weight and measurement per item are fixed.

3. Classification by Types of Ships Used

Apart from the difference due to the types of rates and methods of calculation as mentioned above, rates also vary according to the types of ship used, viz. liner, tramper, single-purpose vessel or oil tanker.

C. PRESENT SITUATION OF RATES FOR EACH TYPE OF SHIP

1. Liner

"Liner" refers to a ship operating on a schedule (i.e. monthly, bimonthly or otherwise) through a fixed route.

Liners are used chiefly to carry a wide range of general cargo (although mainly, industrial products).

Rates are not negotiated each time the cargo is consigned. For each regular line, a shipping conference is organized by the shipping companies who assign their ships on a particular line and negotiate with their major shippers over tariff rates in order to stabilize rates and facilitate the collection of cargo.

Tariff rates are fixed for each route and each kind of cargo. Shippers who are under contract with a shipping conference are obligated as a rule not to use space other than that of the conference liners and, in return for doing so, the shipowners arrange economical contract rates for the shippers (The shipping conference has the right to operate its regular lines and control rates).

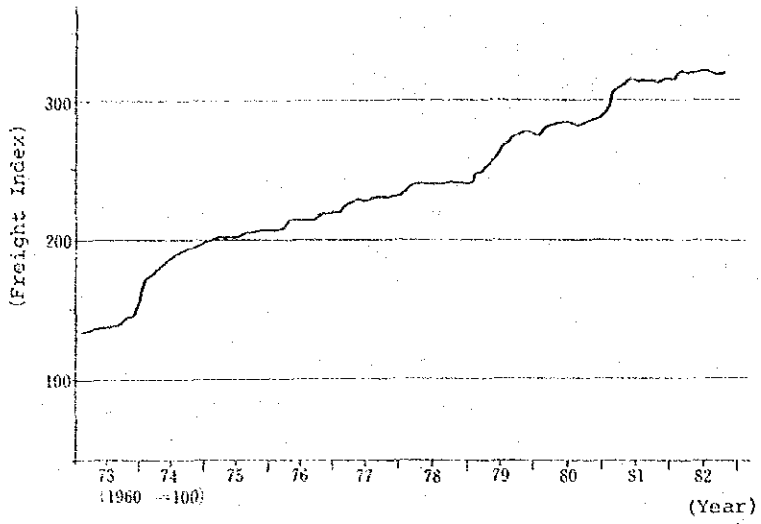
A steep rise in the price of crude oil due to the first oil crisis in 1973 saw the world economy hit by severe inflation. Inflation brought forth sharp rises in fuel costs as well as in crew wages, ship maintenance costs and port disbursement, resulting in higher rates. Consequently, business stagnated and shipping charges levelled off until the second oil cirsis in 1979 accelerated inflation again with rates rising sharply. Even allowing for these situations, as the rates of liners are fixed in advance for almost all cargo by the shipping conference, they fluctuate less than those of trampers and therefore are more stable.

Besides these liners, there are ships operating outside the control of the shipping conference. In the initial stages of the Iran-Iraq War in 1980, ships not under the control of the conference showed a remarkable contrast in business activity to the conference liners. Ordinarily, such ships offer lower rates than conference liners but many of them are superannuated vessels and consequently their accident rate is believed to be higher than that of conference liners.

The shippers who are under contract with the shipping conference cannot use non-conference ships and if such use is detected the conference is allowed to apply non-contract rates which are disadvantageous to the shipping owner.

However, since 1981, the world economic recession has affected the rates market and the trend of rising rates up to that time comes to level off (Fig. C-1).

Fig. C-1 Movements in the Freight Index of Liners (Jan. 1973 - Mar. 1982)



Source: Institute of Shipping Economics, Bremen

2. Trampers

Trampers are those vessels which, in response to demand for cargo transportation, supply space at the time and on the route which the shipper requires, without being limited to fixed routes or shippers.

Principal types of cargo which are frequently carried by trampers are such special articles as mining products, lumber, grains and heavy machinery. As the quantity handled by them is large, cargo of the same kind is often transported at full capacity. Many single-purpose vessels are placed in commission in order to meet the demand for cargo transportation which rises with the expansion of foreign trade. They include bulk carriers used solely for bulk cargo and single-purpose ships which engage in exclusive carriage of ore, oil or automobiles.

Tramper rates are not determined in the same way as liner rates. They are fixed in the charter contract between the shipowner and the shipper for each shipment. Rates, therefore, fluctuate widely depending on the amount of space available to meet the demands for cargo transportation. In short, as foreign trade expands when business is prosperous, demand for space increases resulting in a rise in rates.

When products at a certain point are moved internationally in large quantities and such movement becomes regular the cargo and the rates in question serve as an international freight index for trampers, and these regional factors are incorporated into the tramper market. In the world tramper market, the principal business takes place in Tokyo, London (Baltic Shipping Exchange) and New York (Table C-1).

Table C-1 World Markets of Trampers
(Loading point and Type of Cargo)

a. North American Market		
Atlantic coast	Wheat, Barley	St. Lawrence River Basin
		Northern Range
	Coal	Hampton Roads
Gulf of Mexico	Grain (soybean)	New Orleans, Galveston
Pacific Coast	Wheat	British Columbia
	Iron ore	San Francisco
b. Central American Market		
	Sugar	West Indies
	Iron ore	Venezuela
c. South American Market		
	Grains	La Plata River Basin
d. Australian Market		
	Wheat, Barley	East, west and south coasts
	Sugar	Queensland
e. Asian Market		
Far East	Sugar, Lumber, Iron ore	Philippines
Southeast Asia	Iron ore, Manganese ore	India
	Rice	Thailand

Table C-1 (cont'd.)

f. The Middle and Near East and Mediterranean Market		
	Salt	Aden, Red Sea
	Phosphate rock	Casablanca
g. African Market		
	Sugar	Mauritius
	Maize, Iron ore	South Africa
	Iron ore	West Africa

In order to understand the movement of tramper rates, the movement of rates in the liner market can be used as a comparison. Principal types of cargo and main routes to which inquiries for rates are referred are shown below (Table C-2).

Table C-2 Cargo and Main Routes of the Tramper Market

Cargo	Loading point	Destination
Cereal	Great Lakes	W. Europe
	Great Lakes	UK
	Gulf of Mexico	UK
	Gulf of Mexico	W. Europe
	Plate*	W. Europe
Coal	Hampton Roads	W. Europe
Grain	U.S. Pacific Coast	Japan
	U.S. Gulf	Japan
Coal	Hampton Roads	Japan
Sugar	Durban	Japan
Ore	Marmagoa	Japan

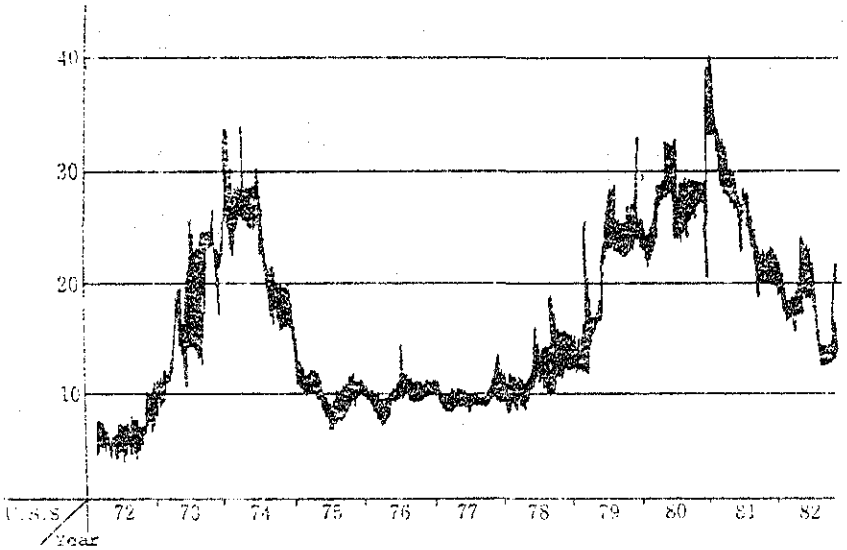
* La Plata Estuary area

Fig. C-2 shows the movement of rates for main routes which serves as a standard for the transportation of grains. It clearly

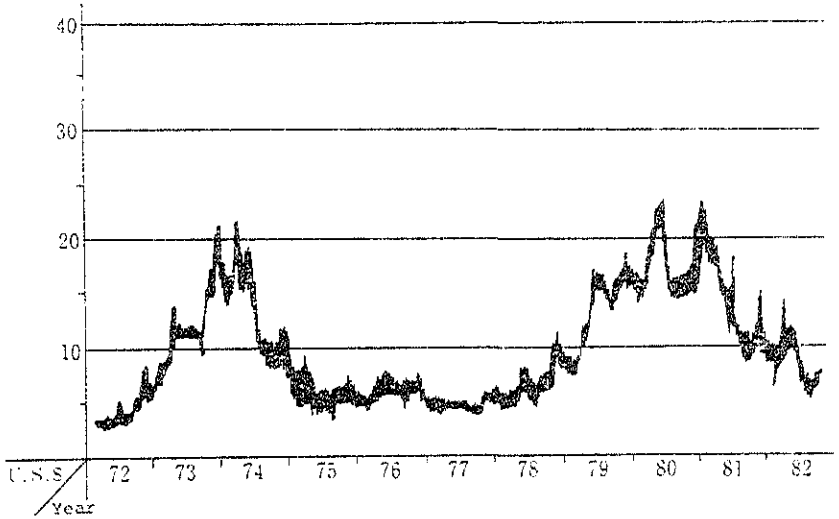
Fig. C-2 Movement of Principal Tramper Rates (Cereals)

(Shown by the range of high and low prices for all types of ships.)

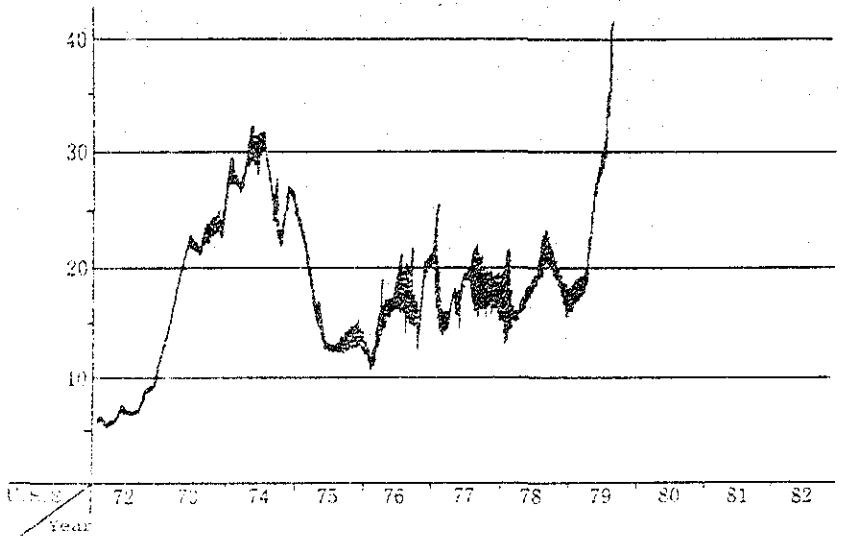
2-1 U.S. Gulf → Japan (Jan. 1972 - Oct. 1982)



2-2 U.S. Gulf → Western Europe (Jan. 1972 - Oct. 1982)



2-3 Plate → Western Europe (Jan. 1972 - Jul. 1979)



Source: Reuter

indicates a violent fluctuation of the tramper market and reflects how the tramper market correlates strongly with the business cycle.

In 1972 and 1973, the USSR bought an unprecedented quantity of grain from the United States due to the former's poor cereal harvest. Rates, which soared as a result of these purchases and the first oil crisis in 1973, declined rapidly with the subsequent downturn in the world economy. In the three years from 1975 to 1977, the world economy, being failed to recover from the oil crisis, business activity stagnated and rates, too, moved within narrow limits at a low level.

Then, rates rose considerably as a result of the Iran Revolution in 1978 and the outbreak of the Iran-Iraq War in 1980. They also rose due to chartering activity by the USSR in 1980 which demanded very large space following the bulk purchase of cereals.

However, since the second half of 1980, rates have gradually declined to the present level because of the global recession.

3. Single-Purpose Vessels (A type of tramper)

In accordance with the expansion of world economy, scale of production and consumption grows larger for a particular article, and volumes of ocean cargo traffic increase. When the trade volume of a certain article comes to stabilize throughout the year and it enables long-term mass transportation, single-purpose vessels will be used in order to reduce transportation costs.

The type, structure, performance and equipment of single-purpose vessels are designed so as to suit best the nature of the cargo, port facilities at the loading and unloading points of the cargo and the trade routes. Therefore, they enable efficient operations compared to ordinary ships. When the type and volume of cargo are predetermined, the capacity ton of single-purpose vessels can be easily increased.

Oil tankers and ore carriers are two examples of vessels whose capacity ton can be increased. The factors involved in the development of such vessels are:

a. Sharp increases in demand for the transportation of petroleum and iron ore.

b. Increases in the cargo units (i.e., quantity of a single-item) following the expanded scale of production at oil refineries and steel mills.

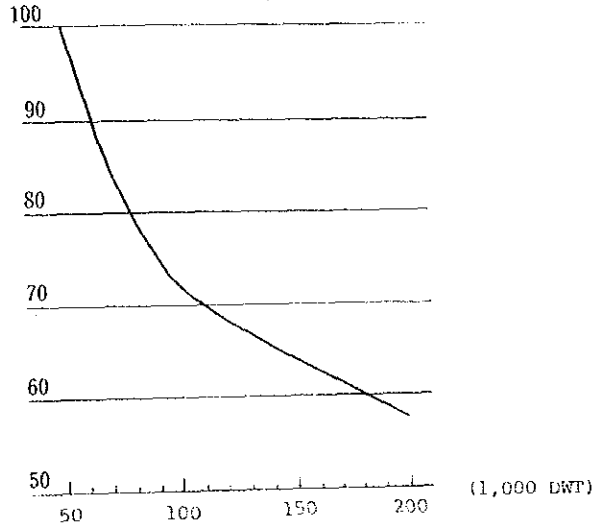
c. Comparative ease of loading and unloading of cargo and capability of handling a large quantity in a short time.

d. Capability of building large ships at a low cost due to the advanced technology of ship building.

e. No necessity to increase crew in proportion to the increases in ship size, resulting in reduced crew costs. Also, as relatively low horsepower is required for their engines, fuel costs are lower.

Fig. C-3 Increased Size of Vessels and Freight Index

(Tankers, 50,000 deadweight ton = 100)



Source: Japan Maritime Public Relations Center

When a shipping enterprise builds a large single-purpose vessel, it enters into a long-term contract with a shipper so that the capital investment can be recovered during the contract period, since the nature of such ships makes it impossible to load any cargo other than that intended. In the case of single-purpose vessels, therefore, rates are not determined according to supply and demand conditions, but are fixed by contract between a shipowner and a shipper taking into account current market rates.

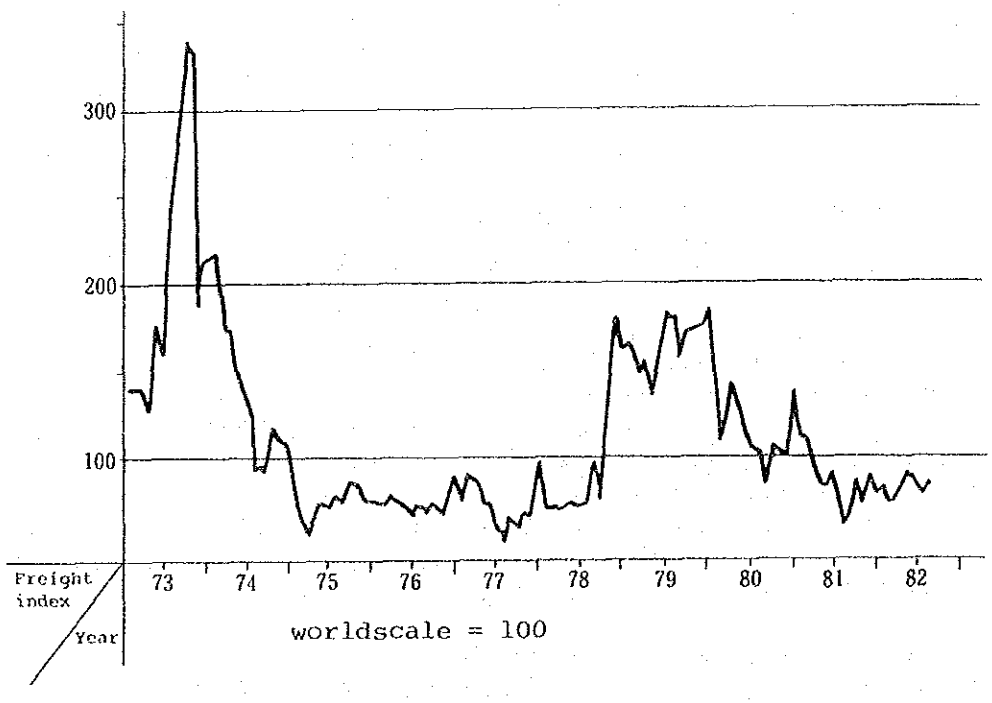
When a large single-purpose vessel is actually chartered, the port facilities at the producing and consuming points become an important consideration. If berth facilities such as loading and unloading equipments, cargo storage facilities, and depth of water in the harbor are inadequate, problems arise in loading and unloading large quantities of cargo. In this case, chartering is impossible even if low rates are contracted.

Since the quantity of shipped agricultural products and that of grain in particular is very large it is examined to transport these products in single-purpose ships. However, as the quantity of trade grain varies due to political and economic considerations, and yields vary due to weather, shippers find it difficult to forward a fixed quantity at a predetermined time. Thus the problem to be solved is how to overcome the risks borne by shippers when a long-term contract has been entered into and a single-purpose vessel chartered.

In the case of tankers, a substantial portion of oil cargo is carried under long-term contract between a shipping company and an oil company (shipper) and rates are determined by agreement similar to that involving single-purpose vessels.

However, as regards other oil cargo which is not under long-term contract, tanker rates are the same as tramper rates, in that they vary according to regularity of cargo movements. The market conditions of both also show rapid change (Fig. C-4).

Fig. C-4 Movements in the Freight Index of Tankers



Source: Institute of Shipping Economics, Bremen

Fig. C-4 shows the movements in the freight index of tankers. The freight index fluctuates sharply because petroleum (crude and refined oil) as an energy resource is highly sensitive to the political and economic climate and tanker space in the free market (that not tied by long-term contract) is in limited supply.

D. TRAMPER RATES

Tramper rates are determined according to demand for, and supply of space. However, they are not determined simply by the availability of space and quantity of cargo even though demand and supply relationships are a primary factor in fixing them.

Rates also vary according to the type, size, route and conditions of assignment of the ship which carries the cargo as well as the kind, quantity and frequency of transport of cargo which is carried. In detail:

a. Rates vary according to the type of vessel (loading capacity per one voyage). Where cereals are transported by a bulk carrier, the larger the carrier, the lower the rates.

b. Rates vary according to the kind of ship, such as ordinary cargo vessels and single-purpose ships when they are used to carry actual cargo. Iron ore, for example, can be carried by a single-purpose ship at lower rates and more efficiently than an ordinary cargo vessel. Heating tankers are used to transport coconut oil which solidify at low temperatures and thus rates are higher than those when ordinary tankers are used.

c. Rates vary according to routes even for the same cargo. They cannot be determined simply by the sailing distance. For example, if the ship sails through an area where the political situation is unsettled or has as its destination such an area, rates charged are naturally higher than those normally charged. Also, rates are affected by the changing conditions of a route.

d. Rates reflect whether a ship of the kind and type desired by a

shipper is available at the time when his cargo is shipped. In the case where a cargo of 50,000 tons is carried by one ship, rates are naturally more economical than those in the case where the cargo is transported in two lots of, say, 20,000 and 30,000 tons respectively. If a ship has to be brought from another port, this also increases the rates.

e. Rates vary according to the type and nature of cargo carried. These factors include the degree to which rates can be imputed to that cargo; cargo which contaminates hold and oil tanks; dangerous goods, and other factors.

f. Rates vary according to the quantity of cargo which is transported at any one time. This factor relates to the size and type of a ship but more obviously to the fact that the greater the quantity of cargo carried at any one time, the cheaper the rates become.

g. Frequency of transport of certain cargo is also a major factor influencing rates. The more a cargo is transported over a long period and in large quantity the more the rates are stabilized and cheaper. Rates charged on cargo which is transported on an irregular basis are, in many cases, higher and more unstable than those mentioned above.

As stated previously, the factors relating to tramper rates are diverse and the mechanism of rates determination is very complicated and difficult to understand. Furthermore, as rates are influenced by the speculation of those concerned in ocean shipping, including shipping companies, shippers and brokers, they also become subject to speculative transactions.

The Tokyo market is so large that its transactions account for about 20%, or 700 million tons, of the total world volume of cargo which amounts to about 3,500 million tons and thus it exerts a considerable influence on the world tramper market.

However, the actual situation of rates negotiation in this market is difficult to grasp accurately. Actual rates which are published are said to cover about 10% of the total volume of transactions.

Since the tramper market is a perfect free market, rates determined there are in fact a market quotation. Therefore, it is customary not to publish actual rates since it is disadvantageous to both the shipping company and the shipper to make public the price agreed between them taking into account the supply and demand situations of vessel space.

The market conditions of tramper rates, which constitute a market quotation, fluctuate sharply every month. As movements in the tanker market suggest (see Fig. C-4), market prices may fluctuate by a factor of 4 or 5. Such market conditions make it very difficult to assess market prospects.

For the reasons stated above, it is not easy to grasp the actual rates in the tramper market. Also, the actual tendencies of the tramper market can only be grasped by analogical inference based on the freight index obtainable from shipping statistics.

In conclusion, tramper rates are determined case by case taking into account overall supply and demand relationships based on the type, quantity and nature of cargo carried; the size, type and location of ships used to carry the cargo; the quality of port facilities in the areas concerned; and political, economic and seasonal factors.

Mention should also be made here of energy-efficient vessels.

Energy-efficient vessels have the distinctive features of greater fuel efficiency by reducing vessel's resistance to waves. The reason for the emergence of energy-efficient ships can be found in the necessity to reduce fuel costs after the price of crude oil soared due to the oil crisis.

At present, the rate of energy-efficient ships in service is very small (several percentage). In order to judge whether these ships will be efficiently used in the future, the following two points should be considered.

The first concerns price. With a rise in the price of crude oil, the demand for these ships will similarly rise or at least remain stable in terms of rate of ships in service, but if oil prices fall the need for them will lessen. The second point involves technology. The aim of reducing fuel consumption may be satisfied by decreasing number of engine revolution which would then necessitate the development of a durable low-speed revolving engine. On the other hand, if a high-speed revolving engine is used a system for utilizing surplus energy will be required.

These problems are concerned with fuel cost and its trend is an important determinant for the future of energy-efficient ships.

[1]-Appendix 2

RECENT WORLD SUPPLY AND DEMAND OF OILSEEDS

RECENT WORLD SUPPLY AND DEMAND OF OILSEEDS

A. Oilseeds: Recent World Supply and Demand*

(1,000 MT)

	1980/81 (Oct.-Sept.)	1981/82 (Oct.-Sept.)	1982/83 (Oct.-Sept.)
Supply			
Opening stocks**			
Soybean	19,142	16,527	15,676
Cotton seed	960	561	929
Peanut (shelled)	332	234	582
Sunflower seed	1,330	480	610
Copra	190	210	200
Total	21,954	18,012	17,987
Production			
Soybean	80,913	86,589	93,563
Cotton seed	25,408	27,931	26,725
Peanut (shelled)	10,754	13,650	11,850
Sunflower seed	13,120	14,824	16,384
Copra	4,822	4,805	4,937
Palm kernel	1,448	1,705	1,884
Castorbean	773	880	793
Total	137,238	150,384	156,136
Grand total	159,192	168,396	174,123
Demand			
Soybean	83,528	87,440	90,339
Other oilseeds	73,704	80,401	81,869
Total	157,232	167,841	172,208
Ending stocks	19,853	19,380	22,482
Of which soybean	16,527	15,676	18,990

* Figures are preliminary.
** Opening stocks are those in major countries.

Source: Oil World, March 25, 1983

B. Vegetable Oils: World Balance

(1,000 MT)

	1980 (Jan.-Dec.)	1981 (Jan.-Dec.)	1982 (Jan.-Dec.)
Opening stocks			
Soybean oil	1,245	1,920	1,969
Cotton oil	279	296	289
Peanut oil	389	315	271
Sunflower oil	801	795	759
Coconut oil	428	482	459
Palm kernel oil	88	129	107
Palm oil	837	816	785
Castor oil	90	97	86
Total	4,157	4,850	4,725
Production			
Soybean oil	13,394	13,167	13,354
Cotton oil	3,044	3,063	3,270
Peanut oil	2,588	2,305	2,882
Sunflower oil	5,036	5,035	5,303
Coconut oil	2,768	2,811	2,877
Palm kernel oil	636	615	708
Palm oil	4,603	4,837	5,695
Castor oil	356	321	326
Total	32,425	32,154	34,415
Imports			
Soybean oil	3,339	3,513	3,585
Cotton oil	443	460	513
Peanut oil	514	354	418
Sunflower oil	1,069	1,170	1,183
Coconut oil	1,118	1,414	1,285
Palm kernel oil	400	378	453
Palm oil	3,721	3,579	4,139
Castor oil	186	183	157
Total	10,790	11,051	11,733
Exports			
Soybean oil	3,301	3,570	3,577
Cotton oil	449	463	518
Peanut oil	491	346	464
Sunflower oil	1,127	1,120	1,235
Coconut oil	1,218	1,386	1,304
Palm kernel oil	388	393	467
Palm oil	3,769	3,489	4,190
Castor oil	188	184	151
Total	10,931	10,951	11,906

B. (cont'd.)

(1,000 MT)

	1980 (Jan.-Dec.)	1981 (Jan.-Dec.)	1982 (Jan.-Dec.)
Disappearance*			
Soybean oil	12,756	13,062	13,574
Cotton oil	3,021	3,067	3,234
Peanut oil	2,683	2,357	2,787
Sunflower oil	4,985	5,121	5,259
Coconut oil	2,615	2,861	2,881
Palm kernel oil	607	622	688
Palm oil	4,577	4,957	5,317
Castor oil	365	331	329
Total	31,609	32,378	34,069
Ending stocks			
Soybean oil	1,920	1,969	1,757
Cotton oil	296	289	320
Peanut oil	315	271	319
Sunflower oil	795	759	751
Coconut oil	482	459	436
Palm kernel oil	129	107	112
Palm oil	816	785	1,112
Castor oil	97	86	88
Total	4,850	4,725	4,895

* Residual of the balance

Source: Oil World

C. Oilseeds: Monthly and Annual Average Prices (1980-1982)

(US$/ton)

	Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual ave.
Soybean	1980	268	271	264	252	260	262	303	309	335	340	367	324	296
	1981	323	306	305	316	306	291	294	283	264	260	257	256	288
	1982	262	254	254	265	269	254	249	234	216	214	230	232	245
Peanut	1980	480	500	485	461	442	440	470	507	-	535	535	620	498
	1981	627	650	-	750	750	715	700	690	690	475	450	450	632
	1982	450	430	420	411	410	360	350	-	-	-	-	-	-
Sunflower seed	1980	288	287	267	257	271	276	328	330	319	315	353	368	305
	1981	346	332	328	337	342	330	317	320	289	287	306	310	320
	1982	321	326	316	329	325	293	264	252	248	244	248	252	285
Copra	1980	587	565	520	440	400	430	455	435	403	365	414	422	453
	1981	433	411	392	385	389	382	367	363	350	360	364	351	379
	1982	347	345	333	338	335	336	320	282	279	271	286	296	314
Palm kernel	1980	411	417	390	348	307	326	327	347	316	292	290	370	345
	1981	340	342	330	324	320	310	311	297	294	320	320	300	317
	1982	290	295	295	278	282	278	253	215	242	250	237	265	265

Soybean: U.S. (cif. Rotterdam)
Peanut: Africa (shelled, cif. Europe), reseller's price, since Nov. 1979
West Africa, prompt shipment
Sunflower seed: USA/Canada (cif. Rotterdam)
Copra: Phil/Indo (cif. N.W. Europe)
Palm kernel: Nigeria (cif. UK)

Source: Oil World

D. Vegetable Oils: Monthly and Annual Average Prices (1980-1982)

(US$/ton)

	Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual ave.
Soybean oil	1980	609	610	580	552	562	570	635	636	615	597	639	574	598
	1981	545	516	535	531	511	513	530	506	485	486	470	455	507
	1982	455	454	452	482	509	475	464	432	426	416	403	399	447
Cotton oil	1980	673	681	665	611	585	593	685	700	670	646	703	675	657
	1981	680	658	628	654	683	701	699	628	633	608	619	600	649
	1982	593	590	573	594	596	588	546	536	539	495	498	495	554
Peanut oil	1980	744	778	720	708	733	713	860	914	928	934	1,093	1,180	859
	1981	1,110	1,110	1,115	1,105	1,185	1,185	1,160	1,160	1,005	863	805	720	1,043
	1982	685	685	644	679	650	600	570	572	530	470	474	466	585
Sunflower oil	1980	645	653	609	553	572	562	632	657	639	631	418	720	633
	1981	690	650	650	652	669	692	685	643	588	576	590	583	639
	1982	588	566	544	575	574	555	535	504	498	475	471	458	529
Coconut oil	1980	885	840	760	660	618	630	648	620	590	580	650	610	674
	1981	614	603	574	552	563	570	585	565	535	564	570	545	570
	1982	536	526	480	502	493	497	465	412	411	406	416	429	464
Palm kernel	1980	872	850	750	655	615	620	635	609	589	560	662	615	669
	1981	629	621	605	585	610	640	617	570	535	557	553	537	588
	1982	558	537	510	515	505	481	425	382	388	367	402	428	458
Palm oil	1980	673	683	637	611	584	555	545	518	509	507	585	622	586
	1981	625	640	620	588	599	640	600	531	509	513	500	483	571
	1982	502	528	507	509	511	494	421	396	380	355	362	376	445

Soybean oil: Dutch (fob. ex-mill)
Cotton oil: U.S. PSBY (cif. Rotterdam)
Peanut oil: any origin (cif. Rotterdam)
Sunflower oil: any origin (ex-tank, Rotterdam)
Coconut oil: Phil/Indo (cif. Rotterdam)
Palm kernel oil: Malaysia (cif. Rotterdam)
Palm oil: Sum/Mal (cif. N.W. Europe)

Source: Oil World

[2] FEEDSTUFF

[2] *FEEDSTUFF*

CONTENTS

[2-1] MAIZE

A. INTRODUCTION

The maize plant originated in the tropical regions of Central and South America. As such, it is easily affected by frosts with germination being impossible below 8°C - 10°C. It actually cannot be grown if night temperatures are lower than 13°C, although the minimum temperature for growing is said to be 10°C.

Recently, varieties of early ripening seed have been developed through plant breeding, resulting in a reduction in the growing period. Consequently, maize can now be grown in the colder temperate climates of Canada, Western Europe and Japan. In these cold growing areas, maize is now planted mostly as a soiling crop.

Among all the kinds of farm products except rice, maize requires the most water. Although it can be grown in regions with annual precipitation of 250 mm to 5,000 mm, in dry regions, it is not as durable as sorghum. Any region with less than about 650 mm annual precipitation would find cultivation uneconomical. As well, during the summer growing period, monthly average precipitation of at least 100 mm is required to produce a reasonable harvest.

The major kinds of maize (or corn) sold as grain are dent corn and flint corn. Since grains of dent corn are soft, protein-rich and comparatively high-yielding, they are often used as feed. Flint corn matures early, and is resistant to vermin attack, so it is slightly more valuable as food.

The maize crop in the United States has drastically increased over the past 30 years mainly due to the development of hybrid corn. This kind of corn is now grown widely in Europe, Africa, and Japan and is beginning to be grown in other Asian countries. Varieties of hybrid corn are being developed with the aim of improving yields, heading time, resistance to disease and resilience.

In the United States, Europe and Japan, maize is used mainly as feed. In Central America, Asia (excepting Japan and Thailand), and Africa, however, maize is used mainly as food. Most of the maize

internationally traded is used for feed, and some is also used in processed foodstuffs such as glucose, starch, corn flour, corn oil, alcohol and paste.

B. PRODUCTION

I. Production Trends

1. Trends in World Production

World production has increased by a factor of approximately 1.7 in 15 years, from 227,814,000 tons in 1965 to 392,249,000 tons in 1980. Over this period, the average annual growth rate was 3.7%, the highest among all grains. World production dropped in 1974, due to a drought in the United States, a major producer. Since 1975, however, production has increased faster than ever. The major reasons for this are its relatively low cost and the increased international demand for grain feed due to the increase in demand for livestock products. There are also other reasons such as the widening acceptance of hybrid corn already mentioned, development of irrigation facilities in the United States, and expansion of cultivated areas in large-scale production regions in the United States and China.

Consequently, crop harvests have been increasing rapidly in the United States and China, while the increases in other regions have been more gradual.

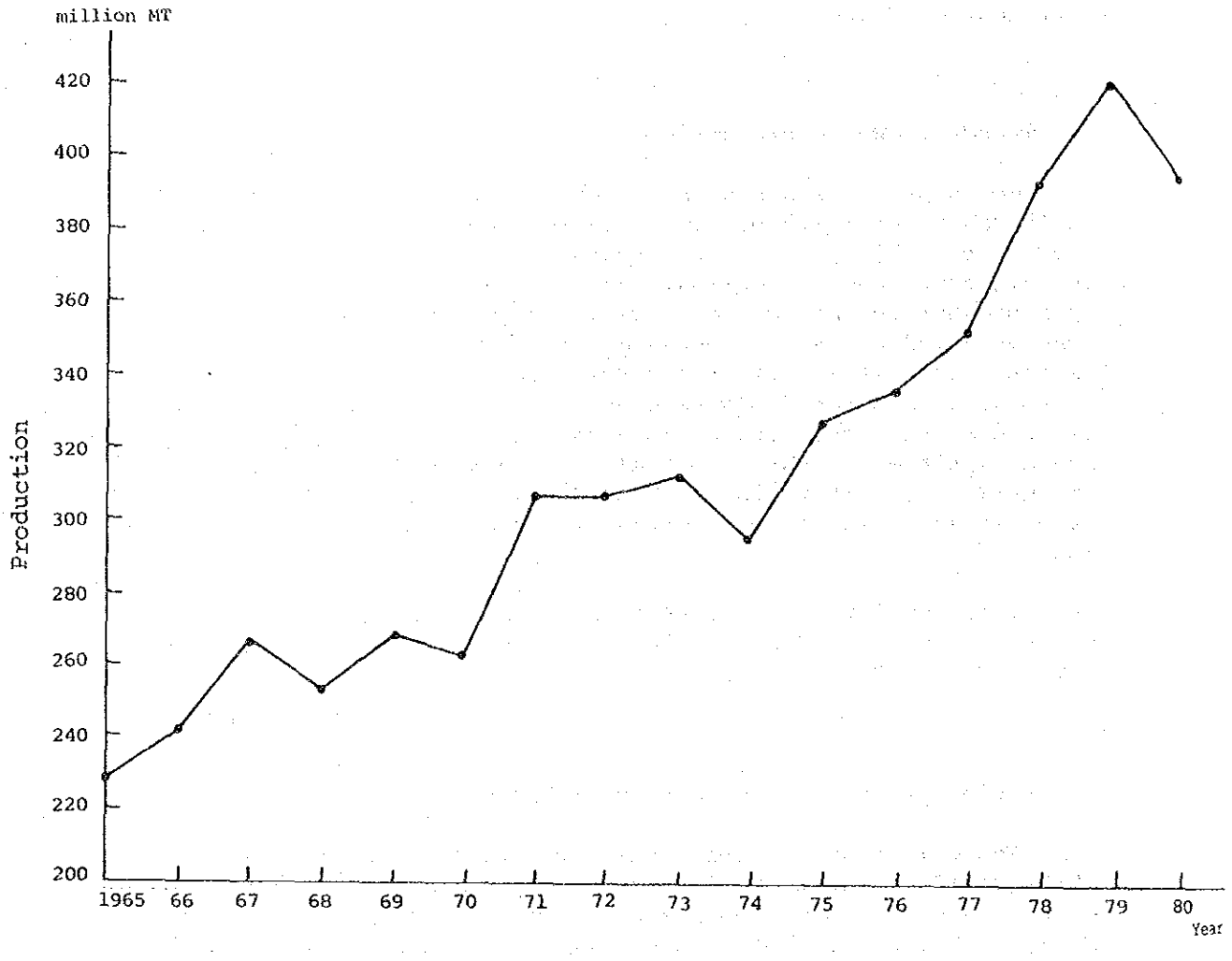
2. Production Volume by Country or Region

The United States leads the world in maize production, whether the classification is by country or by region. The average annual growth rate in the United States in the period 1965 to 1980 was 3.9%, with the rate being especially high after 1975.

In China also, production has increased greatly since 1978. Although the production share by country varies slightly from year to year, the United States produces around 45%, almost one half of total world production. The East European countries including the USSR were, until 1977, the second-largest producers, producing around 12%, followed by China with about 10%. In 1978, however, production in China increased dramatically, with its global share rising to around 15%, thereby overtaking the East European centrally planned economies and the USSR.

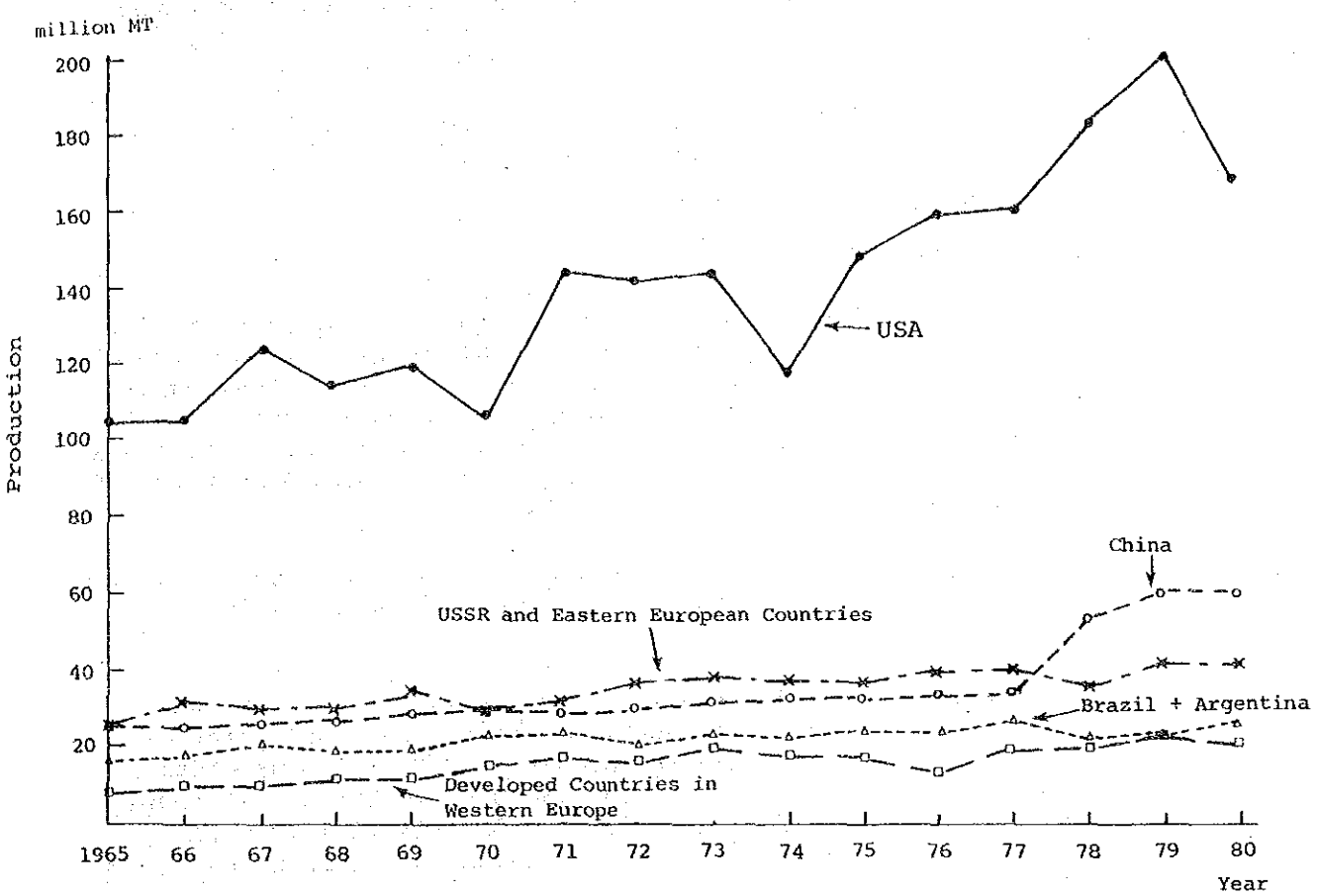
The production volumes of Brazil and Argentina combined, and those of the EC nations and other developed countries in Western

Fig. B-1 Volume of World Maize Production



Source: FAO, Production Yearbook

Fig. B-2 Volume of Production in Major Maize Producing Countries and Regions



Source: FAO, Production Yearbook

Europe are almost the same at 6-7%, with the South American countries producing slightly more.

The other major producing countries are South Africa and Thailand. Although less than 1% is produced in Thailand, the production growth rate has increased recently as a result of export promotion.

3. Production in Major Producing Countries

3.1 The United States

In the United States, which produces over 40% (185 million tons annually 1978-80) of the world's maize (400 million tons for the same period), maize and wheat are major agricultual export products. Consequently, an increase in maize production in the United States not only affects the U.S. economy, but also has a critical bearing on the world market for feed grain in terms of supply and demand and, naturally, price.

Accordingly, the U.S. Government is providing technical and economic assistance to farmers in order to improve maize production.

Over the past few years, the demand for feed grain has risen rapidly due to the world-wide increase in the consumption of livestock products. Although the amount of U.S. maize production was approximately 104.2 million tons in 1965, it has almost doubled since then, with a record 201.7 million tons in 1979 which reflected the increase in the consumption of maize as feed. The major causes for this are:

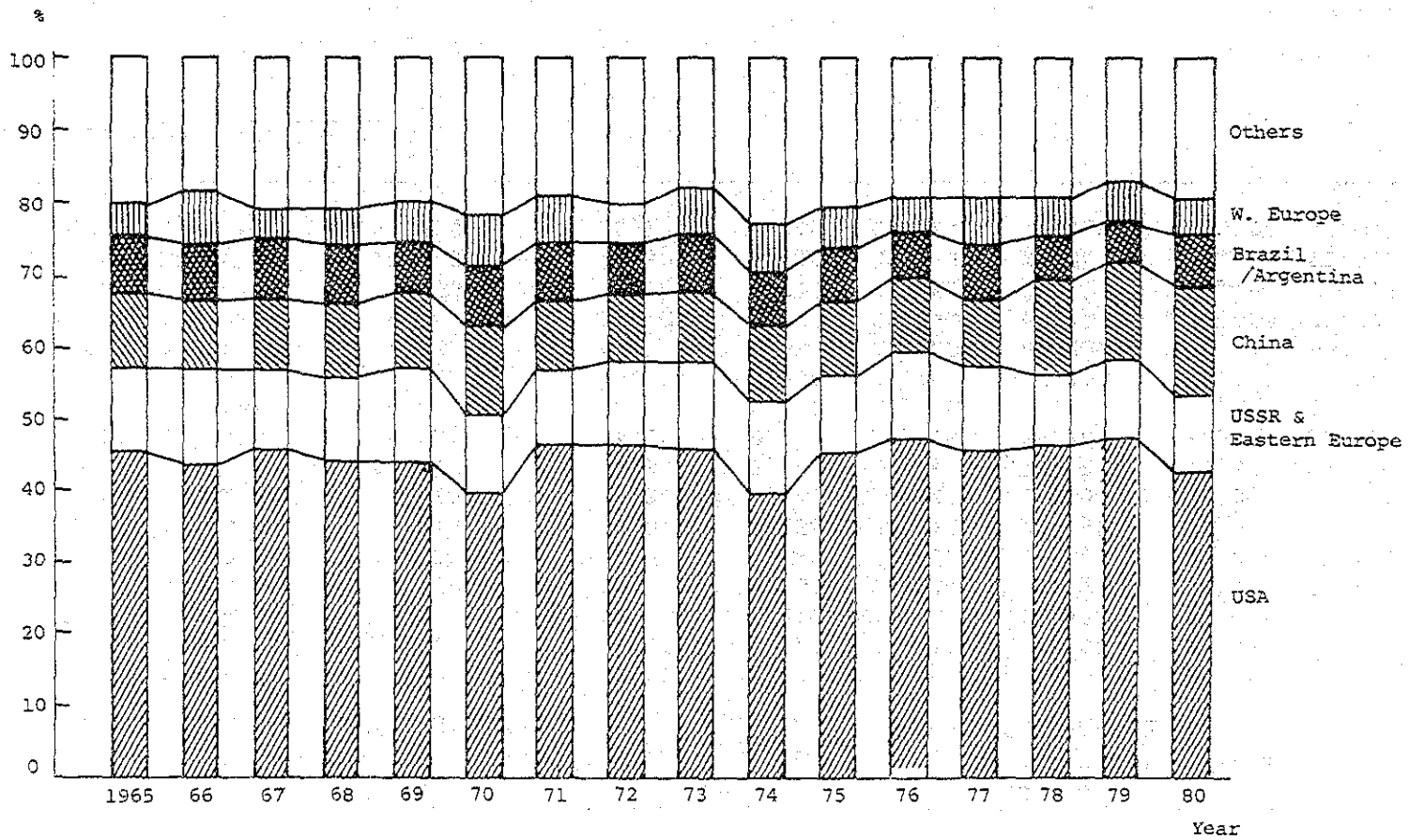
a. Increase in production per unit area and improvement of the crop through the development and spread of high-yield and desease-resistant hybrid corn.

b. Increase in maize cultivated area due to expansion of irrigation facilities in inland regions.

c. Introduction of large-scale agricultural machines, e.g., tractors and combines.

These technical improvements have been paralleled by a steady increase in the demand for maize due to the increase in demand for livestock products in the United States, Western Europe including the EC countries, and Japan, from the latter half of the 1960s; as well as by the rapid increase in maize exports to the USSR and

Fig. B-3 The Share of Production by Major Maize Producing Countries and Regions



Source: FAO, Production Yearbook

Table B-1 World Maize Production by Major Producing Countries and Regions

(1,000 MT)

	World	USA	EC and other developed countries in Western Europe	South America			USSR and East European countries	China	Others
				Brazil	Argentina	Sub total			
1965	227,814	104,217	8,938	12,117	5,140	17,257	25,252	25,541	46,609
1966	242,245	105,861	10,268	11,371	7,040	18,411	31,309	25,555	50,841
1967	266,873	123,485	10,635	12,824	8,510	21,334	29,475	26,046	55,898
1968	252,701	113,023	12,460	12,814	6,560	19,374	29,070	26,051	52,723
1969	267,601	119,056	13,855	12,693	6,860	19,553	35,460	27,245	49,432
1970	261,312	105,463	16,448	14,216	9,858	24,074	30,148	29,057	56,122
1971	305,612	143,290	18,066	14,307	9,930	24,237	31,955	30,053	58,011
1972	305,388	141,568	17,448	14,891	5,860	20,751	37,101	28,571	59,949
1973	310,391	143,435	20,552	14,055	9,700	23,755	38,369	30,384	53,896
1974	292,990	118,144	18,495	16,065	5,900	21,965	37,661	31,087	65,640
1975	324,257	148,041	18,023	16,354	7,700	24,054	37,096	32,138	68,815
1976	333,079	159,172	14,963	17,845	5,855	23,700	40,024	33,114	65,628
1977	349,676	161,485	19,787	19,122	8,300	27,422	40,778	33,615	70,696
1978	390,104	184,614	20,686	13,569	8,700	22,269	36,675	53,107	77,026
1979	418,598	201,655	22,146	16,309	6,410	22,719	42,957	60,079	73,902
1980	392,249	168,855	21,814	20,377	6,410	26,787	41,409	59,705	73,679

Source: FAO, Production Yearbook

Table B-2 Share of World Maize Production by Major Producing Countries and Regions

(%)

	World	USA	EC and other developed countries in Western Europe	South America			USSR and East European countries	China	Others
				Brazil	Argentina	Sub total			
1965	100.0	45.7	3.9	5.3	2.3	7.6	11.1	11.2	20.5
1966	100.0	43.7	4.2	4.7	2.9	7.6	12.9	10.5	21.0
1967	100.0	46.3	4.0	4.8	3.2	8.0	11.0	9.8	20.9
1968	100.0	44.7	4.9	5.1	2.6	7.7	11.5	10.3	20.9
1969	100.0	44.5	5.2	4.7	2.6	7.3	13.3	10.2	18.5
1970	100.0	40.4	6.3	5.4	3.8	9.2	11.5	11.1	21.5
1971	100.0	46.9	5.9	4.7	3.2	7.9	10.5	9.8	19.0
1972	100.0	46.4	5.7	4.9	1.9	6.8	12.1	9.4	19.6
1973	100.0	46.2	6.6	4.5	3.1	7.6	12.4	9.8	17.4
1974	100.0	40.3	6.3	5.5	2.0	7.5	12.9	10.6	22.4
1975	100.0	45.7	5.6	5.0	2.4	7.4	11.4	9.9	21.2
1976	100.0	47.8	4.5	5.4	1.7	7.1	12.0	9.9	19.7
1977	100.0	46.2	5.7	5.5	2.3	7.8	11.7	9.6	20.2
1978	100.0	47.3	5.3	3.5	2.2	5.7	9.4	13.6	19.7
1979	100.0	48.2	5.3	3.9	1.5	5.4	10.3	14.4	17.7
1980	100.0	43.0	5.6	5.2	1.6	6.8	10.6	15.2	18.8

Source: FAO, Production Yearbook

China from the early 1970s. The U.S. Government also implemented a grain price support policy to ensure that the price the producers were receiving for their products was high enough to stimulate them to continue producing.

3.2 Argentina and South Africa

In Argentina and South Africa, the largest maize exporting regions after the United States, the spread of hybrid corn and introduction of mechanized agricultural methods contributed to increased production. On the other hand, there are problems such as insufficient irrigation facilities, shortage of fertilizer and harsh weather conditions which cause production levels to fluctuate.

In South Africa poor infrastructure is a significant factor in limiting production. For example, roads to ports from which exports are shipped are not of sufficient standard.

3.3 Thailand

For Thailand, a country whose maize exports have recently begun to rise, maize production was first boosted by an increase in exports after the conclusion of the Japan-Thailand Maize Agreement in 1959, which aimed to satisfy the growing demand for maize in Japan. Thereafter, abundant land resources and manpower, a change to maize planting due to the policy of maintaining a low rice price, and the switch from the conventional shifting cultivation to more advanced methods, were all factors further boosting production.

The future expansion of production hinges on technical improvements in weeding and prevention of damage from insects and disease, and the development of feeder roads connecting already existing principal roads for collecting.

3.4 Brazil

Although Brazil produces 20 million tons of maize annually, it recently started importing maize instead of exporting it because production could not keep pace with the increase in domestic demand.

3.5 Europe and the USSR

The harvested area of maize in Europe including the USSR has been almost stable with only slight fluctuation year by year. However, yearly fluctuations of yield have been large, greatly

effecting production volumes. The crop is often affected by low temperatures and insufficient precipitation (droughts). Since the European countries and the USSR are geographically located on the border of the climatic zone regarded as suitable for cultivation, weather variations cause large fluctuations in yield. In the USSR and East European countries harvest levels are affected by insufficient water in the soil after a warm winter with little snow. Cold temperatures also severely influence yield.

In the West European countries, there are rather large fluctuations in yield. However, the yield levels have rapidly improved in recent years due to cultivation of hybrid corn with a shorter growing period, introduction of varieties suitable to the European climate, and improvement of cultivation techniques.

4. Trends in Productivity

World maize production averaged 2,300 kg/ha in 1965 and increased to 3,100 kg/ha in 1979/80, the average annual growth rate being approximately 2.2%.

Among major maize producing countries, production per unit area is the highest in the United States, where it is now over 6,000 kg/ha. The second-highest is the approximately 5,800 kg/ha in the EC countries, the difference being a little less than 5% from U.S. production. The third-highest yield, at 4,400 kg/ha, is in the developed countries of Western Europe other than those of the EC. This yield is 20% less than the figure for the EC countries. The fourth is the 4,200 kg/ha in the East European countries excluding the USSR, the difference from the third-ranked region being about 5%. Productivity in other countries, especially in Brazil and South Africa, is quite low.

In all countries, production per unit area generally increased from 1965 to 1980 due to the spread of hybrid corn and improvement in cultivation techniques such as fertilizing.

There have been large fluctuations in productivity, especially in the United States, the USSR and Argentina. In the United States and Argentina, droughts and heat waves are the main causes of poor harvests. In the USSR, however, the crop is often affected by low temperatures (cold weather damage) because maize is grown in the far northern regions.

5. Production Costs

Data on maize production costs were obtained only for the

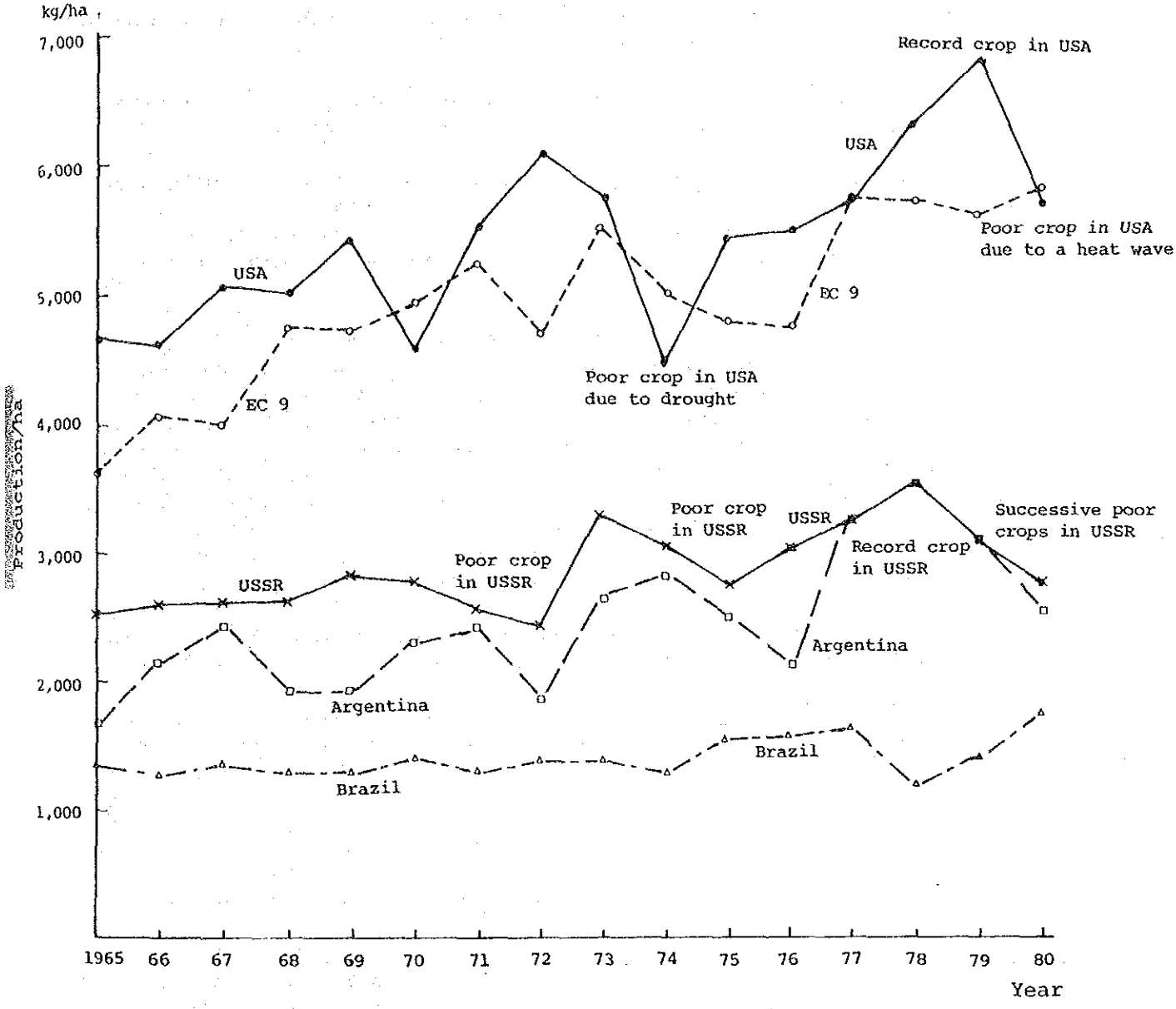
Table B-3 Production per Unit Area in Major Maize Producing Countries and Regions

(kg/ha)

	World	Developed countries				Developing countries			Centrally planned economies			Remarks
		USA	EC	Other countries in W. Europe	South Africa	Brazil	Argentina	Thailand	USSR	Eastern Europe	China	
1965	2,293	4,649	3,574	1,742	1,008	1,381	1,678	1,819	2,528	2,169	2,628	
1966	2,339	4,589	4,022	1,951	1,115	1,307	2,150	1,902	2,606	2,891	2,628	
1967	2,514	5,026	3,956	2,142	1,780	1,383	2,446	1,842	2,629	2,586	2,680	
1968	2,405	4,989	4,718	2,313	949	1,337	1,942	2,355	2,635	2,555	2,680	
1969	2,542	5,391	4,699	2,641	958	1,315	1,929	2,769	2,869	3,012	2,692	
1970	2,437	4,544	4,922	2,817	1,143	1,442	2,330	2,603	2,812	2,749	2,761	
1971	2,739	5,528	5,230	3,096	1,513	1,336	2,442	2,257	2,580	2,988	2,830	
1972	2,792	6,092	4,680	3,025	1,674	1,413	1,862	1,319	2,450	3,419	2,714	Poor crop in USSR
1973	2,785	5,727	5,523	3,386	1,032	1,418	2,649	2,343	3,279	3,245	2,858	
1974	2,510	4,478	5,013	3,268	1,760	1,339	2,840	2,260	3,070	3,206	2,938	Drought in USA
1975	2,849	5,420	4,766	3,342	1,574	1,562	2,508	2,426	2,763	3,710	2,990	Poor crop in USSR
1976	2,857	5,517	4,787	3,159	1,277	1,597	2,117	2,229	3,069	3,665	2,999	
1977	2,952	5,700	5,763	3,734	1,653	1,637	3,278	1,458	3,270	3,712	2,962	
1978	3,068	6,342	5,747	3,731	1,500	1,220	3,612	2,014	3,531	3,693	2,790	
1979	3,315	6,883	5,639	4,236	1,457	1,442	3,107	2,187	3,139	4,346	2,981	Poor crop in USSR
1980	2,995	5,711	5,858	4,491	1,672	1,782	2,625	2,017	2,771	3,996	2,980	Heat wave in USA, poor crop in USSR
Average annual growth rate	2.2%	2.2%	3.0%	6.3%	2.8%	1.3%	2.9%	0.9%	0.9%	3.6%	0.9%	

Source: FAO, Production Yearbook

Fig. B-4 Production per Unit Area in Major Maize Producing Countries



Source: FAO, Production Yearbook