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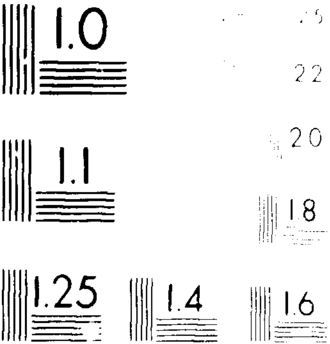
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A REPORT ON THE PROCESSING OF OILSEEDS IN DEVELOPING COUNTR.ES

A study undertaken by the Tropical Development and Research Institute

January 1984

TDRI Contract No. C321 Tropical Development and Research Institute
Overseas Development Administration
127 Clerkenwell Road
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Acknowledgements

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Notes

In this report the term 'oilcake' has been used to include both oilcake and oilmeal. The term 'crushing' includes solvent extraction as well as mechanical expression.

The regional country groupings ie Developed Countries, Developing Countries and Centrally Planned Economies are those designated in the FAO Production/Trade Yearbooks.

All units are in metric tonnes.

Where data are omitted from tables ... indicates that information is not available and - denotes a nil or negligible amount.

Abbreviations

ADB	Asian Development Bank
APCC	Asian and Pacific Coconut Community
CPE	Centrally Planned Economies
EEC	European Economic Community
FAO	Food and Agriculture Organisation (of the UN)
FAO/IGO	FAO Intergovernmental Group
GDR	German Democratic Republic
ITC	International Trade Centre (UNCTAD/GATT)
LDC	Less Developed Country
SCOPA	Seed Crushers and Oilseed Processors Association
TDRI	Tropical Development and Research Institute
TNC	Transnational Corporation
UCAP	United Coconut Association of the Philippine Inc
UNIDO	United Nations Industrial Development Organisation
USDA	United States Department of Agriculture
FFB	Fresh Fruit Bunches (Oil Palm)
ffa	free fatty acids
Kg	Kilogram
pa	per annum

Introduction

1 Product Coverage

This study has been undertaken by the Tropical Development and Research Institute (TDRI) under contract to the United Nations Industrial Development Organisation (UNIDO). In July 1983, Mrs T S Buckle of the Sectoral Studies Divison of UNIDO contacted TDRI with a view to updating the Draft World-Wide Study of the Vegetable Oils and Fats Industry which was presented to the First Consultation Meeting on the Vegetable Oils and Fats Industry in 1977.

Because of its already heavy staff commitment TDRI was not able to undertake a revision of the entire document but, with some reservations concerning the paucity of data and the lack of time, TDRI agreed on the 26th September to accept a contract to cover Chapters IV and V of the study and to provide an overview of all six chapters. The terms of reference for the study as a whole were forwarded from UNIDO and were as follows:

I. Importance of the vegetable oil and fats industry relative to other branches of the food-processing industry in terms of: production, annual growth rate, share of developing countries in production, in trade, nutrient supplied by (calories, proteins). In main producing countries relative importance within the manufacturing sector and the FPI sub-sector (value added composition), backward and forward linkages, inter-industry linkages compared with other food industry sub-sectors.

II. Oilseed production*

1. Geographical distribution
2. Growth rates by commodities and regions
3. Demand-supply situation
4. Oilseeds prices (consider substitutability)
5. Prices of substitutes
6. Progress made in overcoming constraints detected in the past in agricultural production of oilseeds for industrial processing in developing countries.
7. Share of tropical seeds in the world production.

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* Oilseeds to be dealt with are: oil palm, palm kernels, coconut, groundnuts, cottonseed, sesame, soya, sunflower and safflower. Olive oil, when applicable

III. Trade in oilseed and oilseed products (seeds, cakes, vegetable oils, oil products, compound feeds)

1. International trade on global level
2. Contribution of developing countries by groups*
3. Past trends and future prospects
4. Imports by developing and developed countries
5. Domestic, regional and sub-regional present and potential markets in the developing world - trade among developing countries
6. Export opportunities for developing countries to:
   - Developed countries
   - Developing countries
   - Constraints for

IV. Processing of oilseeds

1. Present distribution between developed countries and developing countries - Trends in
2. Distribution according to level of technology in developing countries**
3. Advances and or improvements made in four different levels of technology
4. Economics of small scale production
5. Technological innovations made in uses of oilseed products in developed countries
6. Installed capacity:
   a. share of developing countries according to technology
   b. raw materials production/installed capacity balance
   c. % utilisation of installed capacity
      i) trends in
      ii) constraints for full utilization
      iii) local spare parts and machinery supply - trends in
7. Role of transnationals in the industrial processing of vegetable fats and oils. Past trends and future prospects.

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* Grouping should be done with respect to their position as importers, producers, exporters of raw materials, intermediate and end products in a manner similar to the one used by TPI in the 2nd report on Vegetable Oils and Fats.

** Village scale, small expellers, medium-large expellers solvent extraction

V. Integrated development

1. The strategy of integrated development applied to the vegetable fats and oils agroindustry in developing countries.
2. Trends in its application
3. Identification of opportunities for application at national, binational or subregional level.

VI. Consumption

1. Consumption of vegetable fats and oils and oil products in developed and developing countries
2. Trends in
3. Its relationship with income growth and prices in developing countries.

VII. Conclusions

Subsequently to the acceptance of the terms of reference Mr Alan Marter of TDRI visited FAO to gather data for the study and there had a meeting with Mrs T S Buckle and Mr T Spina of UNIDO, also visiting FAO. The terms of reference were discussed at length and the following points agreed on:

1) Rapeseed should be added to the list of oilseeds stipulated in the terms of reference. Oilseeds crops to be covered are therefore oil palm, coconut, groundnuts, cottonseed, sesame, soyabean, sunflower seed, safflower seed and rapeseed.

2) As this report was essentially concerned with vegetable oil for human consumption, TDRI would not cover oilcake except in so far as the oilcake industry was an element in Integrated Development Strategies.

3) TDRI would not cover edible products derived from non-crushing technology eg desiccated coconut, coconut cream, tofu etc.
Neither would TDRI cover oilseeds for direct human consumption except in cases where problems were raised for the crushing industry, eg where groundnut supply to the crushing industry was affected by diversions to direct consumption.

4) TDRI would not take the study "downstream" of refined oil except for those processes eg fractionation and hydrogenation, normally carried out at the refinery.

5) Countries should be grouped, if possible, with respect to their position as importers/exporters of oil and oilseeds, as stipulated in the terms of reference. It was however recognised that in view of the time constraints, this would prove difficult. Appendix Table 11 lists all the

oil trading countries covered in the FAO Trade Yearbook according to whether they are in surplus or deficit and the implications have been worked into the text as appropriate particularly in Section 4.4. TDRI has not however extended this analytical concept further in the report, partly because of time constraints and partly because the earlier chapters of the report, written by UNIDO, were not available until after TDRI's own in-house deadline for report completion had passed. It was therefore decided that rather than reconceiving the TDRI report on a surplus/deficit basis, the FAO country groupings would be retained. This had the benefit of simplicity.

As regards the actual oilseeds to be covered it must be pointed out that there is something of an "overlap" problem when discussing crushing capacities. It depends very much which seed is being crushed when crush capacity is being discussed. For example, a given plant will crush significantly less sunflower seed than it will soyabean in the same time period. As practically all the countries in the World will have their national crush made up by different proportions of different oilseeds, no one crush capacity figure is directly comparable with another. Each figure quoted is furthermore issued by different sources, often from an institution in the country in question, and the assumptions behind the calculation of the figure are often unknown.

In this report a 300 day year has been used as the basis for calculating crushing capacity. Many of the published figures, however, do not stipulate the year on which they are calculated. Furthermore some countries crush on the basis of an 8 hour day, others 12 hours, others 24; some work for 24 hours a day for three months of the year. There is therefore considerable scope for error here and these methods of estimation and calculation must be borne in mind when using data on crush capacity.

2 Chapter Outline

Following acceptance of the terms of reference, TDRI forwarded to UNIDO a draft layout of Chapters 4 and 5. This and the section headings in it has been very broadly adhered to although, where it was thought that change would help either readability or coverage, headings have been altered appropriately.

TDRI later submitted an interim progress report which elaborated on the original report structure. This merely outlined the direction of research and the topics being covered.

The basic approach behind the original structure was to investigate capacities and capacity utilisation in all the crushing countries of the world. It was recognised from the outset that this task would involve considerable difficulties and that there would be many gaps in the data collected. It was part of the rationale of the work that these gaps, and hence areas for further research, be identified; this in the general context of an overall study designed to provide information to developing countries for "planning the development of the subsector at national and, if possible, at sub-regional levels".

Sections 4.1, 4.2 and 4.3 are essentially descriptive. The aim is to provide the available data as objectively as possible. Comment and analysis of the data is undertaken in Sections 4.4 and 4.5.

Summary

Crushing

1. An analysis of global crush by region and by oilseed is presented (Section 4.2). It is shown how Developing Countries accounted for 30 per cent of the 1981/2 global crush of 127 million tonnes. This latter figure does not include oil palm for which a separate analysis is included and in which it is shown that developing countries accounted for nearly all the 20 million tonnes of oil palm crushed in 1981.

2. In Asia oil palm was the major oilseed crushed (45 per cent of total) followed by copra and groundnuts; in Africa oil palm took a still bigger proportion of total crush (63 per cent), followed by cottonseed and groundnuts; while in Latin American the major seed crushed was overwhelmingly soyabean (70 per cent) followed by sunflower seed and cottonseed.

3. Trends in global crush show a 33 per cent growth between 1976/7 and 1981/2 although, again, oil palm is not included in this analysis. The considerable variations in the rates of growth by region are also discussed (Section 4.2).

4. The rate of growth in Asia was only 21 per cent and so Asia's share of global crush can be seen to have declined. It is known however that oil palm crush in Malaysia and Indonesia, which together accounted for nearly 70 per cent of global oil palm crush in 1981, has grown considerably over the period under review. Asia 'declining share' must therefore be seen in this context.

5. In Africa average oilseed crush shrank by 10 per cent during the period under review. Although oil palm is also significant in this continent it is believed to be declining in the largest producing country, Nigeria. These figures therefore clearly indicate a decline in oilseed processing in Africa in recent years.

6. In Latin America crushing figures are only available for four countries. These all exhibit a healthy growth of 45 per cent and more. Indeed it is the dynamism of these countries that brings the developing country average growth rate up above that of the world as a wole.

Processing

7. Section 4.3 reviews oilseed processing and how it relates to capacity on both the micro and macro level.

8. The three basic levels of processing - traditional, modern village and industrial - are discussed and all available information on global crush and global crush capacity is presented according to five designated regions.

9. Total crush capacity for the Developing Countries for which data has been found was 117 million tonnes. The corresponding crush figure for these countries was 56 million tonnes.

Estimates have been made however to allow for missing data and capacity and actual crush figures for the developing world are estimated at 125 million tonnes and 60 million tonnes respectively. This represents a capacity utilisation figure for the developing countries of 48 per cent.

10. The major developing country crushes were Brazil, Malaysia, India and Indonesia.

11. Because of the lack of data in the non-developing world it was not possible to estimate a figure for global crush capacity. Global crush is put at 192 million tonnes although this figure is essentially a best estimate. The method of and problems with its calculation are discussed in full in Section 4.3 and in the footnotes to Appendix Tables 4-8.

12. Although the data is patchy it is clear that capacity utilisation in the Developing World is considerably less than in the Developed World and the Centrally Planned Economies. In Africa capacity utilisation was put at 32 per cent, in Asia 45 per cent and in Latin America 51 percent. By contrast capacity utilisation in the rest of the world varies between a low of 55 per cent in Portugal to over 85 per cent for several countries.

13. The countries with the biggest crushes in the world were the USA (18 per cent of global crush, Brazil (7 per cent), China (7 per cent) and Malaysia (6 per cent).

Refining

14. Data on refining is reviewed where it has been found. It is only in Asia that the cummulative data has much meaning. Clearly consideable work is necessary if capacity and actual refining totals by region are to be calculated.

15. Sectins 4.2 and 4.3 highlight the serious deficiencies in data on oilseed processing worldwide. Clearly if a more detailed analysis is to be undertaken, it will be necessary to gather further information. Data on refining is particularly sparse and it is believed that further study in this area would be valuable.

Factors affecting capacity, utilisation and extraction efficiency

16. Economic and technical factors affecting levels of capacity, utilization and extraction efficiency are discussed; economic factors at a macro level and technical issues at micro/plant level. (Sections 4.4.2 and 4.4.3).

17. Macro economic data indicate that Developing Countries have largely switched to domestic crushing of oilseeds rather than export for crushing elsewhere. The only major exception is Argentina. Most Developing Countries in fact have net vegetable oil deficits of varying sizes and the relatively low level of crushing capacity utilization in such countries stems primarily from limited domestic oilseed production (Section 4.4.2.3).

18. Difficulties in obtaining adequate domestic oilseed supplies are exacerbated in some countries, especially in east Asia, by non-crushing oilseed requirements eg. for direct human consumption of oilseeds or non-crush oilseed products.

19. Domestic oilseed defficiencies could be offset by imports but in practice most deficit countries import vegetable oils. This is primarily because oil available on international markets is highly price competitive and includes oils from a number of major Developing Country exporters. A second reason is the limited domestic demand for oilcake in most oil deficit countries stemming from relatively underdeveloped intensive livestock feed industries.

20. Commercial sector crushing levels are further constrained in a number of countries by the widespread existance of 'traditional', village level, small scale extraction which are very inefficient in terms of oil extraction.

21. Technical constraints largely influence capacity utilzation and/or extraction efficiency (Section 4.4.3). Both of the latter are primarily constrained by poor maintenance scheduling and spare part availability and quality, together to a more limited degree by problems of oilseed storage.

22. Analysis of economic and technical factors suggest that the most crucial areas for Developing Countries to improve their oilseed processing industries are via expansion of domestic oilseed production and improvement of existing crushing capacity operation especially with regard to maintenance and spare parts.

23. Where 'traditional' small scale extraction is widespread, further opportunities may exist through the adoption of new small scale expeller technology. Whilst viability can only be determined by individual technical and financial analysis, field evidence suggests that numerous opportunities for successful adoption exist.

Trans National Corporations

24. At the other end of the processing scale Developing Countries may be concerned with the operation of Trans National Corporations (TNC's) (Section 4.5.3). Whilst it is possible to sketch the opertions performed by TNC's, industrial secrecy and the consequent lack of information precludes any detailed appraisal.

25. TNC performance can only be judged in the context of detailed country by country studies but final conclusions will stem crucially from the view adopted towards agreements reached between host country governments and TNC's.

Technical Innovation

26. Recent developments in oilseed processing technology and oilseed products are described (Section 4.5.4 and 4.5.5), those most relevant to Developing

Countries being innovations in oil palm fractionated products and the technology required for shipping derivatives. However, for a large number of Developing Countries developments in relatively 'sophisticated' end products are of little current relevance, as many are still seeking to maintain and improve consumption of basic food products such as cooking oil and solid fats.

27. Technical innovations are however increasingly important for the relatively small number of major exporting Developing Countries since relatively small domestic markets for 'sophisticated' products can be supplied as a sideline to export markets.

Integration

28. Chapter 5 is concerned with the nature and opportunities afforded by integration in the oilseed sector. The concepts involved are first defined in order to improve the clarity of discussion which in other sources is often clouded and confused (Section 5.1).

29. Because of the absence of information it is not possible to provide a detailed discussion of integrated development and associated strategies. However, examples are given of both vertical and horizontal linkages which form part of the integrated development processes (Section 5.3).

30. Opportunities for integration stem in part from the matrix of factors affecting production, processing and marketing; as examples, certain oilseeds such as oil palm 'naturally' lend themselves to vertical integration, whilst the presence of a significant export sector tends to encourage TNC participation and associated horizontal and vertical linkages.

31. The production, processing and marketing matrix may also be used as a means for identifying suitable countries for study with regard to their potential gains from integrated development. On the basis of a preliminary examination, countries with large oilseed sectors which nonetheless are confronted with domestic vegetable oil deficits would appear to warrant priority in any future programme of studies.

Chapter Four The Processing of Oilseeds

4.1 Introduction

4.1.1 General Outline

This chapter is concerned with oilseed processing with special reference to Developing Countries and to the major edible oilseeds. Limitations to the available data however mean that much of the chapter covers processing only up to the crushing stage.

The chapter commences with the definition of the major concepts relating to processing capacity and to scale of enterprise. Subsequent sections continue with a discussion of current actual crushing levels on a regional and country basis. Crushing performance is then related to levels of capacity in order to derive utilisation rates. Technical and economic factors which contribute to the pattern of capacity and its utilization, as revealed by the data, are then discussed. Economic factors stem primarily from considerations of macro issues whilst technical appraisal is related to stages of the crushing and refining process at the micro level.

The chapter concludes with a selection of topics relating to the performance of the crushing industry in Developing Countries and includes an analysis of the importance of scale of enterprise as well as a description of recent technical innovations in processing and products.

4.1.2 Definition of Capacity and Utilisation

The same items of modern oil extraction plant are available world wide. The plant must, however, be fitted into a tremendous variety of cultural environments and can therefore be operated in many different ways. The majority of the world's oilseed crops are seasonal and to meet the problems this engenders, plants can be employed in several different ways: storage can be provided so that seed is available for crushing all year round; different oilseeds can be processed at different times of the year; or the plant can be operated for just a few months of the year. As examples, many of the world's soya bean solvent plants run on soya all year by buying in seed throughout the year. In Mexico soya and safflower seed are harvested at different times of the year and plants are constructed to process soya for up to 7 months and safflower for the remainder of the year. In the Kathmandu valley of Nepal rapeseed mills work for a few months of the year only.

Coconuts and oil palm bunches are harvested throughout the year and are always available fresh for processing locally. With oil palm there are several peaks and troughs and a mill is designed to cope with the peak crop level available.

Modern oil extraction plants are designed for continuous use. There operation is, however, difficult in some parts of the world. In the Pacific it is usually possible to get a factory running 24 hours/day for 5½-6 days of the week. No plant operates on Sunday. In Central America and parts of South America it is difficult to run plants overnight but it is possible to have long shifts running 12 hours/day.

Generalisations have to be made and, as was said in the Introduction, this report assumes a 300 day year, having three 8-hour shifts per day which gives a plant running time of 7,200 hours per year. Clearly the same plant operating for only 8 hours per day would only run for 2,400 hours, or one third of its capacity.

When identifying actual capacity levels, two further problems arise. The first is that most oilseed crushing equipment can handle a range of oilseeds (with or without minor equipment modifications). However the throughput rating differs with each oilseed and no uniform measurement is applicable. Secondly, stated crushing capacity in a number of countries includes a significant level of mothballed equipment. Whether or not such equipment could be made operational is a moot point in many cases.

4.1.3 Definitions of Scale

Processing techniques from village to industrial scale are discussed in detail in Section 4.3.2. Defining scale is, however, extremely difficult when the process range lies between a few kilos and over one million tonnes per year. Certain arbitrary decisions have to be made particularly in defining the cut off point between one scale and another.

The following values have been selected and relate more to equipment capacity rather than hours of operation.

Type	Hours per year	Capacity per hour	Capacity per year
Village	100-1,000	1kg-15kg	100kg-15 tonnes
Small industry	2,000	25kg-10 tonnes	50-20,000 tonnes
Medium industry	2,000-7,200	10 tonnes-25 tonnes	20,000-180,000 tonnes
Large industry	7,200	25 tonnes-170 tonnes	180,000-over 1,000,000 tonnes

4.2 Global overview of processing

4.2.1 Introduction

This section describes the basic features of the global crush by country, by region and by seed and over time. It is based on the actual crush figures published by Oil World which unfortunately do not include oil palm. Consequently a derived figure for oil palm crush has had to be included but although this is useful in providing an overall picture of global crush it was felt that a total so derived, if used as a basis for analysis, might cause more problems than it solved. Consequently the analysis in this section is largely based on the Oil World figures as they stand, (see Appendix Tables 1 and 2) while comment on oil palm has been introduced on the basis of the derived oil palm crush (shown in Appendix Table 3).

4.2.2 Crushing at global and regional levels

4.2.2.1 Analysis by country

Appendix Tables 1 and 2 are the basis for an outline of the scale and nature of current oilseed crushing. In Appendix Table 1 average total crush for the years 1981 and 1982 is shown for 51 countries and for the country grouping of Asia, Africa, Latin America, Developed Countries and Centrally Planned Economies. Total global crush was 126.9 million tonnes, 61.4 million tonnes, or 48 per cent, of which was accounted for by crushings in the Developed Countries. The next largest crushing area was the Centrally Planned Economies with 26.9 million tonnes or 21 per cent of total crush. They were followed by the countries shown in Latin America (15.7 per cent) Asia, (12.9 per cent) and Africa (1.9 per cent). Developing countries therefore accounted for 30.4 per cent of all crushings.

Appendix Table 2 shows crushings by seed and it can be seen that, in 1982, the major component of the Developed Country crush was soyabeans (79 per cent). The figures have been extracted from Oil World and are summarised below in Table 1 for all the other regions covered. [Unfortunately these figures do not include oil palm and a separate analysis has had to be conceived to bring in this commodity (see below).]

Table 1 Regional crushings, by seed 1982 (not including oil palm)

Region	Oilseed	Percentage of total crush 1982
Asia	Cottonseed	20.2
	Copra	21.4
	Groundnuts	19.7
	Rapeseed/Mustardseed	14.9
	Soyabean	12.6
	Palm kernels	5.5
Africa	Groundnuts	33.6
	Cottonseed	35.6
	Palm kernels	8.4
	Sunflower seed	13.5
Latin America	Soyabean	77.5
	Cottonseed	8.5
	Sunflower seed	11.4
Centrally Planned Economies	Soyabean	25.5
	Cottonseed	27.5
	Sunflower seed	22.1
	Rapeseed	18.9

The country with the largest average crush in 1981-2 was easily the United States with 33.8 million tonnes or 26.7 per cent of global crush. The next largest countries were Brazil with 14.3 million tonnes or 11.3 per cent of global crush, China with 13.2 million tonnes, (10.4 per cent), and the USSR with 9.4 million tonnes (7.4 per cent). The EEC accounted for a further 12.1 per cent of global crush.

The main oilseeds crushed in these countries in 1982 were:-

USA;	soyabeans - 82 per cent
Brazil;	soyabeans - 89 per cent
China;	rapeseed - 29 per cent; cottonseed - 26 per cent
	soyabeans - 25 per cent

USSR;	sunflower seed - 36 per cent; cottonseed - 43 per cent
EEC;	soyabeans - 72 per cent; rapeseed - 14 per cent

As has been stated these figures do not include oil palm crush and, as a consequence, major seed crushing countries in whose total crush oil palm is a major component, such as Malaysia, Indonesia and Nigeria, appear to be much smaller crushers than they actually are. The figures are therefore not accurate as a description of global crush. However no better source of comparable data exists and these figures have had to be used as the basis for the analysis in this section.

The exclusion of oil palm crush is however a serious omission which distorts the overall picture and it was thought useful to derive an oil palm crush in order that a more complete picture be presented even if this cannot be used as the basis for analysis.

Appendix Table 3 presents oil palm crush figures derived for 12 of the major crushing countries from FAO Production data. Palm oil production in these countries totalled 5,057,000 tonnes and represented 94% of total world palm oil production. Of this 5,057,000 tonnes, 71 per cent is produced in Asia and 23 per cent in Africa so it is only in these regions that the exclusion of oil palm crush from the Oil World figures materially distorts the picture. Oil palm crush, calculated from the above palm oil production figur, was 20,228,000 tonnes and, if this figure is included with the Oil World figures for the crush of other oilseeds, the breakdown of vegetable oil crush in these areas will be obviously quite different from that presented above. It is summarised below.

Table 2: Regional crushings by seed, including oil palm

Region	Oilseed	Percentage of total crush
Asia	Cottonseed	11.0
	Copra	11.7
	Groundnut	10.7
	Rape/mustardseed	8.1
	Soyabean	6.9
	Palm Kernels	4.2
	Oil palm	45.4

Region	Oilseed	Percentage of total crush
Africa	Groundnuts	12.6
	Cottonseed	13.3
	Palm Kernels	3.2
	Oil Palm	62.7
	Sunflower seed	5.0

In Asia and Africa oil palm has now emerged as overwhelmingly the major "oilseed" by size of crush. In Asia the tonnage crushed is nearly four times that of the next most commonly crushed seed, copra, while in Africa it is nearer five times that of the next seed, cottonseed.

4.2.2.2 Analysis by seed

Using the Oil World figures presented in Appendix Table 2, soyabean is clearly seen to be the world's major oilseed. It has been shown above however that oil palm, not included in the Oil World figures is the major seed in both Asia and Africa. Using the global oil palm crush derived in Appendix Table 3 with the Oil World figures, global crush by seed breaks down as follows:

soyabean	49 per cent
oil palm	13 per cent
cottonseed	13 per cent
rapeseed	8 per cent
sunflower seed	8 per cent
groundnuts	4 per cent
copra	3 per cent
palm kernels	1 per cent
sesame seed	1 per cent

a) Soyabeans

Soyabean crushing is very much a feature of the developed countries which account for 66 per cent of crushings. Of a total 74.4 million tonnes of soyabeans crushed in 1982, 28.5 million tonnes or 38 per cent were crushed in the USA alone. A further 16 per cent was crushed in the European Community. Brazil is however also a major crusher of this seed and accounted for 17 per cent of crush in 1982. A further 6 per cent was crushed in China in that year.

b) Oil palm and palm kernels

Oil palm crushing by comparison is entirely a feature of developing countries, and overwhelmingly of those in Asia and Africa. Malaysia is easily the biggest crushing country with 55 per cent of oil palm crush (see Appendix Table 3) followed by Indonesia (14%) and Nigeria (13%). China, the Ivory Coast and Zaire are also significant producers.

Obviously these countries are also major crushers of palm kernels. 940,000 tonnes of palm kernels were crushed in the Asian countries in 1982, that is 70 per cent of global palm kernel crush. 17% was crushed in Africa. Again the single largest country was (West) Malaysia with 805,000 tonnes or 65 per cent of global crush in 1982. Nigeria was also a major crusher with 156,000 tonnes in that year.

c) Cottonseed

Crushing of cottonseed is less region specific than with some of the other oilseeds described. 18.9 million tonnes were crushed worldwide in 1982 and the Centrally Planned Economies were the largest crushing group with 42 per cent of total. The USSR and China were both major crushers (22 per cent and 20 per cent respectively in 1982). A further 25 per cent of cottonseed crushed is accounted for by the Developed Countries, amongst which is the USA, the world's largest cottonseed crusher which crushed 4.4 million tonnes or 23 per cent of total in 1982. Crush figures for the other regions were as follows:- Asia, 3.5 million tonnes or 18 per cent; Latin America, 1.7 million tonnes or 9 per cent; Africa, 979,000 tonnes or 5 per cent. The biggest developing country crushers are India (9 per cent), Pakistan (6 per cent), Brazil (6 per cent).

d) Rapeseed

Global crush of Rapeseed in 1982 was 12.8 million tonnes. The largest crushing areas were the Centrally Planned Economies with 5.5 million tonnes or 43 per cent of total and the Developed Countries with 4.7 million tonnes (37 per cent of total). The largest crushing countries were China with 34 per cent of global crush, India (18 per cent) and Japan (9 per cent). The EEC accounted for a further 18 per cent of global crush.

e) Sunflower seed

12.2 million tonnes of sunflower seed were crushed in 1982. The largest crushing group of countries were the Centrally Planned Economies with 53 per cent of total crush. The Developed Countries and Latin America accounted for a further 20 per cent and 19 per cent respectively. The individual countries with the largest crush were the USSR (3.4 million tonnes), Argentina (1.8 million tonnes), China (998,000 tonnes) and Turkey (531,000 tonnes).

f) Groundnuts

Global groundnut crush was 6.4 million tonnes in 1982. Again Asia is the largest crushing group, accounting for 53 per cent of total, the overwhelming share being in India which, with 3.4 million tonnes in 1982, was the world's largest crusher of this oilseed. Centrally Planned Economies accounted for a further 21 per cent of crushings in 1982 by virtue of the 1.4 million tonnes crushed in China, the second largest.

g) Copra

Copra crushing is dominated by the Asian countries which crushed 3.7 million tonnes or 87 per cent of total copra crush in 1982. The biggest crusher was easily the Philippines with 2.1 million tonnes or exactly half of world crush. Indonesia was the second largest crushing country with 23 per cent of global crush.

h) Sesame seeds

Asia is also the dominant crushing region for sesame seed. 806,000 tonnes were crushed worldwide in 1982, 43 per cent of it in India. A further 39 per cent was crushed in China giving these two countries a complete dominance in the crushing of this oilseed.

4.2.3 Trends in crushing

4.2.3.1 Analysis by country

Appendix Table 1 also shows time series global crush data but, as has been stated, does not include oil palm. Average crush figures 1976-1977 are shown for all 51 countries and, for 24 countries for which the data is available, average actual crush 1970-71 is shown. It can be seen that, with global crush at 126.9 million tonnes in 1981-82 there has been a growth of 33.4 percent since the years 1976-77 when the global crush was 95.1 million tonnes. (As the data for 1970-1 is incomplete the total for these years is unfortunately not comparable so it is not possible to derive a growth rate for the 1970s). This increase in global crush was not however uniform in all regions. Developing Countries which accounted for 29.8 per cent of all crushings in 1976-77 accounted for 30.4 per cent in 1981-82, that is the rate of growth very slightly exceeded the global average while the rate of growth of the Centrally Planned Economies and the Developed Countries was slightly less than the global average. Within the general developing country picture however there were a variety of different situations:-

a. Asia

The average rate of growth of crush in Asia, 1976/77 - 81/82, was only 20.7 per cent and so Asia has lost some of its share of global crush. Figures for West Malaysia show considerable growth of crush in that country (227 per cent 1976/77 - 81/82) and this is very largely due to increased palm kernel crush. Again it must be repeated that oil palm crush is not included here. Malaysia is known to have dramatically increased its crush of this commodity and if a rate were to be included, the overall picture would be quite different. This is made clear in the preceding section.

The growth rate in Taiwan and Pakistan also exceeded the global average but, for all other Asian countries listed, the growth rates are less. India, which represented nearly half of total Asian crush in 1981-82, achieved a growth rate of only 10.7 per cent during the period under review and it is this figure which pulls down the regional growth rate. Additionally crushing in Indonesia, a major crusher, also declined.

It should be noted that in countries such as the Philippines, growth in crushing represents a shift of policy from one of exporting whole oilseeds for crushing abroad to one of retaining them at home for domestic crushing with the subsequent export of the oil. It does not necessarily imply increased production of oilseeds.

b. Africa

Average oilseed crush in Africa has shrunk, 1976/77 - 1981/82, by 9.8 per cent. Only one country, South Africa, has a growth rate exceeding the global average and, if it is excluded from the African total, the rate of decline of crush in that continent rises to a still more significant 17.4 per cent.

Five African countries out of the nine shown exhibit negative growth rates, Benin and Senegal being a significant -50.9 per cent and -44.9 per cent respectively.

c. Latin America

Data for Latin America is only available in respect of 4 countries but they all exhibit very healthy rates of growth, indeed they are all in excess of 45 per cent. It is, in fact, the growth rate of these countries that has pulled up the otherwise poor to very poor rates of growth of the developing countries as a whole, such that the average growth rate is similar to that of the global rate and such that the poor performances in Africa and Asia are hidden by the statistics.

Brazil, for which figures are also available for the years 1970-71, shows an astonishing 362 per cent growth over the 11 year period and a 66.3 per cent growth over the 1976/77 - 1981/82 period. Following its enormous expansion Brazil became the second largest crusher in the world in 1982.

In the rest of the world, between 1976/77 - 1981/82 there are to be observed, several countries exhibiting considerable growth in oilseeds crushed, some of them albeit from a relatively small base; eg China (97.1 per cent), Hungary (62.5 per cent), Spain (63.3 per cent), Belgium-Luxemburg (81.0 per cent), Greece (62.3 per cent), the Netherlands (65.9 per cent) and Canada (68.2 per cent). On the other hand the USSR, the fourth largest crusher in the world, is amongst five Developed Countries and Centrally Planned Economies with a negative growth rate.

4.2.3.2 Analysis by seed

Appendix Table 2 shows the way in which the share of global crush by seed has altered. This is summarised in Table 3 below. [Again it must be emphasised that oil palm is not included in the total.]

Table 3 Percentage Share of global crush

Oilseed	1979	1982
Soyabean	58.1	56.8
Copra	3.3	3.2
Palm kernels	0.8	1.0
Sesame	0.7	0.6
Cottonseed	14.1	14.4
Groundnuts	5.5	4.9
Sunflower seed	9.7	9.3
Rapeseed	7.8	9.8

There has not been a great deal of change in the 4 year period under review. The share of rapeseed crush in the total has increased the most - by 2 per cent, while the share of palm kernels and cottonseed crush has only increased a little. Soyabeans have lost ground by 1.3 per cent.

It is interesting to note too the shifts in the regional share of the crush of a particular oilseed. For example Latin America increased its share of soyabean crush during the period 1979-82 by 4.2 percent while the large share of the Developed Countries fell by nearly 6 per cent. This is mainly due to huge growth in Brazil although this is not well reflected in these particular statistics. The other significant development in respect of the changing share of crush is the considerably increased share which West Malaysia now commands in the palm kernel crush - 60 per cent in 19[illegible] as opposed to 51 per cent in 1979; the loss of share by Africa and the EEC in total palm kernel crush; China's growth of share of sesame seed crush; the loss of share of groundnut crush by Brazil and Argentina and its growth in China; and the shift of rapeseed crush towards the Centrally Planned Economies and away from the Developed Countries.

4.3 The processing of oilseeds with particular reference to Developing Countries

4.3.1 Introduction

This section deals with crushing and refining on both a micro and macro level. Section 4.3.2 discusses the three basic levels of processing in Developing Countries - traditional, modern village and industrial - and describes the technology and equipment used. Section 4.3.3 looks at oilseed processing on a global basis and reviews all available information on the crushing and refining capacities of some 72 countries. The data is presented in Appendix Tables 4-8 for Asia, Africa, Latin America, the Centrally Planned Economies and the Developed Countries. It was part of the purpose of this study to identify areas where data has been particularly scarce and this section shows how data on crushing is more widely available than that on refining, while some regions, notably Asia, have a more plentiful output of published data than others, notably Central America.

A summary of crushing capacities and how they relate to actual crushing is provided for both Developing Countries and the World at the end of Section 4.3.3.

4.3.2 Types and levels of processing

4.3.2.1 Traditional village processing

Traditional processing of oilseeds, handed down from family to family, exists in a variety of forms throughout Oceania, Asia and Africa. Such processing provides the family group with edible oil produced either from oilseeds grown as subsistence crops or from raw materials harvested wild. The efficiency of oil extraction by these techniques varies according to the method used but is generally very poor. Standard methods include:

a) grate and squeeze: applicable to coconut whereby the wet meat from a fresh coconut is grated and squeezed in either a coir fibre lattice or cloth. The emulsion so obtained contains coconut oil which is consumed directly or heated to break the emulsion.

b) boil/decant: applicable to palm kernel whereby the kernels are pounded, mixed with water and ground to a paste. The paste is heated over a fire and the cooking releases oil which is decanted.

c) boil/skim: applicable to coconut whereby the wet meat is grated and boiled with excess water. The boiling releases coconut oil which is skimmed from the surface of the pot.

d) pestle and mortar presses: these include the chekku, koklu and ghani of the Indian sub-continent and are used to extract oil from rapeseed/mustard seed, groundnut and sesame. These presses are available in many forms and sizes. In smaller versions which extract oil from only a few kilos of rapeseed per hour the pestle is hand-powered. In larger versions (40-80 kg oilseed per hour) the pestle is either powered by bullocks or is motorised.

e) log and wedge presses: these include the traditional log presses of Nepal and wedge presses of China. The pressure is generated either by forcing wood slabs together using wedges or large screws. There are many sizes and designs and throughputs can vary between 5-60 kg of oilseed per hour.

4.3.2.2 Modern Village Processing

Modern village processing techniques are widely practised in certain developing countries particularly in the Indian subcontinent. Improvements in equipment design confer substantial benefits in oil extraction efficiency over traditonal techniques. Training is through on-job experience. The smallest of expellers are well-adapted for these rural environments and, at a throughput of about 100 tonnes/year of oilseed, can service the edible oil needs of up to 5,000 people (assuming production of 25 tonnes oil and consumption of 5 kg oil/capita per annum). A small mill might directly employ 3-5 people and can offer a flexible service selling oil and cake or custom milling. Everything from seed production to edible oil marketing is at its simplest level.

Modern village oilseed processing can have an important and desirable social impact on the remote village community it services. In particular it effectively eliminates problems of seed supply and oil distribution in the community which might otherwise occur if seed and oil have to be transported several hundred miles to and from a larger more centralised oil mill. Strictly speaking these small mills should not be able to compete with larger oil mills yet on the Indian sub-continent for example, they co-exist and it is recommended that a detailed study be undertaken to identify the key features which permit this situation.

Even at the village level there can be considerable variation in the scale of oilseed processing from the discontinuous processing of a few kilos of seed per day up to the continuous processing of 100-200 tonnes of oilseed per year. The latter uses techniques more allied to larger industrial processing but it is more convenient to include the description under the above heading.

a) discontinuous presses: there exist a number of such presses manufactured from iron, steel and wood designed to apply pressure to oilseeds thereby releasing oil. They include small hydraulic presses (up to 15 kg/hour oilseed), car jacks, and a variety of fulcrum/lever devices. They are designed for occasional use either in situations where seed availability is limited or for supply of oil to small family groups.

b) motorised improved ghanis: already mentioned in 4.3.1.1 (d) above.

c) small expellers: designed for continuous operation up to about 200 tonnes/year. Depending on the press and oilseed, throughput can be between 30-200 kg per hour of oilseed. They are usually powered by a 3-phase electricity or diesel motor. In the simplest operation the oilseed undergoes no pretreatment and is fed directly to the expeller. The crude oil (containing suspended fine seed particles) is settled in oil drums and the clear oil is decanted.

In some cases, the mill can be equipped to apply the techniques of oilseed pretreatment (see Section 4.3.1.3.2) which results in greater efficiency of oil extraction. Filtration units are often used to speed clarification.

d) palm oil presses: these are designed specifically for palm oil extraction which requires a low operating pressure of about 800 psi. They will not extract oil from typical oilseeds.

4.3.2.3 Industrial Scale Oilseed Processing

Industrial oilseed processing factories from small to medium scale exist throughout the developing world. They vary considerably in age.

There are three oil extraction technologies in common use:

a) high pressure mechanical pressure: oilseeds are passed once or twice through an expeller press which generates high pressure. This can be used for all typical commercial oilseeds.

b) solvent extraction: the oil is extracted from the oilseed by solvent. This is done directly on oilseeds containing up to 35 per cent oil.

c) prepress/solvent extraction: usually applicable to oilseeds having over 40 per cent oil content. The prepress lowers the oil content of the seed to about 18 per cent and the remainder is removed by solvent.

There are exceptions to the above; palm kernel with an oil content of around 50 per cent can be direct solvent extracted. Also sunflower seed having a kernel oil content of around 54 per cent can be solvent extracted in a two stage process after decortication. The various stages along the industrial scale processing chain are outlined below.

4.3.2.3.1 Seed reception and storage

Seed is transported to the factory by road, rail or boat (depending on location) either in bulk or bags. At the plant the seed is stored in bulk or bags in warehouses, storage silos or Muskogee-type buildings.

4.3.2.3.2 Pretreatment

a) drying: depending on the condition and type of oilseed received at the plant, it is either dried before going to safe storage or is further dried during the conditioning step of processing. Drying for safe storage depends on many factors.

b) cleaning: as a first step to processing, the oilseed is cleaned to remove stones, dirt, trash and tramp metal which might otherwise damage the process machinery.

c) decortication: this depends on the oilseed being processed. It is usually undertaken with cottonseed and groundnut, is optional with soya bean and sunflower and not done with rapeseed, sesame and sunflower. Palm kernels are normally decorticated at the palm oil factory.

d) grinding/rolling/conditioning: the relative order of these process steps depends on the oilseed. Grinding usually increases material bulk density and can improve throughput in later process stages. Conditioning with moisture and steam assists coagulation of oil droplets in the tissue and denaturation of seed protein and breakdown of cell walls. It can improve oil extraction efficiency considerably. Rolling breaks up oil cells in the tissue releasing more oil.

e) flaking: applicable only to solvent extraction. Here it is important to flake to correct thickness for best results. The flake must be thick for mechanical strength but thin for a speedy efficient oil extraction rate in a reasonable time. A compromise is necessary.

4.3.2.3.3 Mechanical extraction

For medium and large scale oil extraction using presses, expellers are recommended for all applications with the exception of castor oil extraction for which continuous hydraulic presses are recommended for the highest grades.

High pressure expellers are available in capacity from 6-100 tonnes oilseed throughput/day giving oil cakes of only 3-4 per cent residue oil content. Low pressure presses are available up to 400 tonnes/day oilseed throughput producing cake at 18-22 per cent residual oil for subsequent solvent extraction.

4.3.2.3.4 Solvent extraction

Three basic technologies are available:

a) immersion extraction: ground raw material is immersed in solvent. More applicable to recovery of oil from crushed bones and animal residues rather than oilseeds.

b) percolation extraction: solvent percolates through a bed of oilseed flakes up to 2 metres in depth.

c) combined percolation/immersion extraction: a composite of (a) and (b) above designed to extract oil completely from materials having oil content over 50 per cent without using low pressure presses.

Solvent recovery from the oil/solvent mixture (miscella) is carried out by distillation, usually in two stages with about 90 per cent removal of solvent in the first stage (atmospheric pressure) and the remainder removed under vacuum.

Residual solvent in the meal is removed by a desolventiser and different designs are available for general purpose or soya bean meal for concentrate/isolate preparation.

Meals and cakes can be dried (or moistened if high pressure presses are used), cooled, ground or pelletised and then bagged.

4.3.2.3.5 Refining

There are a number of steps involved and their importance depends on the crude edible oil being processed. Chemical refining proceeds as follows:

a) washing/degumming: it is important to reduce the level of phosphatides in the oil for good results in later stages of refining. Can be done using hot water and a variety of inorganic acids, usually phosphoric.

b) neutralisation: treatment of the oil with aqueous sodium hydroxide to neutralise free fatty acids and destroy certain colour bodies in the oil. Oils having low level of phosphatides are usually neutralised and degummed in a single step. Many procedures are available using strong or weak alkali.

c) bleaching: usually done by heating and stirring with bleaching earth. The selection of bleaching earths and the procedures of bleaching are varied.

d) deodorising; steam sparging under high vacuum and temperature to remove volatile materials in the oil.

In physical refining there is much variation in technique depending on the edible oil being refined. Generally speaking the major steps are degumming followed by either an intermediate bleach or a very intense high temperature/vacuum steam sparge to remove free fatty acids, volatiles and pigments.

The major by-product in chemical refining is the soap stock which can be acidulated to produce acid oil. The major by-product from physical refining is the fatty acid distillate. Both can be used for soap production or as starting material for fatty acid production and subsequent oleo-chemical manufacture.

4.3.2.3.6 <u>Modification</u>

a) winterising: the oil is cooled and held at a low temperature for several hours (even sometimes days) before it is filtered. In this way waxes in maize oil and sunflower oil or stearines in cottonseed oil or groundnut oil are removed giving the product a clear appearance at cool temperatures (eg for a salad oil).

b) fractionation: commonly employed with palm oil to give solid and liquid oils having different applications. There are a number of different techniques in use.

c) hydrogenation: it can be applied in a number of ways; selectively modifying the most unsaturated fatty acids in a liquid oil to give it improved oxidative stability and increasing the trans acid content to lower the melting point of an oil.

d) inter-esterification: changing the position of the fatty acids on the triglycerides molecules can alter its physical properties. The changes can be made randomly or in a directed manner.

e) fat splitting: gives glycerol and fatty acids for industrial use.

f) soap: saponification of mixtures of vegetable oils and/or animal fats produces soaps.

4.3.3 Oilseed processing: capacities and capacity utilisation

4.3.3.1 Crushing

Appendix Tables 4 - 8 in the Appendices present all available evidence on the capacity and capacity utilisation of global crushing and refining. The data is assembled according to the five regions or groupings already described in Section 4.2. The quantity and quality of the data varies considerably. It is best for the Developing Countries, particularly the Asian ones, and worst for the Developed Countries and Centrally Planned Economies where practically the only useful information is the regularly published actual crush figures in Oil World. Although capacity figures are available for some Developed Countries and for the USSR and Poland, data on the number of mills and on refining appears to be virtually non-existent. It also varies both in terms of its source and its age. Where possible the base year has been taken as 1981/2 but the frequent use of figures from other periods is noted in the extensive footnotes.

Where sensible the national figures have been added to reach a regional or group total. This is only possible for crushing data where there are enough countries with the necessary information. A sub-total is also shown which includes returns from only those countries for which both capacity and actual crush figures are available. This figure is therefore a more accurate if less comprehensive method of calculating capacity utilisation.

It should be noted that several countries are excluded from the Tables due to a complete lack of data.

a. Asia

Appendix Table 4 presents the available data for Asia. Capacity figures for all the Asian countries shown are complete and so it is possible to derive a regional estimated total of 68.34 million tonnes. The figure must be taken as an estimate because of problems with assumptions behind the data, the possible unreliability of certain sources, the age of the data and its accuracy, all described more fully in the footnotes to the tables. Actual crush figures are available for all countries shown except Afghanistan and Iraq, which are, in any case, very minor crushing countries, and total crush can be shown as 30.79 million tonnes or 45.1 per cent of capacity.

The country with the largest crush capacity is Malaysia with 33.2 million tonnes. This is a composite figure made up from two sources, one giving oil palm capacity of 32.9 million tonnes, the other copra capacity as 0.35 million tonnes, and so will be liable to some degree of error. Additionally it was not possible to discover capacity figures for palm kernel and soyabean which are also crushed.

Malaysia's actual crush figure must be still more suspect. The basic crush figures from Oil World do not include oil palm crush. Consequently for countries which are major producers/crushers of oil palm (like Malaysia), a capacity figure which includes oil palm capacity will bear no comparison to the actual crush figure. In order to rectify this problem an estimate of oil palm crush has been made based on FAO production figures for palm oil. The countries for which this procedure has been adopted are shown in Appendix Table 3, along with their derived oil palm crush. The details of the procedure are given in General Footnote No 1 to Appendix Tables 4-8.

Malaysia had a derived oil palm crush in 1981 of 11.3 million tonnes and an average actual crush of other oilseeds of 968,000 tonnes. This makes it also the country with the largest recorded crush in Asia, indeed its crush capacity is nearly twice that of the next largest country, India, while its actual crush is over 50 per cent greater than India's.

With a capacity of 17.3 million tonnes and an actual crush of 8.0 million tonnes, mostly consisting of groundnuts, rapeseed, and cottonseed, India had a capacity utilisation of 49 per cent. The other important countries in Asia, in order of capacity, are Indonesia, crushing oil palm and copra; the Philippines, crushing largely copra; Turkey, crushing cottonseed and sunflower (and also olives, although there are no figures here for this crop); and Pakistan, crushing cottonseed and rapeseed. The highest capacity utilisation recorded was in Papua New Guinea (85 per cent for copra only) and lowest in Thailand 36 per cent. No country had a capacity utilisation of less than 35 per cent.

Where information relating to likely increases or decreases in capacity is available it has been noted in the footnotes to the Table. Quite simply there is insufficient data available to determine any continental trend with regard to likely changes in capacity levels. Projects to increase crushing capacity have however been noted in the Philippines, Thailand and Papua New Guinea.

b. Africa

Appendix Table 5 shows the available data for Africa. It is less extensive than that for the Asian countries as, for only 11 out of 17 of the countries shown, could a crush capacity figure be found. Somewhat more countries return an actual crush figure.

The country with the largest recorded capacity was the Ivory Coast with 3 million tonnes which includes that country's large oil palm crush. The Sudan, the second largest country recorded has a capacity of 1.2 million tonnes which is used for cottonseed, groundnuts and sesame. The third largest capacity recorded is in Nigeria with 1 million tonnes which is used for groundnuts and cottonseed. Nigeria's considerable oil palm crushing capacity is not included.

The country with the largest recorded actual crush was Egypt for which a capacity figure was not available. Most of Egypt's crushing is of cottonseed but also includes soyabean, some of it imported. The next largest recorded crushes were in the Ivory Coast, the Sudan, South Africa (groundnuts and sunflower seed) and Senegal (groundnuts and a very little sunflower seed). Total capacity for the African continent is calculated at 7.7 million tonnes although the major countries of Egypt, and Ethiopia are omitted from this total. The capacity utilisation, based on those countries for which both capacity and actual crush figures are available is 32.1 per cent. The highest capacity utilisation recorded was in Morocco with 70 per cent, the lowest in Somalia with 11 per cent. Four countries were calculated to have capacity utilisation figures of less than 25 per cent.

The only countries for which direct evidence of expansion of capacity was found were Zaire and The Sudan. Details are given in the footnotes to Appendix Table 5.

c. Latin America

Data for the Latin America is shown in Appendix Table 6. It is reasonably complete for the countries of South America but non-existent for the countries of Central America with the exception of Mexico. In addition it has not been possible to find crush capacity figures for Chile and Ecuador.

For the ten countries shown in Appendix Table 6 total capacity has been calculated at 40.5 million tonnes, 67 per cent of which is accounted for by crushing in Brazil, 17 per cent by Argentina and 12 per cent by Mexico.

It is recorded that some 80 per cent of Brazilian capacity is for soyabeans and certainly actual crush in 1982, 14.34 million tonnes, was made up of soyabeans (91 per cent), cottonseed (8 per cent), and groundnuts (1 per cent). Information on capacity by oilseed for Argentina is not available. However edible crush in 1982 consisted of sunflower seed (46 per cent), soyabeans (44 per cent), cottonseed (6 per cent), and groundnuts. There is also no available data on the allocation of capacity to oilseed crop in Mexico. The actual crush, was, in 1982, made up of soyabeans (60 per cent), cottonseed (19 per cent) and sunflower seed (10 per cent), plus a small quantity of all the other oilseeds covered here.

Actual crush figures are available for all the countries shown in the table, Brazil, Argentina and Mexico again showing the highest returns. The capacity utilisation for those eight countries with both capacity and actual crush figures shown in 50.6 per cent, the highest capacity utilisation coming from Colombia with 56 per cent (although oil palm, a considerable crop in Colombia, is excluded) and the lowest from Bolivia with 21 per cent. Three countries were calculated to have capacity utilisations of 35 per cent or less.

The only countries for which evidence of an intention to expand capacity has been found are Brazil and Peru.

d. Summary: Developing Countries

Total crush capacity recorded for the Developing Countries is 116.6 million tonnes. This figure however excludes several major crushing countries such as Egypt and also is to varying degrees selective in terms of which oilseeds are included. Some major oilseeds are excluded from some countries nd where this has occurred it is recorded in the footnotes.

As a consequence the total figure is certainly too low and it is suggested that 125 million tonnes might serve as a better rough estimate of total Developing Country capacity.

Total actual crush recorded for the Developing Countries in 1982 was 55.9 million tonnes. However again several countries are excluded entirely although this time none of them are particularly major ones. Individual oilseeds are also missing for some countries but is is unlikely that actual crush exceeds 60 million tonnes.

Using these two figures capacity utilisation for the Developing Countries can be estimated at 48 per cent. The main crushing countries in order of their actual crush in 1982 were Brazil, Malaysia, India, Indonesia, Argentina, Mexico and the Philippines.

e. Centrally Planned Economies (CPEs)

Data for the CPEs is shown in Appendix Table 7. As has been stated already the only CPEs for which capacity figures have been found are the USSR and Poland. The former had a capacity of 11.4 million tonnes and an 83 per cent capacity utilisation in 1981/2, the latter a capacity of 900,000 tonnes utilised at 62 per cent.

Actual crush figures, which are available for all the countries shown in Appendix Table 7 indicate that total crush was 27.6 million tonnes. 51 per cent of this total was accounted for by crushing in China which, as was discussed in Section 4.2, has apparently achieved a remarkable expansion in crush in the last 10 years. Chinese crush in 1982 was accounted for by soyabeans (25 per cent), cottonseed (27 per cent), rapeseed (3 per cent), groundnuts (9 per cent) and sunflower seed (7 per cent).

The USSR with 9.4 million tonnes is the next biggest crushing CPE with 34% of total crush. In 1982 this was made up of cottonseed (44 per cent), sunflower seed (36 per cent) and soyabeans (19 per cent).

The seven countries of Eastern Europe shown in the table account for the remaining 15 per cent CPE crush, the largest being Romania with 1.3 million tonnes.

Due to the lack of data on available capacity is is not possible to estimate a capacity utilisation figure for the country group. It should be noted however than in Hungary, capacity is recorded as being inadequate to meet domestic demand and is consequently to be expanded. In Bulgaria, Romania and Yugoslavia, capacity is also scheduled to expand (for details see the footnotes to Appendix Table 7). USDA sources have stated that capacity in Poland is also inadequate, despite the under-utilisation indicated in the table.

f. Developed Countries

Appendix Table 8 shows capacity and actual crush figures for the Developed Countries. Capacity figures are shown for 10 out of 18 of the countries in the table although as actual crush exceeds capacity in some cases, some of the data must be regarded as suspect. Actual crush figures are complete.

The USA is of course the major crushing country both in the Developed Countries and the world. Its actual crush accounted for 55 per cent of Developed Country crush in 1981/2. This was made up of soyabeans (83 per cent), cottonseed (13 per cent) and sunflower seed (1 per cent). Capacity shown is however only for soyabeans and for oilseeds crushed at soyabean plants; total crush capacity may therefore be somewhat larger.

The next biggest country in terms of crushing in 1981/2 was the Federal Republic of Germany with 5.1 million tonnes. This comprised soyabean (74 per cent), sunflower seed (10 per cent) and rapeseed (13 per cent). Japan's crush in 1982 was fractionally less than Germany's although crushing capacity is reported to be greater. Japanese capacity utilisation in 1981/2 was in fact reported to be only 64%. The main seeds crushed in Japan in 1981 were soyabeans (70%) and rapeseed (23 per cent).

The next largest Developed Country crushers were Spain, crushing soyabeans and sunflower seed; the Netherlands, soyabeans, sunflower seed and rapeseed; and Canada, soyabeans and rapeseed.

Although crushing capacity figures are scarce and several of those that exist are suspect, a total for the group has been estimated. This shows developed country capacity as 63.5 million tonnes. Average capacity utilisation for all those countries shown with returns in the Table is 85.5 per cent. There are obviously problems with these calculations but they are shown and in the belief that they indicate the approximate available capacity.

g. World Summary

The total global crush recorded is 192.4 million tonnes. Unfortunately due to the lack of capacity information, particularly for the Developed Contries and Centrally Planned Economies, it is not possible to estimate a global capacity figure and therefore a capacity utilisation figure.

It is however clear from the sources and from the evidence collected that capacity utilisation in the Developing Countries is a great deal less than in the rest of the world. For the three developing "regions" shown, capacity utilisation rates are estimated as follows:

Asia 45.4 per cent

Africa 32.1 per cent

Latin America 50.6 per cent

The lowest recorded capacity utilisation rate for the Developed Countries is, by contrast, 55 per cent for Portugal. For the USSR and Poland the figure is 83 per cent and 62 per cent respectively. It is unfortunate that capacity utilisation figures are not more widely available for the non-developing world but it is generally believed by the trade that average capacity utilisation is between 65 - 85 per cent for these countries.

The countries with the biggest crushes were as follows:

Country	Percentage of global crush
USA	17.6
Brazil	7.4
China	7.3
Malaysia	6.4
USSR	4.9
India	4.2
Germany	2.7
Japan	2.7
Indonesia	2.1
Argentina	1.6
The Philippines	1.1

There is no basis on which to make time series comparisons, particularly as the data collected in Appendix Tables 4 to 8 is not all from the same year, and is, in some cases, a composite of information from different sources. As has been said already, the data in the tables must be treated as a rough, but it is hoped reasonably accurate, estimate. The only reliable time series data available is that shown in Appendix Table 1 and already discussed in Section 4.2.2. This comments on the decline in crushing in Africa, the relatively poor performance of most Asian countries (although this performance would be radically improved had oil palm crush figures been included) and the high growth rates in Latin America. There is unfortunately no additional data available with which to supplement or further comment on these already identified trends.

4.3.3.2 Refining

Appendix Tables 4 - 8 also include the available information on refining. This is considerably thinner than the data for crushing and has been assembled from a selection of sources, including TDRI in-house information and unpublished reports. The availability of the data varies from the Asian countries where there are returns of some kind for more than half the countries and the African countries where there is also a reasonable amount of information; by contrast, for the Centrally Planned Economies there is no information at all and in the Developed Countries the only returns are for the UK and Australia. For no region is the data sufficient to assemble a regional or group total or to make comparisons across groups or regions.

a. Asia

Refining capacity data is available for 10 out of 16 of the countries shown in Appendix Table 4 although for three of them the information is that they have no refining.

A figure for refining capacity is available for the four biggest crushing countries with the important exception of India, although the accuracy of these estimates, given their different sources must be open to doubt. An actual refining figure is also missing for Indonesia.

From the information assembled, Malaysia, the largest crushing country in Asia, is easily the largest refining country. There is reportedly a refining capacity of 4.7 million tonnes in Malaysia and, in 1981/82, 3.4 million tonnes of oil were actually refined. Given that the Malaysian crush is some 53 per cent greater than the crush in India it is likely that refining in Malaysia is on a greater scale than in India.

The only other significant figures for refining capacity are for the Philippines and for Indonesia, these countries possessing a refining capacity of 644,000 tonnes and 548,000 tonnes respectively. The Philippines figure is for coconut oil only, would be somewhat larger were other oils to be included. Evidence of intention to expand refining capacity was discovered for Pakistan and Malaysia.

Capacity utilisation rates, range from 92 per cent for Bangladesh through 72 per cent for Malaysia to 22 per cent for Pakistan.

b. Africa

The African data is even less complete than that for the Asian countries. Refining capacities are only available for 5 out of 17 of the countries shown and in Appendix Table 5 an actual refining figure for an even smaller number. Furthermore, the figure for Kenya (1.4 million tonnes) is impossibly high and probably the result of a confusion between hourly and daily capacities. Other than Kenya the biggest refining countries recorded are Morocco and Egypt with 150,000 tonnes and 115,000 tonnes respectively. Their capacity utilisation rates are 75 per cent and 58 per cent.

Evidence of new refining capacity, either under construction or under consideration, was found only for Egypt.

c. Latin America

Of the three Developing Country regions, Latin America has yielded the least information on refining (see Appendix Table 6). There is information confirming the existence of refining capacity in five countries but for only two of them, Peru and Bolivia, is there an actual figure (and that for Peru includes refining of fish oil). The quantity of this information is clearly inadequate to make any regional comparisons or generalisations.

d. Centrally Planned Economies

Information on refining in the Centrally Planned Economies is completely non-existent. No mention of any aspect of it was discovered during these researches.

e. Developed Countries

Information on refining in the Developed Countries is no more easily available than in the CPEs. A figure for actual refining in Australia is given in the table and a production table for refining in the UK is reproduced in the footnotes. However, quite clearly the information is so sparse that no general comment can be made.

4.4 Factors affecting processing capacity and capacity utilisation

4.4.1 Introduction

The level of capacity and its utilisation are affected by a wide range of technical and economic factors and this section identifies these with special reference to the Developing Countries. Economic factors are considered first in a consideration of the macroeconomic environment within which oilseed crushing is undertaken.

The shortage of data and the limited resources available to the study preclude a full country-by-country analysis. However an attempt has been made to identify some of the major economic issues for the more important oilseed-processing Developing Countries. The range of microeconomic circumstances affecting individual plant operation are so diverse that it is not possible to extend the discussion to this level, but it is felt that consideration of macroeconomic conditions provide a useful explanation for many features of the crushing industry in Developing Countries. The lack of data relating to processing stages beyond crushing has already been referred to; clearly analysis of these stages is not possible.

The discussion of technical factors is much more closely tied to specific areas of plant operation ie. a micro-level consideration of the crushing process. Whilst it is very difficult to generalise from individual plant experience, an attempt is made to indicate the constraints on production levels and utilisation rates which arise from the specificly technical aspects of crushing in many Developing Countries.

The operating efficiency of crushing plants depends not only on the level of capacity utilisation but also on the efficiency of operations at any given level of utilisation. The latter represents a key area of importance both in terms of the efficient use of scarce resources and the relative international competitiveness of oilseed crushing industries established in Developing Countries. The measure of such efficiency of utilisation is the extent to which the minimum rated capacity of oil extraction is achieved. The latter is of key importance since oil is always the higher priced of the joint derivatives of crushing. Price differentials between oils and oilcakes in conjunction with oil to oilcake production ratios also mean that vegetable oil has the higher value per unit of seed crushed for all oilseeds except soya beans.

4.4.2 Economic factors affecting processing capacity and its utilisation

4.4.2.1 Introduction

The wide range of economic factors affecting crushing capacity utilisation stem from the complexities of the oilseed economy itself. Whilst many issues are common to all crushing countries, some are of more specific relevance to Developing Countries; it is these that this Section is concerned with. These issues, and their inter-relationships are most easily identified through an analysis of the supply and demand "balance sheet" which exists in any given national oilseed economy. A simplified diagramatic presentation of these inter-relationships, up to the crushing stage, is shown in Figure 1.

4.4.2.2 The International Oilseed Economy: Trade Flows between Country Groups

A more detailed discussion of issues affecting Developing Countries is given in Section 4.4.2.4 below. This section briefly considers some of the implications stemming from the international trade in vegetable oil and oilseeds between major country groupings, ie Developing Countries, Centrally Planned Economies and Developed Countries.

Trade flows between country groups are indicated in Table 4. This is derived from Appendix Tables 11 and 12 which are a more detailed presentation of the information by country and by region. From Table 4 it can be seen that Developed and Developing Countries are the major participants in international trade with Centrally Planned Economies playing a secondary role. With regard to Developing Countries the bulk of trade for both net exporters and importers is in oil rather than in oilseed. In the past a substantial proportion of Developing Country net exporters' trade was in the form of oilseeds, often directed towards countries in the Developed group.

Over the past decade, partly as a result of specific policies implemented by Governments, oilseed exports are now relatively insignificant. So whilst a majority of Developing Countries still export oilseeds, with a few exceptions, the volumes involved are very small. Argentina and Brazil still export quite large volumes and these two countries alone account for 60 per cent of the total shown in Table 4. For the majority of exporting Developing Countries therefore, participation in trade does not significantly reduce domestic crushing capacity requirements. In passing it may also be noted that the role of oilseed suppliers to Developed Countries, formerly filled by those in the developing group, has been largely taken over by the United States and Canada, the latter two countries accounting for 82 per cent of global net exports, as shown in Table 4.

Table 4

The International Trade in vegetable oil and oilseeds by Country groups 1981

Country Groups	Surplus/Deficit '000 tonnes		Number of Countries	
	Total[1]	Oilseed[2]	Total[1]	Oilseed[2]
Developing Countries				
Net Exporters	6,721	1,040	19	28
Net Importers	4,650	504	36	19
Centrally Planned Economies				
Net Exporters	200	37	3	2
Net Importers	1,279	626	6	7
Developed Countries				
Net Exporters	6,169	5,230	4	3
Net Importers	5,670	4,832	10	11

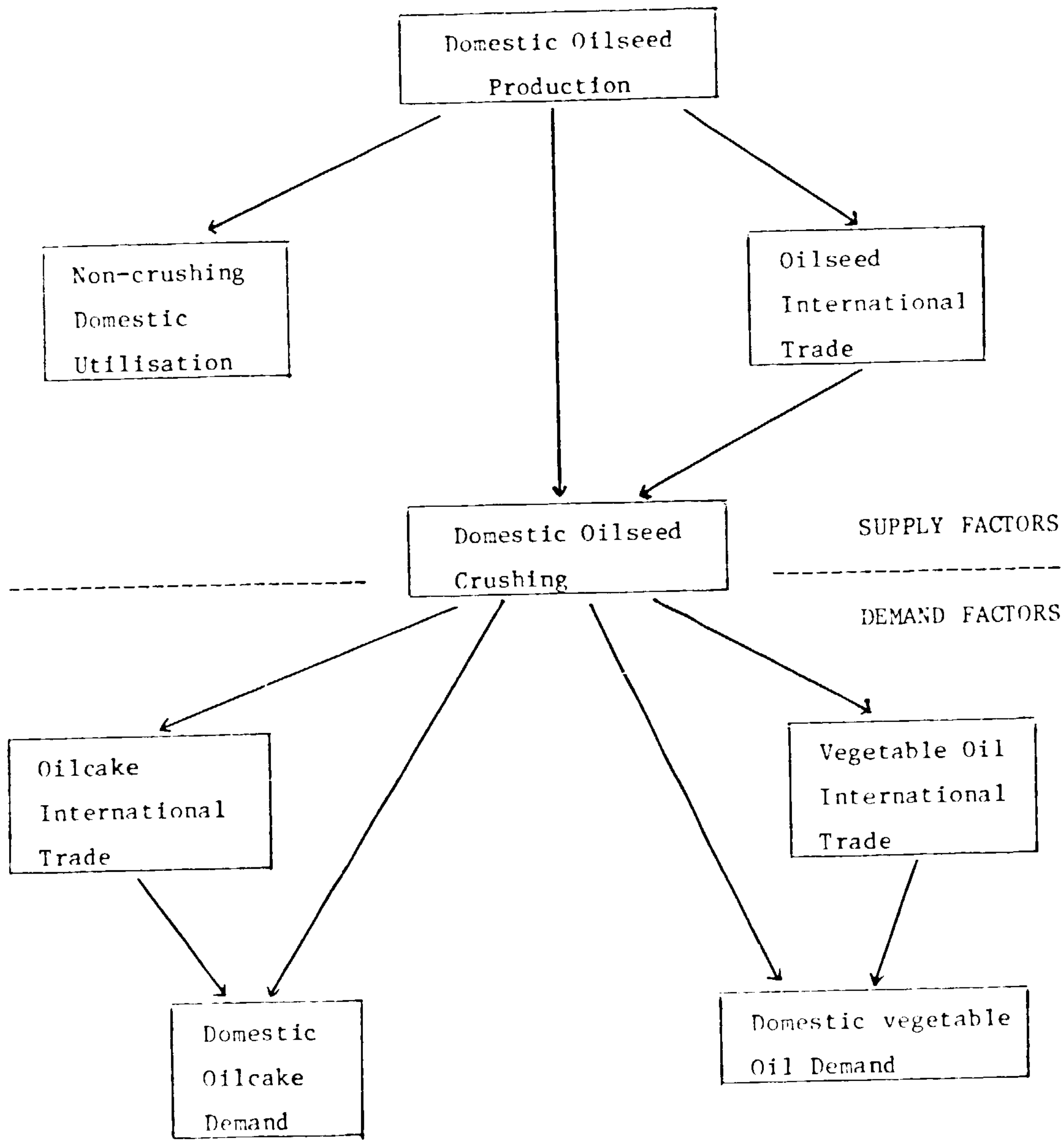
Notes:

1. Total of vegetable oil and oilseed (expressed in oil equivalents) net exports and number of countries contributing to each total

2. Oilseed (expressed in oil equivalents) net exports and imports and number of countries contributing to each total.

Figure 1

Major Elements of the Supply/Demand 'Balance Sheet' as they affect Oilseed Crushing



Developing Countries which are net importers overall (ie in terms of oils and oilseeds) also derive the bulk of their needs from oil rather than oilseeds. For these countries the choice of oil imports clearly has a constraining effect on domestic crushing. The effect on Developing Countries as a whole is much less marked since a substantial proportion of importing countries needs are met by oil exported from exporting countries within the group.

The decision to import oil rests in part on the relative efficiency of domestic crushing industries and it is apparent that competitively priced oil is increasingly becoming available from a few large scale Developing Country exporters in particular, as well as from some Developed Countries.

4.4.2.3 Supply side factors

The supply of oilseeds for crushing is primarily affected by three factors: the level and composition of domestic oilseed production; demand for oilseeds other than for crushing; and the possibility of securing oilseeds from international trade. These are examined below and, in addition, the particular issues relating to seed supply at different levels of scale are looked at in more detail.

4.4.2.3.1 Domestic oilseed production

Domestic oilseed production can be analysed usefully in terms of both its level and its composition although the two cannot be entirely separated. The production function of oilseeds, sometimes referred to as the technological conditions of production, is dependent on a number of factors: most obviously the price of the oilseed in question and the prices of other oilseeds and other agricultural products, ie. the relative profitability of production of differing oilseeds and other crops; the structure of the agricultural sector ie. its organisation and efficiency; Government objectives and policies towards the oilseeds sector and the agricultural economy in general; and the extent to which the specified production is in terms of the crop, or oilseed, itself or as a by-product, eg. cottonseed.

Determining the availability of a particular oilseed for crushing is further complicated by its seasonal production although the provision of storage can reduce problems in this area.

The problems of seed supply can be very different, depending on the level of operation to be serviced. For the purpose of classification it is helpful to sub-divide seed supply into the requirements for village, small, medium and large scale sectors.

a) Village industry. Unselected seed indigenous to the area is grown as a subsistence crop, the producer using seed as a source of his own edible oil by extraction according to techniques noted in 4.3.2.1. At this subsistence level, supply and demand relate to the family group and the major external influences which might drastically reduce seed supply are agricultural and climatic (crop failures). Production and utilisation of seed are both local.

b) Modern village processing (see section 4.3.2.2) can be as above but the seed is more efficiently milled using expellers. This is also the simplest level at which cash crop seed appears. As a cash crop the smallholder is primarily interested in the return to labour so expects a seed price incentive. The mill receives ungraded seed in small lots.

If the seed is an annual crop the mill either purchases seed for the year over several months or, provided seed sellers are willing, as required during the year. The number of mills competing for seed may influence this practise. Production and utilisation of seed are usually local.

c) Small industry: as (b) above but as the scale of operation progresses upwards towards the 20,000 tonne/year level problems resemble more closely those of (d) below. Production and utilisation of seed are usually local.

d) Medium to large scale: many developing countries have oil mills capable of processing over 100 tonnes of oilseed per day. The supply of locally grown seed at this level or over can be fraught with problems. It is desirable that the mill be located centrally in an area growing seed intensely, utilising as few suppliers as possible.

Many variations exist. Mills buy seed, ungraded, from local farmers and smallholders locally. Alternatively, if seed is supplied from a large diffuse area it may be concentrated at a local Agricultural Marketing Board out-station and then transported and pooled at a larger or main depot for onward transmission to the oil mill. Such an operation needs a well-developed and defined infrastructure and distribution network to succeed.

4.4.2.3.2 Uses of oilseed other than for crushing

The availability of seed for crushing also depends on the degree of other competing requirements: these include the direct use of oilseed for food, the direct use of oilseed for animal feed, the use of oilseeds as seed for further production, and simple wastage. Food use is generally the most important competing area although its significance varies considerably by country and by oilseed. Obviously the demand for oilseeds for direct consumption hinges upon several factors - the population level, population growth, income levels, the distribution of income, the price of the oilseed, tastes, etc. etc.

4.4.2.3.3 International trade

International trade in oilseeds and the derivatives of crushing - oil and oilcake - influences both the supply and the demand side of the equation. For countries with a shortage of oil, importing oilseeds for crushing is an option as is importing oil or oilcake or even substitutes for these. The degree of participation of a given country in international trade is of course dependent on the factors operating in the market.

The trade options available generally highlight a range of issues confronting the importing countries.

(i) The relative pricing of one oilseed as against another and the opportunity cost of domestic production as against buying from abroad.

(ii) The availability of foreign exchange.

(iii) Government policies towards production, trade, pricing etc.

Conversely for countries with surplus oilseed production the possibility of exporting seeds or derivatives arises. This can be to crushers overseas or for non-crushing utilisation.

4.4.2.4 Demand side factors

Analysing the domestic demand for oilseeds is more complex than if it would be were the product a single derivative. These complexities arise from the fact that oilseeds have differing oilcake/oil ratios and different qualities and purposes and hence variable values.

4.4.2.4.1 Vegetable oil

To analyse the domestic demand for vegetable oils is relatively straightforward. In the Developing Countries demand is especially likely to be strong for several reasons: the historically low per capita consumption and hence potential for growth, the prevalent high rate of population expansion, the low income elasticities of demand for oil and the constrained alternatives to oil consumption, particularly the shortage of animal fats.

4.4.2.4.2 Vegetable oilcake

Demand for vegetable oilcake is derived at several stages removed from human consumption needs, that is the vast majority of oilcake demand is derived from livestock feed demand. This in turn hinges on the scale of the livestock industry, the quality of husbandry and management, the nature of the feed regimes and the availability of alternative feeds, especially protein feeds. The scale and composition of the livestock industry in a given country in turn hinges upon both domestic and international market factors (ie. incomes, elasticities, alternatives etc.). Livestock composition changes over time in response both to production capacities and consumer demand and generally involves increasing emphasis on monogastrics eg. pigs and poultry, where opportunities for intensive feeding are greater.

In general vegetable oil demand is the most crucial factor on the demand side of the oilseed economy/processing industry of a developing country although for some surplus oilseed producing countries, the international oilcake market may be of greater importance. The following sections examine the influence of some of the factors discussed above in relation both to the regional groups of countries already identified (especially Developing Countries) and to some major individual Developing Countries. The discussion is presented under several sub-headings: oilseed production, the human consumption requirements of oilseed and their noncrushing derivatives, the international trade in oilseeds, oils and oilcakes, and domestic vegetable oil and oilcake demand. Particular attention is paid to the overall supply/demand balance in terms of vegetable oil deficit and surplus countries.

4.4.2.5 Regional Analysis

4.4.2.5.1 Asia

(i) Production of oilseeds

Oilseed production in most Asian Developing Countries is insufficient to meet domestic vegetable oil demand and the scale of crushing therefore partly depends upon the capacity to import oilseeds and the choice between oilseed imports and vegetable oil imports (see section (iii) below).

In many cases limited success in the agricultural sector in achieving increased oilseed production and variable yields year on year, also limit crushing capacity utilisation.

In contrast, a small number of countries have considerable (export) surplus oilseed production over domestic needs, but even in these countries, capacity utilisation is relatively low. Part of the explanation for this is that the surplus oilseed production of these countries is largely confined to the perennial tree crops with oil palm often predominating (the other major crop being coconuts). Oil palm has to be processed within hours of harvesting to avoid rapid deterioration of oil quality (ie. rising f.f.a. content). Oil extraction capacity has therefore to be geared to meet seasonal peak levels of production and since such equipment is unsuited to processing other oilseeds, capacity utilisation levels fall below those technically possible. This problem is exacerbated where oil palm production is expanding rapidly with the need to build oil expansion capacity in advance of production. Countries particularly affected by these issues include Malaysia, Indonesia and Papua New Guinea.

Because of the importance of cottonseed in their total oilseed crush uncertainty as to crushing capacity requirements and utilisation levels is a feature of several major Asian countries including Pakistan and India. As a by-product, output of cottonseed is largely determined by market forces exogenous to the oilseed economy. Palm kernels may also be regarded as a by-product of oil palm production and cultivation practices, although they are linked to the oil seed economy via the latter.

(ii) Human consumption requirements: oilseeds and non-crushing derivatives

Human consumption of oilseeds or non-crushing derivatives is more important in many Asian countries than in Developing Countries elsewhere. Such utilisation acts as a significant, if variable constraint on the availability of oilseed for crushing, particularly in the case of groundnuts, coconuts, soyabeans and sesame seed.

Groundnut utilisation, other than for crushing is wide spread throughout most Asian countries with particularly large volumes consumed in Indonesia. Alternative utilisation also takes the form of exports of high grade nuts for direct consumption elsewhere eg. in the case of Hand Picked Selected grade exports from India.

Coconut cultivation and associated non-crushed utilisation is more geographically restricted and per capita consumption levels vary considerably. In almost all cases, however, non-crushing uses take precedence over copra production for crushing as a result of differentials in relative pricing and returns to producers. Competition for coconut supplies also arises from more "modern" commercial products, most notably dessicated coconut, largely produced for export. Countries most affected by such competing demands include Sri Lanka, Indonesia, Thailand and (Southern) India. In the Philippines, however, scale of production and the relatively restricted demand for coconut as a "traditional" food source mean that such contraints are of little importance.

Soyabean utilisation for non-crushing purposes is largely confined to East Asia (and Chinese Overseas Communities elsewere). Substantial volumes are consumed in the form of "traditionally" processed food products, Korea and Taiwan being among the countries most affected.

In general the most important form of non-crushing utilisation is the "traditionally" preferred and processed food products such as tofu. Such needs generally receive priority and hence availabilities for crushing are constrained and liable to more substantial degrees of fluctuation in the context of variable oilseed production levels. Consequently both the level of crushing capacity and the degree of capacity utilisation may be adversely affected.

(iii) International Trade in oilseeds, oils and oilcakes

Trade and trade related issues are of variable importance amongst Asian

Developing Countries and may be evaluated in the context of a broad distinction drawn between countries whose oilseed production is in surplus or in deficit in meeting domestic vegetable oil demand. (See Appendix Table 12).

The majority of "mainland" Asian countries are in the deficit grouping ie. net importers in vegetable oil equivalents. Major countries of the Indian sub-continent, India, Pakistan and Bangladesh, are notable importers as a result of strong domestic demand pressures and constrained domestic oilseed availability (ie. both production constraints and demand for oilseeds for purposes other than crushing). In contrast South East Asian countries include some large scale net exporters; Malaysia, Philippines, Indonesia and Papua New Guinea. The exports of these countries are very largely made up from oil palm and coconut production.

Many net importing countries meet their requirements via oil rather than oilseed imports. Oil imports are favoured in part as a result of the international availability of oils and competitive pricing but they also arise from the nature and significance of trade within the Asian region. A significant proportion of the needs of deficit countries are met by oil palm which can only be traded in the form of oil. Regional availability and pricing make the latter oil highly attractive particularly in the context of the foreign exchange difficulties faced by a number of deficit countries. The result is however, a reduction in the crushing requirements in these countries.

Many countries in the Middle East region of the Continent are also net importers, partly because potential domestic oilseed production is quite constrained. Oil rather than oilseed imports are again often of greatest importance with palm oil again taking a significant role. In some cases the strength of livestock feed requirements acts as an offsetting factor as noted below.

Aside from palm oil exporters, the bulk of exports comprise palm kernels and coconut derivatives. Within Asia and especially South East Asia a conscious decision by Governments has resulted in policies designed to promote domestic crushing of such oilseeds prior to export; which results in an often very rapid expansion in crushing capacity.

(iv) Domestic vegetable oil and oilcake demand

The joint production of oil and oilcake from crushing complicates the effect of demand side market forces both because of the widely differing market circumstances facing the two derivatives and because of the variable value of differing oilseeds in terms of oil and oilcake content and quality.

As elsewhere demand for vegetable oils is generally of much greater significance in Asian Developing Countries than is the case for demand for oilcake. Factors contributing to the strength of vegetable oil demand have already been briefly noted (4.4.2.3.1). The strength of such demand has often been reinforced by government price policies in the vegetable oil sector. The imbalance between domestic oil demand in comparison to that for oilcake tends to favour oil rather than oilseed imports by oil deficit countries. However vegetable oil deficit countries with relatively high per capita incomes, eg. in East Asia and especially in the Middle East, also give rise to much higher effective demand levels for meat and dairy products and a consequent expansion in livestock feed utilisation including oilcakes. In such cases oilseed imports (rather than oil imports alone) may be more attractive and hence contribute to domestic crushing industries. Examples of the latter case include Saudi Arabia and Korea.

Oilseed imports in a few instances may also arise even in countries with a substantial net surplus of vegetable oil production. Such imports stem from the requirements of the domestic feed industry and are evident in both Malaysia and the Philippines. In the case of Malaysia domestic production is inadequate to meet feed requirements because of the overwhelming dominance of oil palm whilst Philippino imports stem from the rather limited feed value of copra cake.

(v) Conclusions

The combined effects of domestic oilseed production and non-crushing utilisation are easily the most important influence on the level of crushing capacity and utilisation in Asian Developing Countries. Vegetable oil deficit countries crush virtually all of the available oilseeds as indeed do the surplus countries. In the latter case this is partly due to necessity as oil palm has been grown as a result of policies for other oilseeds.

Trade issues may also be of secondary importance. In deficit countries the tendency to import oil rather than oilseeds tends to inhibit domestic crushing although a minority of more wealthy countries import part of their needs in the form of oilseeds as a result of livestock feed sector demand. The latter feature also arises in some oil surplus countries.

Unique features of the oil palm, ie the necessity to extract oil at the point of production and the absence of oilcake as a joint product, have a broad ranging impact on Asian Developing Countries. Whilst the capacity of oil extraction industries in palm growing countries are automatically linked to the level of oil palm production, other countries crushing industries are adversely affected to the extent that imports of palm oil arise. The absence of joint production of oilcake also helps to explain certain apparent anomolies, most notably the import of oilseeds by Malaysia which has a high surplus of domestic vegetable oil production over consumption needs.

The factors discussed above help to explain both the level and rate of utilisation of crushing capacity in Asian countries, although it is not possible to provide any degree of precision in the analyses. In the majority of cases the factors identified tend to inhibit the level of capacity requirements for crushing and also contribute to relatively low levels of capacity utilisation (eg. in comparison to Developed Countries). A further issue not covered earlier, is the degree to which "traditional" as opposed to conventional oilseed crushing arises. In many Asian countries, particularly those in the Indian sub-continent and Indonesia, traditional extraction accounts for a substantial proportion of total oilseed crushing. Whilst the relative importance of traditional processing may be declining to varying degrees it is likely to influence both the distribution and scale of future commercial production.

4.4.2.5.2 Africa

(i) Production of oilseeds

African countries have achieved varying degrees of success in meeting domestic vegetable oil demand from domestic oilseed production. On balance, more countries are in deficit than surplus (see Appendix Table 12) although many countries exhibit either small net deficits or surpluses. In absolute terms the influence of domestic production in general over oilseed crushing capacities is therefore less marked than in the case of many Asian countries. However, even small surpluses and deficits may have significance given the restricted scale of the oilseed economy in many African countries.

Oil palm cultivation in Africa has a similar influence on capacity levels and utilisation as it does in the Asian countries although such cultivation is confined primarily to West Africa and to some equatorial states. The oil palm sector in most countries is also considerably less dynamic than in the Asian producing countries and surplus capacity arises in a number of cases as a result of falling oil palm production.

Cottonseed is important for two large scale crushing countries in particular - the Sudan and Egypt - and this introduces a degree of uncertainty into crushing requirements, cottonseed being essentially a by-product of cotton production. Palm kernels are significant in West and equatorial Africa but the link with the palm oil sector is complicated to a degree by kernel collection from "wild" palms. Such collection may vary considerably in response to international market pricing and tends to mitigate against the establishment and/or full utilisation of kernel crushing capacity.

(ii) Human consumption requirements: oilseeds and non-crushing derivatives

Human consumption of oilseeds is of some significance in a number of African countries. Groundnut edible utilisation is widespread and is particularly large (in absolute terms) in Nigeria. To varying degrees groundnuts are also exported for direct consumption elsewhere but the level of such trade is usually quite small. Direct consumption of sesame seed is also significant primarily in North-East Africa.

As in the Asian countries the combined effect of direct oilseed consumption requirements and variable production levels is to restrict availabilities for crushing and to introduce considerable instability in supplies.

(iii) International trade in oilseeds, oils and oilcakes

The relatively small size of vegetable oil surpluses and deficits for most African countries has already been mentioned. Obviously trade related issues are relatively less important influences on crushing in Africa in this situation than they are in Asia and Latin America.

Deficit countries are in a majority most notably in North Africa (where limitations to production other than olives, and strength of demand stemming from relatively higher income levels arise). In the majority of cases, deficit countries import oils rather than oilseeds and hence inhibit domestic crushing. However, North African countries do import fairly significant volumes of seed, partly because of developments in their livestock feed sectors (see below).

Only two relatively large oil exporting countries exist: the Sudan and the Ivory Coast. Most exporting countries export oil rather than oilseeds, the major exception being the Sudan where the export of sesame seed for direct consumption is significant.

(iv) Domestic vegetable oil and oilcake demand

Factors affecting domestic vegetable oil demand largely correspond with those affecting developing countries elsewhere. For some, mainly North African, countries however, the development of livestock production with its associated feed requirements, produces a greater degree of balance in demand between crushing derivatives.

(v) Conclusions

Crushing levels in African countries are closely linked to domestic production levels with relatively restricted participation in international oilseed trade. Variable production of oilseeds in conjunction with the non-crushing requirements for oilseeds for human consumption introduce quite substantial fluctuations in availabilities for the crushing industry. In a number of countries the "traditional" extraction of oil is important, especially in West African countries. However some of such production utilises more or less "wild" crops, (eg of oil palm) and does not directly impinge upon commercial availabilities.

4.4.2.5.3 Latin America

(i) Production of oilseeds

Although oil palm and coconut cultivation are of some significance in the central and northern part of South America, production of oilseeds overall is dominated by annual crops. Of the annual oilseeds, soyabeans usually predominate, with cottonseed and sunflower of secondary importance.

Most countries in the region are deficit countries in terms of meeting domestic vegetable oil requirements. However, a small number of countries in the south of the continent most notably Brazil and Argentina, produce very large surpluses. The influence of cottonseed as a by-product is significant in a number of countries, particularly Mexico and Argentina.

(ii) Human consumption requirements: oilseeds and non-crushing derivatives

Compared to other regions direct consumption of oilseeds or non-crushing derivatives is relatively unimportant in many Latin American countries. Groundnut and copra availability are the most affected by such forms of utilisation although coconut production is restricted geographically and generally plays only a minor role in the oilseed economies of the region.

The relatively small role of such "direct" consumption requirements reduces the instability introduced into oilseed availability for crushing that is apparent for many developing countries outside the region.

(iii) International trade in oilseeds, oils and oilcake

The pattern of surplus and deficit oil producing countries is indicated in Appendix Table 12. Except for Argentina, Brazil and Paraguay virtually all countries are net importers. Venezuela and Mexico both imported more than 230,000 tonnes in 1981/2 but most countries' imports are on a relatively modest scale. Most of these deficit countries import vegetable oil rather than oilseed, the exception being Mexico with very substantial soyabean and sunflower seed imports.

The pattern of importing oil may arise in part from the dominant position of soyabeans and oil in regional production and trade since a number of smaller deficit countries do not have the capacity for crushing soyabeans. Where the requirements of the domestic market are small the scale of such plant may be too low to operate economically in the context of comparatively priced oil available on the international market.

Amongst the few surplus countries, soya exports predominate with sunflower being of secondary importance. Brazilian exports are largely in the form of oil and cake although those of Argentina and Paraguay include significant volumes of seed.

Government support policies for crushing favour continued expansion in capacity in association with plans to expand oilseed production.

(iv) Domestic vegetable oil and oilcake demand

Demand for vegetable oil appears to be stronger than that for oilcake in most of the countries under review in Latin America. This demand is strengthened by relatively high population growth rates and per capita incomes. Whilst meat production and hence livestock feed demand has also expanded for similar reasons, oilcake demand is not a particularly strong feature in many countries. This is because of the predominance of ruminants in many livestock populations and the ready availability of pasture.

International feed demand is however highly significant for the few large scale surplus/exporting countries with their high proportion of soya in oilseed production and crushing. Levels of capacity utilisation in these countries are therefore linked, to a degree, to developments in the international soya economy.

(v) Conclusions

In general crushing levels in Latin American countries are quite closely linked to domestic oilseed production. However, partial exceptions exist for two major countries, Mexico and Argentina. In the case of Mexico, an oil deficit country, substantial volumes of seed, notably soya, are imported. In Argentina crushing levels have tended to lag behind expansion in oilseed production.

The scale of individual crushing plants appears to be correlated, to a degree, with the overall scale of production in the country concerned, ie with large scale plant in major producing/crushing countries. The type of plant is also influenced by the composition of oilseed production, with extensive solvent extraction capacity geared to soya processing.

"Traditional" oil extraction is of little significance for most countries in the region with crushing largely confined to the commercial sector.

4.4.3 Technical factors affecting processing capacity and operating efficiency

4.4.3.1 Introduction

Evaluation of technical factors entails an examination of each stage in the processing operations at plant level. Given the range of equipment available, almost any desired capacity level can be met both at national and at plant level. However, the choice of technology adopted may be influenced by both the level of oilseed production and its composition.

Technical factors are of greatest significance in relation to operating efficiency, defined to include both the level of capacity utilization achieved and the efficiency of oil extraction or refining for a given throughput of oilseeds. Capacity utilization may be affected by a wide range of factors, but certain of these eg. storage and spare parts, are found, on the basis of field experience in Developing Countries, to be of particular importance. Efficiency of oil extraction and the quality of derived oil are similarly affected by a range of factors of which spare parts and management are found to be of special significance.

A selection of important technical factors are discussed below and, where possible, an attempt is made to provide indicators of their relative importance, notably in relation to operating efficiency.

4.4.3.2 Oilseed reception, storage and pre-treatment

The layout of the mill must be such that there are no problems with reception and storage of seed. The reception area must be sufficiently large to cater for regular deliveries of seed without forming a bottleneck. For oil palm and coconut which are perennial crops raw material comes in throughout the year; with oil palm this is daily. For the annuals which include soya, safflower, sunflower, sesame, cottonseed, rape, mustard and groundnuts there might be intense seasonal activity requiring storage capacity to be planned for a year.

Safe seed storage should be capable of minimising seed quality deterioration and depends on many factors. The plant might have to include a provision for drying seed before it can be stored safely. Seed must also be protected from a variety of pests and kept covered to prevent damage by rain. Seed can be received and stored in bags or bulked in storage silos. Generally it is better to have seed stored in a number of small silos rather than in a few big ones.

If the seed is stored incorrectly there can be significant losses due to attack by rodents or damage by fungi and this may result in the consignment being condemned. If less severe it may make the seed difficult to process or may result in a high acid and/or oxidised oil which is difficult or impossible to refine and market.

Overall storage capacity may influence the level of crushing capacity especially for annual oilseeds with short seasonal harvest periods and hence greater storage requirements. Poor oilseed storage facilities may also reduce capacity utilization both because of limitations in the amount of storage and where inadequate facilities lead to deterioration in seed quality to the point where batches are rejected.

More frequently the constraints imposed by poor storage affect the quality of seed. Oilseeds stored for long periods are especially susceptible. For example, seed stored over a 6 month period may result in a rise in ffa levels from around 1 to 2 per cent to 6 to 7 per cent. Even higher ffa levels may occur and beyond the 10 per cent level, oil refining is uneconomic even where physical refining (with lower loss levels than chemical refining) is undertaken.

Seed received at the mill can have a significant trash content and should be cleaned of sand, stones, dirt, straw, tramp metal and other debris. Failure to do so will lower throughput or damage plant machinery which apart from causing plant shut down may result in expensive and unnecessary repair bills.

Some oilseeds are decorticated before oil extraction. Advantages include increased throughput and higher protein content residual meals and sometimes crude oils which are more easily refined. If, however, decortication equipment is not kept in good running order loss of kernel to the hull fraction can be significant resulting in lower oil yield per unit of original seed.

4.4.3.3 Oil extraction and refining plant

Section 4.3.1 shows that there are many types of plant available for edible oil extraction. Selection of plant depends on the quantity and types of seed to be processed. Expellers can process most oilseeds but even the most efficient will leave over 4 per cent oil in the cake. Expellers really are the only choice when seed availability is less than 10,000 tonnes per year. Above this level solvent extraction or prepress solvent extraction is possible.

Pre-press solvent extraction is as versatile as expelling in terms of the range of oilseed that can be processed. High oil content seeds are first expelled to give cake containing 17-20 per cent oil which is subsequently solvent extracted. Clearly the throughput of expeller(s) and solvent extractor must be matched.

Direct solvent extraction plants are less versatile than the other types of plant noted above. They are particularly well adapted for use with soya beans and with oil cakes from other oilseeds having 17-20 per cent residual oil. Extractors which agitate or turn the seed bed halfway through the extraction cycle are claimed to be able to extract oil from seeds having up to 40 per cent oil content. One manufacturer of percolation/immersion technology claims to solvent extract seeds having up to 70 per cent oil content. Thus if the plant is expected to process a variety of different oil content seeds the extraction technology needs careful consideration.

Expellers have worms, flights, cage bars, knife bars and chokes etc. which exhibit continuous wear. Refining equipment consist of tanks, pressure vessels, pipelines, valves, pumps etc, all of which will deteriorate with use causing leakage and contamination. Regular replacement or refurbishing is necessary to maintain efficient oil extraction and refining. Also correct seed conditioning is important; too much or too little moisture and heating of seed can reduce expeller efficiency. In solvent extraction wear of flaking rolls is important because flake thickness is critical to good solvent extraction.

The choice available between crushing and refining technology is sufficiently wide to cover almost any level of desired capacity. However, the choice of technology is influenced by both the scale and type of oilseed available. Expellers are the only realistic choice at capacities below 10,000 tonnes p.a. whilst direct solvent extraction is less versatile ie. it can only effectively handle oilseeds and oilcakes with relatively low oil contents. Relatively small scale plants where expellers are the only option are thus at some disadvantage in terms of operating efficiency in comparison to cases where solvent extraction can be applied, since expelling generally leaves at least 4 per cent residual oil in oilcake in comparison to below 1 per cent residual oil for solvent plants (and pre-press expeller/solvent plants).

4.4.3.4 Maintenance and Spare Parts

The proper organisation of maintenance schedules and spares procurement is essential for any enterprise wishing to achieve an efficient, cost effective undertaking.

It is therefore important to establish genuine and reliable sources of spare parts for equipment requiring a regular replacement on a preventative maintenance basis.

The usual procedure adopted on deciding the scope of such maintenance procedures is to consult the equipment manufacturers who, on the basis of past operational experience, are able to advise on spares to be carried and the timetable for replacement against the operating cycles of a given material being processed.

The consequences of the non-availability of suitable spares and the lack of control of preventative maintenance procedures can be significant; starting with a fall in production levels and effic[illegible]y and leading to an eventual shut down of plant due to ultimate failure o[illegible] key equipment. The latter situation could result in complete machines having to be replaced because of the nature of the failure induced.

As a general rule spares are best obtained from the original equipment maker. However, there are situations where alternative local sources can provide these items at less cost. There can be serious implications attaching to these "local spares", namely the specification of materials used in their manufacture together with the achievement of compatible surface finishes and tolerances for use with the original machine. If these "local" spares fail to meet the original specifications on any of these aspects, the effect on equipment performance and durability could be significant.

It is essential to confirm that these "local spares" conform in <u>all</u> respects to the original equipment specifications and drawings.

Where maintenance procedures involve parts re-furbishing, as with some expeller worms (screws) it is important to confirm that the techniques employed and the materials used will result in a final result compatible with the materials and surface finishes as specified for the original machines.

The role of spares in overall plant operations should be given proper priority in the organisation of any oil extraction enterprise. It is clearly false economy to adopt any other approach on these matters.

Maintenance and spare parts usually represent the most critical area with respect to the potential technical constraints in crushing performance. For example capacity utilization may be critically affected by breakdown resulting from weaknesses in maintenance scheduling and performance and poor spare part availability and quality. For similar reasons oil extraction rates are often poor; residual oil levels between 10 per cent to 20 per cent are commonly found in expeller oilcake rather than levels around 4 per cent which are technically feasible.

4.4.3.5 Conclusions

Given the range of technology available, pressing equipment can meet almost any desired level of capacity. Smaller scale enterprises where expellers are the only real choice are at a disadvantage in terms of oil extraction efficiency leaving as much as 4 per cent residual oil in oilcake. In comparison larger scale enterprises can employ solvent extraction to produce oilcake with below 1 per cent residual oil.

Capacity utilization may be affected by a range of factors but the most important are usually problems with maintenance, lack of spares and limitations to storage capacity.

Operating efficiency, in the sense of oil extraction rates achieved compared to those technically possible, are affected by the choice of equipment noted above. However, easily the most important factor is the extent to which maintenance and spare parts are adequately covered. Where refining is also undertaken (as is often the case), storage facilities are also particularly important since poor storage may result in high ffa levels and hence heavy losses in refining.

4.5 Further issues relating to processing

4.5.1 Introduction

This section covers only a selection of issues related to processing, the selection being based upon the requirements of the terms of reference for this Chapter.

The first two sub sections deal with two essentially economic aspects which are associated with the scale of enterprise. Firstly the economics of small scale expellers are discussed. This represents an area of particular importance given the widespread existence of traditional small scale units in many Developed Countries and the potential for improved efficiency afforded by the introduction of modern technology. The second topic discussed is the role of Trans-National Corporations (TNCs) which play a significant role in many major oilseed crushing Developing Countries.

Two further sub-sections examine technical aspects and are concerned with recent developments both in processing technology and derived products with special reference to applications in Developing Countries.

4.5.2 Economics of small-scale processing

The development of traditional technology (4.3.1.1) and modern village oil extraction equipment (4.3.1.2) has been particularly marked on the Indian sub-continent (India, Bangladesh, Nepal, Pakistan and Sri Lanka) where today many hundreds of thousands of these ventures co-exist with their larger scale counterparts which invariably consist of expeller and/or solvent plants. It must be assumed therefore that these smaller ventures operate successfully in their own environment. As well as purchasing seed on their own account and selling oil and cake, many operators will also extract, for a fee, oil from seed provided by farmers, householders and other traders. The fee could be either a cash payment or alternatively oilcake and/or a portion of the extracted oil could be retained. Nowadays, the products of this scale of operations are exclusively for highly localised domestic consumption.

Medium scale edible oil production in developing countries demands a high level of skills (technical, managerial, adminstrative) to avoid the problems highlighted in Section 4.4.3. In many cases these skills have not developed quickly enough with the result that the industry operates well under capacity and the domestic market, particularly in remote areas, remains unsatisfied. In such circumstances the introduction of small scale processing, which is not so demanding of the above-noted skills may offer a viable alternative. Such a development may also stimulate increased production of oilseeds in an area which could ultimately benefit large processors as well. It must be noted however, that the establishment of even small scale enterprises may present difficulties, for example the problem of obtaining spare parts noted in Section 4.4.3.4.

Obviously, it is impossible to provide a detailed economic analysis which would cover all circumstances and situations but the components of such an analysis can be listed in order to provide a framework for application:

a) method of operation: either custom milling or seed purchase by the mill and the subsequent sale of cake and oil. The choice would depend on local requirements.

b) technology: at its simplest consisting of an expeller and drums for collection and clarification of crude oil. The efficiency of oil extraction and, in particular, the recovery of clean oil for sale might be improved considerably by inclusion of seed cleaning and conditioning equipment and an oil filter press.

c) yields of products: oil and cake yields will depend on the oilcake used but even for a particular oilseed there will be variations depending on operator skill, quality of oilseed, level of maintenance and spares replacement.

d) markets for products: the market will probably be much more localised than for a larger factory. The products might be expected to have a simpler packaging and distribution network and therefore to be used more quickly. Crude oil production and marketing is probably more widely practised than for refined oil in this sector. Crude oil will have a characteristic taste and smell, often termed traditional, which will depend on the oilseed and the method of oil extraction. Although analysis by modern chemical techniques would classify these oils as inferior to their refined oil counterparts, their prompt use and flavour capability frequently ensures favour for traditional market outlets.

Cake sales can be to the animal feed market, smallholders or large-scale farmers. Alternatively, because there can be a significant residue oil content the cake (as much as 20 per cent), it might be sold to larger scale extraction factories for the production of oil for soap manufacture.

e) labour and training: in contrast to their medium to large scale counterparts small scale mills are labour intensive. The level of skill demanded, though not high in any particular area, must be considerable and the same people might be involved in each stage from seed reception to edible oil distribution, maintenance of machine and basic book-keeing.

f) maintenance and spares: no less important than for larger factories. With the operation being entirely domestic there is no generation of foreign exchange which could be a constraining factor on the import of spares from abroad. If spares have to be imported the Government should have a rural credit scheme from which foreign exchange can be made available for spares replacement. Agents for overseas companies will only operate a spares replacement programme when there is sufficient local business to justify this. The alternative to importing spares is to employ skilled blacksmiths to refurbish components of machinery locally.

g) finance: setting up a small-scale village oil expeller can require considerable sums of money when compared to a typical village income from subsistence agriculture or wage employment. The equipment for the factory might have to be imported and this will require foreign exchange. Buildings for the factory will have to be constructed, and perhaps even land purchased.

Commercial banks do not give credit without collateral and, for villagers or those wishing to set up small-scale oil extraction factories, this can be a severe financial constraint to development. Some countries now operate schemes where the Central Bank will guarantee the loan advanced by the commercial bank, and to this end, cooperatives might have a better chance of securing loans than individuals.

Working capital is an essential requirement and the amount needed will depend on the method of plant operation and expected sales turnover. The major variable cost will be seed purchase (up to 80% of the total annual cost even in the first year of operation). The method of seed purchase is therefore of considerable importance. For a perennial crop (eg. oil palm and coconut) financing a month of operation may be adequate. For an annual crop (harvested over 2-3 month period) the cost of purchasing seed for the whole year would be considerable and could make an otherwise well-structured operation difficult to establish. It would be preferable to buy seed on a regular monthly basis from local farmers or a local Agricultural Marketing Board particularly if the farmer requires income as a lump sum after seed harvest.

The viability of small scale expellers hinges upon individual financial and economic analyses which should take full account of Government policies, especially price policies likely to affect raw materials and/or end products. It is probable however that a positive return would be indicated in a variety of circumstances and Developing Countries.

4.5.3 The Role of Transnational Corporations (TNCs)*

4.5.3.1 Introduction

Transnational corporations, or Multinationals companies as they were once known, are broadly defined as firms which undertake direct foreign investment, ie. they own productive assets, in two or more countries. They are responsible for the bulk of direct foreign investment but are conceptually different from foreign investment in that they contribute other factors (skills, technology, etc) as well as capital.

Distinguishing features of TNCs include their large size - one hundred food processing companies enjoyed revenues of at least $1 billion in 1976 (UN 1981); their oligopolistic character and their unique ability to be able to view the world as a single economic unit and thus plan and manage on a global scale. Their basic objective is to maximise global profits and thus it is inevitable that conflict arises between host country governments, which seek to safeguard specifically national interests, and the TNC subsidiary in those countries.

The power and influence of TNCs lies in their ownership and control of knowledge, built up over the years and broadly defined to include the technology of production, organisational management skills and marketing techniques. In fact this 'soft' technology may be more important than the 'hard' technology embodied in machinery and equipment.

* Sources

1. UN Department of Social and Economic Affairs. Multinational Corporations in World Development. 1974.

2. UN Department of Social and Economic Affairs. Transnational Corporations in World Development. 1973.

3. UN Department of Social and Economic Affairs. Transnational Corporations in World Development - a re-examination. 1978.

4. UN Centre on Transnational Corporations. Transnational Corporations in Food and Beverage Processing. 1981.

The geographical spread of TNCs reflects both the spheres of interest and the former colonial ties of the major western powers. 70 per cent of US affiliate are located in Central and South America while of British TNC affiliates, 40 per cent are in Africa and 32 per cent in Asia (UN 1974). Japanese TNC affiliates are concentrated in Central and South America, although this is quite clearly not related to previous colonial ties. TNC investment is heavily concentrated in a few developing countries. Argentina, Brazil, India, Mexico, Nigeria, Venezuela and some of the smaller Caribbean islands account for 43 per cent of the total stock of foreign direct investment in developing countries. Another 13 developing countries account for a further 30 per cent of total (UN 1974). Historically the extractive sector (especially petroleum) and infrastructure have been the most important areas of foreign involvement but this has lessened as developing country governments have become increasingly successful in gaining control over their non-renewable natural resources. TNCs have in recent years developed new strategies in the light of these changed economic and political conditions. The local processing of raw materials has become more important, new ownership schemes and contractual arrangements have been introduced and new technologies developed, all of which demonstrate the flexibility and resourcefulness of the TNCs (UN 1974).

There is a wealth of information on TNCs in developing countries but as far as can be ascertained there is very little material specifically on TNCs and oilseed processing. Neither is their much comprehensive data on the importance of TNCs in individual developing countries. The remainder of this section is therefore limited to reviewing the available information on TNCs in the food processing sector where it is relevant to this study and to presenting the available data on TNCs and oilseed processing. This has been entirely gathered from UN sources and for a more detailed exposition on TNCs in developing countries readers are advised to refer to the original sources at the end of this section.

4.5.3.2 Transnational Corporations in Food Processing

About one third of the food processed outside the Centrally Planned Economies is produced by large enterprises - that is those with 1976 food-processing revenues in excess of US$300 million. Some 189 firms were found to fit this definition, all but one of which (Bunge and Born) are based in the Developed Countries. Appendix Table 13 shows 28 firms in order of their 1976 all food sales which have declared a major interest in vegetable oil processing. Just as with food processing TNCs in general, a high proportion of the firms are highly diversified, both within food processing and among non-food manufacturing and service activities. In fact, of the 28 firms listed all but Nisshin Oil Mills have several processing enterprises other than vegetable oils. Many of the biggest companies have lines quite unrelated to food, including steel mills, oil refining, mining, publishing, travel agencies, hotels etc.

The manner in which some of these firms have achieved their position in the food processing sector is also relevant. For a significant number of the largest food processing firms, prominence in this industry grew out of other food related activities, ie. commodity trade, shipping and finance. Cargill, Mitsui, Continental Grain, Bunge and Born and the East Asiatic Company, among others, moved into food processing as an extension of their trading activities. Nearly all the largest food retailers of Europe, North America and Japan have also integrated upstream into processing. Several leading pharmaceutical and toiletries manufacturers have similarly expanded their product lines to include food, eg. Proctor and Gamble, Foremost-McKesson and Colgate-Palmolive. Other firms have used their food processing base to diversify into other areas, for example General Mills are now engaged in numerous lines of business outside the food industry.

The number and relative importance of foreign investments differs widely among host countries. The larger and richer of the Developing Countries have attracted the greatest number of TNCs affiliates. The 15 countries whose food processing industry output exceeded US$1 billion were host to an average of 18 TNCs with local processing activities. Brazil and Mexico are each host to more than 40 foreign-based investors. Appendix Table 14 shows the share of various sectors of Brazilian industry held by foreign firms. The table includes the vegetable oil sector and the considerable increase in foreign domination of this sector can be clearly seen.

Studies have shown that it is where market potential and government policies favourable to TNCs coincide that these companies become most actively engaged. As a corrolary it can be taken that TNC management believe that market potential is better and Government policies more favourable in Brazil than in most other developing countries in the world.

In the case of processing operations for local markets the TNC normally establishes its affiliate in such a way as to capture a share of the growing market or in an effort to expand its sales in the face of either host country import restrictions or the rising cost of imports. The pattern of development has tended to be that food firms firstly export into foreign markets from home country plants then arrange foreign licencing, perhaps followed by local investment in processing. The success of any one TNC in an overseas market will often attract rivals, each seeking to protect its market position by similar expansion.

TNCs will establish successful affiliates only if they are allowed to enjoy an advantage over local firms and their potential TNC rivals. The advantage that TNC affiliates enjoy over local firms is their established access to foreign markets, their expertise and their ability to invest large amounts of capital. The strategies which TNCs follow in establishing themselves in new countries will normally be built around their particular strengths or advantages.

4.5.3.3 Transnational Corporations in the Oil Seed Sector

Appendix Table 15 shows the 28 largest vegetable oil companies with the extent of their investments overseas. 19 of these firms have affiliate activities in 38 Developing Countries (see Appendix Tables 16 and 17). Unilever, with affiliates in primary processing and/or consumer-oil products in 24 of these countries is by far the leading firm in the industry, as well as in soap and detergent manufacture, which uses the same raw materials. Although Unilever has significant rivals in many of its developed country markets, the only firm whose developing country affiliates are of comparable scope is CPC which has affiliates producing edible oil products although, apparently not actually crushing oilseeds, in 14 Developing Countries. Most of the primary oil processors carry their production downstream into margarine and table oils but only a few of the major consumer-product firms besides Unilever are so heavily engaged in primary oil processing.

Other large processing firms with significant interests in developing country oil processing include Cargill, (Brazil and the Philippines), Bunge and Born (Brazil), Continental Grain (Brazil), Anderson Clayton (Brazil and Mexico), Archer-Daniels-Midland (Brazil) and United Brands (Central America). The activities of the companies operating in Brazil have benefited greatly from the continued expansion of soyabean and from various official incentives to the oil-crushing firms.* Lesieur, the leading French consumer oil firm draws on African affiliate production for home country use, as does Nisshin oils from its Malaysian operation.

4.5.3.4 Conclusions

In discussing the role of TNCs in developing countries the question at issue is the contribution they can make to economic development. TNCs can certainly offer access to technology, foreign markets and managerial and technical skills and, given present conditions in many developing countries today, these are indispensable ingredients to change and improvement which may perhaps only be available to developing countries through some kind of arrangement with TNCs.

TNCs may be the only institution with the financial resources to develop new products, undertake capital intensive projects and open up markets. Their potential contribution is therefore enormous, although from the developing country point of view the greater this contribution the greater is the reliance of the host country on the TNC in question.

It is however the nature and structure of this arrangement and its cost to the host country that is really at issue and over which any conflict is likely to arise. TNCs, their prime objective global profit maximisation, can hardly be blamed for the lack of development in a host country or for the introduction of "inappropriate" technology when development was never their aim. Nonetheless developing countries can seek to extract from TNCs guarantees of behaviour and reasonable conduct and even to claw back profits they believe to be excessive. In the final event if must be the responsibility of the host country government to pursue policies which maximise domestic welfare although it must be recognised that in any country there are a variety of interest groups and it is often between these interests as much as between the TNC and the host country that conflict arises.

In order to provide any useful advice to host countries on the managing of TNCs specifically in oilseed processing, much more information is necessary on the basis of this "arrangement". It is not possible to evaluate the contribution of TNCs in this area without some detailed case study information on the relationship between a given country and a given TNC. As has been stated however TNCs are notoriously possessive about this type of information.

Because of shortage of data then generalisations are inappropriate and have not been attempted. Even with such data, the final judgement as to the suitability or otherwise of a given arrangement between a TNC and a host country is as much concerned with political or philosophical perspectives as it is with purely economic ones.

It is however clear that TNCs have a major role in oilseed processing, that very little information is available concerning the effects of this situation and that such information is difficult to obtain. This report therefore recommends further study in the area and believes that case studies which relate to particular companies and countries would be especially useful.

4.5.4 Advances in Technology

A continual on-going programme of research and development undertaken largely by equipment manufacturers or sponsored by specific commodity development agencies, ensures that successful research ideas or new materials are gradually converted to practical application and eventually result in marketed hardware or consumables.

Of particular note over the past decade or so have been improvements in both the design and operation of machinery aimed at achieving reductions in energy requirements, undoubtedly a response to the increases in petroleum prices experienced world-wide since the formation of OPEC; the more widespread application of fractionation processes to palm oil and the separate marketing of the derived liquid and solid components; and the wider acceptance of physical refining as opposed to the traditional neutralisation/bleaching/ deodourisation sequence.

In soyabean processing, for instance, innovations include new methods of air recirculation for energy efficiency in drying and modified cracking, as well as new equipment for dehulling and flaking. The innovations provide energy savings, better particle size control and improved flake yields. A more recent development applies fluid bed technology to dehulling, conditioning and drying.

Improved solvent extraction designs, applica ble to many oilseeds, are leading to reduced solvent losses, and more manufacturers are now marketing extractors which physically turn the bed of seed flakes during the solvent cycle, a procedure which is claimed to increase oil extraction efficiency by exposing fresh surfaces to solvent action so reducing channelling, and lessening solvent retention by the deoiled bran. The process should held reduce the energy requirements of desolventisation.

Palm Oil extraction and processing technology has made numerous advances in recent years which have resulted in both better quality standards and an increased range of traded products. Palm Fruit specific screw presses have virtually replaced hydraulic presses in all but the very smallest mills and the emphasis on good harvesting routines, rapid undelayed bunch sterilization on receipt at the factory, and improved oil drying equipment have all contributed to the reduced free fatty acid levels found in crude oil from the major producers. The increased use of stainless steel and magnetic traps within the factory has minimized contamination with iron and the consequent oxidation - a major cause of the traditional bleachability problems - of this oil. Frequent routine monitoring and analysis ensures the maintenance of high yields and low losses. The development of satisfactory effluent treatment systems has been forced on the industry in many parts of the world by strict pollution control legislation. The introduction of efficient, versatile, fully automated fractionation units developed specifically for palm oil has greatly enhanced penetration of palm oil products into the cooking oil and solid cooking fat/vanaspati markets, hitherto the domain of the more unsaturated vegetable oils, their hydrogenated derivatives and animal fats.

The basis of physical refining is the operation of a traditional deodouriser at higher temperatures and lower pressures so that steam distillation of both the fatty acids and the flavour volatiles from the oil takes place. By eliminating the caustic neutralisation stage the major source of neutral oil loss is avoided, capital and operating costs are reduced and soap stock treatment - with the attendant pollution problems - is unnecessary since the fatty acids are recovered directly. To be successful however, the input oil has to be virtually free of the phosphatides (gums), trace metals and pigments which cause darkening of the oil at the high temperatures employed. Development of physical refining has therefore stimulated inprovements in pretreatment degumming, bleaching and, in some cases, dewaxing - improvements which have also been of value in conventional refining procedures. Although initially developed to deal with high levels of free fatty acid in the oils (about 5 per cent ffa), at which level losses during caustic refining become very significant, physical refining has now become the preferred method for all qualities of palm oil. It is also increasingly used for coconut oil and has been successfully applied to maize and sunflower oils. Soyabean and rapeseed oils still present problems due to phosphatide and pigment contents but work is proceeding to develop pretreatment procedures so that refining by the physical route will become possible.

Improvements in expeller design have included the introduction of harder wearing components to reduce maintenance schedules. Manufacturers' model ranges have been extended at both large and small throughput levels and work has been carried out on the development of pre-press expellers which eliminate the need for the other traditional conditioning steps - cooking, rolling, flaking - which are normally required as a prerequisite for solvent extraction. These developments allow very substantial energy economies. Conventional edible oil processing is turning rapidly away from batch operation and towards continuous refining procedures. Greater use can then be made of centrifuges and self-cleaning filters for such steps as degumming, dewaxing, water washing; the removal of spent bleaching earth, hydrogenation catalyst and soap stock; clarification/polishing; these steps are conventionally carried out by sedimentation or plate/frame filtration. Speedier processing and enhanced yields are the major aim for such innovations but the automation that becomes possible with the introduction of such equipment also reduces labour requirements.

With oil palm, fibre by-products (sometimes together with kernels - although these are now almost invariably recovered) have always been used as fuel for the boiler to power the factory; other oilseed by-products such as sunflower shells, cottonseed hulls, and groundnut husks can be similarly used as a result of multi-fuel boiler development, clearly greatly reducing petroleum fuel requirements.

The technological aspects of acqueous coconut processing using fresh coconut meat, which aims at avoiding the quality deterioration of both oil and protein that invariably accompanies copra manufacture, has been intensively examined and much progress made over the past few years. A pilot plant employing the most appropriate comminuting, extraction, separation and drying equipment has been assembled in a USAID funded project in the Philippines and the yield and quality characteristics of a wide range of products - coconut milk, coconut cream, coconut oil, coconut skim milk powder, and a variety of protein and fibre products - evaluated and documented. Doubts, however, still remain on the economics of the process. The increase in revenue obtained by using the process as a source of edible oil is largely attributable to higher value of the better quality oil, but is not sufficient to outweigh the substantial increase in capital costs compared with conventional copra crushing. However, if a high value market can be found, or developed for the edible grade protein products wet processing may become economically viable. Until this is achieved copra crushing will remain the preferred source of coconut oil.

The market for groundnut cake has continued to be influenced by fear of aflatoxin contamination (a toxic metabolite produced by the mould Aspergillus flavus).

Consequently many countries severely limit the level of groundnut cake in livestock feed or even prohibit the importation of the commodity entirely. Despite many years of research and development no detoxification procedure has, at the time of writing, been universally accepted but recent investigations into ammoniation technology show great promise. The problem may well be significantly reduced in the not too distant future when appropriate equipment becomes commercially available.

4.5 5 Innovations in Raw Materials and Products

Although improvements in crop yield brought about by breeding work has received most publicity with respect to cereal crops - "the green revolution" - analogous advances have been made with virtually all the world's major oilseeds. Attention has been given to agronomic factors such as yield, disease resistance, maturation period and oil palm, coconut, soyabean, groundnut, rapeseed and sunflower, in particular, have benefitted from such developments. However improved cultivars developed by breeding programmes have passed, for a variety of technical and sociological reasons, from the plant breeder into commercial use far more rapidly in the developed countries, and in plantation and large scale farming environments, than in the subsistence and small farmer situation in Developing Countries.

The chemical characteristics of oilseeds have been the subject of marked innovation in the case of rapeseed and sunflower. Over a period of a decade the so-called "double zero" varieties of rapeseed have replaced the earlier types in Western Europe and North America. These are low in, or virtually free of erucic acid (previously the dominant and characteristic fatty acid of rapeseed oil) and of glucosinolates (previously the characteristic flavour component of the oil and a limiting factor in the utilisation of the oilcake in livestock feed). Both these components are nutritionally undesirable in the crop and their elimination has greatly widened the utilisation potential of both oil and oilcake. Lower fibre content cultivars are also now reaching commercial use enhancing further the oilcake value. Breeding work on rapeseed and mustard seed in developig countries is still concentrating entirely on yield factors. Indeed it is unlikely that glucosinolate reduction or elimination will become important in, for instance, the Indian subcontinent because the pungency imparted to the oil by its presence is a valued characteristic - the bulk of the oil being consumed in the crude form.

With sunflower the innovations have concerned oil content, European and American cultivars now typically have oil contents of around 45 per cent, an improvement largely attributable to a reduction in the hull content of the seed to around 20 per cent. In contrast, varieties grown in Africa have oil contents typically between 25 per cent and 35 per cent due to a hull content at around 40 per cent. Improved tropical varieties developed by breeding programmes are, hwoever, slowly coming into use in these countries.

Cloning of oil palm is now nearing commercial exploitation and similar success with the coconut palm is unlikely to be too long delayed. These innovations result from many years of intensive research and, in any case, follow spectacular improvements in yield by the development of early maturing, high yielding, disease resistant hybrids of both crops by conventional breeding techniques.

Just over the horizon there are as yet unimagined innovations brought about by the application of genetic engineering concepts still in their infancy. These should bring forward both the possibility of wholesale modifications to fatty acid composition and protein quality as well as all round yield improvements.

Cottonseed breeding has traditionally been guided by consideration of fibre quality and yield; seed characteristics, other than viability and vigour, have generally been ignored. Gossypol-free cottons have been introduced and their widespread use could have important implications for the oilseed industry, notably in the extraction of a less highly pigmented crude oil. Such oil is less costly to refine, has a higher value oilcake, and offers the possibility of preparing edible grade protein products and lecithins for the food industry. These markets are currently dominated by soyabean products.

As well as the move towards trading in oils rather than oilseeds, highlighted in other chapters of this report, there has also been a trend, particularly with palm oil, towards trading in refined oil rather than crude. This has been encouraged by the imposition, by Governments anxious to add value to primary products, of differential export tariffs which favour the more highly processed products. The move has also stimulated research and led to the development of improved handling techniques aimed at reducing hydration, aeration and metal contamination of the oil. It has also led to innovations in storage tank, pipe line and pump construction for the transportation of refined oils, these being more susceptible to deterioration than their crude counterparts.

The most significant new products to appear on the international markets in recent years have been palm olein and palm stearin often available RBD (refined, bleached, deodourised). As mentioned in the previous section these have resulted from the development and widespread commercial use of fractionation equipment for separating the normally semi-solid palm oil into its liquid (olein) and solid (stearin) fractions. Palm olein, with an iodine value of 55-60, has become a serious competitor to the more unsaturated liquid vegetable oils as a liquid cooking oil, although it is limited here to countries which enjoy a tropical climate and year round high ambient temperatures (75F). Palm stearin (IV 25-50), on the other hand, is available in a number of grades, and is increasingly used in tropical countries as a solid cooking fat or vanaspati, replacing animal fats or hydrogenated soyabean oil in this application.

Commercial food companies in the oils and fats field in developed countries pursue continuous research and development programmes aimed at improving consumer products and introducing new ones. An enormous range of cooking oils, cooking fats, bakery and confectionery fats, shortenings, margarines, ice creams, spreads etc. exist each backed by research and development teams investigating modified formulations, costreducing manufacturing procedures, performance improving additives and monitoring production to ensure the maintenance of quality. There are a wide variety of techniques that exist for modifying the characteristics of edible oils eg. hydrogenation, trans- and inter-esterification and fractionation and any of then can be employed to vary the performance of a given raw material. A typical example here would be that of cocoa butter and similar confectionery fats which have a characteristic sharp melting point at around body temperature. Although natural cocoa butter would be the commodity of choice in most applications, its high price frequently precludes its use. Thus a range of substitutes or replacements, derived most frequently from hydrogenated lauric oils (eg palm kernel oil) or inter esterified palm oil fractions, are manufactured in developed countries. Natural cocoa butter, like vegetable fats such as those derived from shea, sal or illipe, would undoubtely be used in far greater quantities if its supply and quality were more reliable. Innovations in the formulation of consumer products are shrouded in commercial secrecy and details are not available publicly.

The worldwide increase in petroleum prices has stimulated research into the potential of liquid vegetable oils as fuel for internal combustion engines. Work has been undertaken in many countries into the blending of soyabean, sunflower, rapeseed or coconut oils with diesel fuel for this application.

There have been varying reports of success. Short term performance tests of up to 30 per cent vegetable oil blends are invariably promising but longer term trials tend to reveal carbon deposits in the combustion chamber, injection orifice blocking, ring sticking and a thickening of lubricating oils. Close attention to oil filtration and the removal of phosphatides and waxes may overcome some of these problems. The use of simple fatty acid esters rather than triglycerides also shows promise. Investigations will undoubtedly continue since the concept is very attractive to countries with abundant oilseed supplies but no fossil fuel deposits but, even with technical success, it will be the economics of the technology which will decide its feasibility.

Chapter 5 Integrated Development

5.1 Introduction

The Terms of Reference for this chapter refer to "the strategy of integrated development" and call for the identification of opportunities for its application. It must be emphasized from the outset that an extensive search of available literature provides very little information on integration relating to the oilseed sector and especially in terms of detailed case studies. In this chapter it is therefore not possible to provide a detailed analysis of the many possible strategies and current patterns of integration existing in Developing Countries. Instead, an attempt is made to define the concepts involved, and to discuss forms of public and private sector integration referring where possible and in relatively general terms to the experience of individual Developing Countries or oilseed sectors. The Chapter concludes with a brief statement of action needed to identify opportunities for and to provide a fuller analysis of integration than is possible with current information sources.

The first requirement is to define the term "integrated development". In economic theory there are to be found the terms "vertical integration" and "horizontal integration". "Vertical integration" is commonly defined as the amalgamation of firms engaged in different stages of production of the same commodity to achieve greater economic strength and profitability. Although the units may be far apart geographically, both the sources of raw materials and the outlets for the product are assured.

"Horizontal integration" on the other hand, is defined as the amalgamation of firms engaged in the same stage of production of the same commodity to achieve greater economic strength and profitability. The concept of horizontal integration may become blurred where firms which produce a range of similar rather than, identical products amalgamate. Where such amalgamations involve large scale companies a wide range of products may be involved and such links are therefore better described by the term "product differentiation" rather than horizontal integration.

Horizontal and vertical integration are therefore two quite distinct concepts, which are unfortunately not always made clear in the literature on integrated development in oilseed processing.[1] This may be partly because the distinction

(1) eg. in Patterson: Measures and Forms to promote Integrated Development of the Vegetable Oils and Fats Industry within the Food Processing Industry (UNIDO, 1983) the distinction is blurred.

is a particularly difficult one to make in the oilseed sector, which is typified by a number of value added stages, with many co and by-products at each stage.

The concepts identified above need to be carefully distinguished from the term "integrated development" which is widely used, but seldom closely defined in development circles. Integrated development at sector level should be used to refer to the manipulation of the matrix of factors which affect production of oilseeds, derived products and their markets. Strategies for integrated development will therefore hinge upon the composition of the matrix, the form of government policy objectives and the means used to achieve those objectives, in any individual country. It is clear that no single strategy for integrated development exists which can be applied to Developing Countries as a group. Indeed a number of strategies are usually available for a single country, ie. the production, processing and marketing matrix may be manipulated in a variety of ways depending upon the choice of objectives by government and the instruments used to achieve such aims. Horizontal and vertical integration (as defined earlier) may play a role within such strategies under public, quasi-public or private sector initiatives.

5.2 The objectives of integrated development

The idea of integrated development in the Developing Countries, as a concept in planning, has emerged as part of recent attempts to meet certain perceived developmental objectives. In the context of this study, there are particular policy objectives from which Developing Countries may wish to choose whole in pursuit of their integration strategies. These include:

(i) Expansion of the capacity of the oilseed and oilseed products industry in the developing country.

(ii) Maximising potential value added in the oilseed processing industry

(iii) Maximising the potential benefits from economics of scale

(iv) Maximisation of the use of all co and by-products (including the reduction in waste).

(v) Increased export earnings and/or foreign exchange savings through import substitution.

(vi) Developing market strength, partly via the production of more sophisticated downstream products for export and/or import substitution.

In the presence of such objectives, governments may employ a range of policies, for example:

(i) Efforts to control marketing problems associated with the increasing degree of substitution between end-uses of oilseed products from Developing Countries.

(ii) The establishment and support of price stabilisation schemes geared to the oil deficit problems of developing countries, in order to promote self sufficiency

(iii) Agreement on the removal of trade barriers which affect imports of oilseeds and oilseed products in Developed Countries, plus other measures to maximise export potential of Developing Countries.

(iv) The commitment by the Developed Countries to seek means of controlling the expansion of their own oilseeds and oilseed products industry.

(v) The provision of improved market information services to Developing Country producers of oilseed products.

(vi) The improvement of the flow of information with regard to technological trends and innovations in the oilseed and oilseed products industry, and other measures to maximise the range and sophistication of products

(vii) The development of ways to monitor national plans for expansion of production of oilseeds and oilseed products in order that situations of over-supply in international markets be either avoided or anticipated sufficiently well in advance for remedial action to be agreed.

Integrated development has as its particular aim a desire to retain as much processing and manufacturing activity in the Developing Countries, each activity having its own linkage and multiplier effect. This will help retain value added in the Developing Countries.

Faced with a national demand for vegetable oil for example, a country can either import the oil, or import the oilseeds and crush them themselves, or produce the oilseeds domestically and crush them themselves. There are circumstances in which importing vegetable oil will be less costly than developing a domestic processing industry. However the viability of such an industry will be improved if it is planned in such a way as to use all the co-products and by-products. In the case of the co-products, oilcake, for example a domestic or export market must be found. This may invove establishing a new local livestock feed project with all the implications such an investment entails.

Recent research has also shown that other by-products can be recovered from factory residues. Empty oil palm bunches can be burnt to provide an ash rich in potash that can be used as fertilizer. Dried fibre and kernel shell can also be used as a fuel. Enhanced returns via use of by-products assumes that markets can be found for such products. It is of course essential that these be identified before any project or plan gets under way.

Similarly by integrating backwards, savings can be made. In the oil palm processing industry cultivation must be organised alongside processing as the fruit must be crushed immediately after harvest. However, integration of this sort is also applicable to other oilseeds and will enable savings on the costs of transport, storage, physical deterioration of the seed etc.

It may then be that a particular oilseed project will only be economically viable if it is integrated backwards and forwards so that raw material supply is assured, by-products utilised and markets properly identified. Other objectives of integrated development projects include the desire to bring employment to rural areas and the desire to establish regional equality. A benefit can of course be ascribed to this in the economic schedules.

Whilst a large number of potential advantages stem from the pursuit of integration within the sector, certain drawbacks may also arise eg:

- reduction in competition at all stages and hence the possibility for price fixing and 'abnormal' profits to arise

- possible adverse employment effects with movements from small scale to large scale enterprise.

- possible adverse social effects where production of oilseeds is reorganised.

- small scale processors, who repreent those taking the initiative on the first stage of the entrepreneurial ladder, may be adversely affected by integration of processing units and/or the promotion of medium and large scale enterprise.

- rural consumers may suffer where production of oil is rationalised to primarily serve urban areas.

In pursuing integration objectives, governments therefore need to be aware of potential drawbacks and to implement policy measures to counteract adverse factors.

5.3. Opportunities and examples of integration

Opportunities for integration depend upon the matrix of factors which determine the production, processing and marketing of oilseeds and derived products. Integration is used to describe all of the earlier defined items:

- integrated development
- horizontal integration
- vertical integration

In particular countries the selection of key elements within the production processing and marketing matrix will influence the extent to which integration in its various forms is feasible, ie:

- the oilseed agricultural base, including the oilseed mix produced and potential for expansion
- the economic environment including the relative scale and potential for public and private enterprise and government economic and fiscal policy
- the extent to which the country concerned is in net (oil) surplus or deficit
- the overall scale of the oilseed production and processing industry and the degree of sophistication of the latter.
- the size and composition of market demand notably where requirements for sophisticated end products stimulate further downstream processing

The remainder of this section provides examples of integration related to elements of the production, processing and marketing matrix. This discussion only covers examples of the more narrowly defined horizontal and vertical integration (Section 5.1). A broader discussion of integrated development in relation to individual countries is not possible as a reuslt of the dearth of information also referred to earlier. However, subsequent sections briefly outline both the nature of sector planning associated with integrated development and the means for identifying suitable countries for study ie. those where potential is likely to be greater.

5.3.1 Integration related to oilseed type and levels of production

For all oilseeds under consideration except palm, crushing yields both oil and oilcake as co-products. Linkages between the vegetable oil and oilcake/animal feed industries are therefore strong simply by virtue of such co-production.

The potential for further linkages varies between oilseeds. Cottonseed is itself a by-product of cotton ginning and hence a 'natural' link normally exists between cotton mills and cottonseed crushing enterprises. Links also exist between ginneries and seed cotton production since the former often represents the sole market for the latter. Ginneries may control production directly or indirectly through the issues of seed planting, credit etc. Examples of this type of integration are found in the Sudan and in Afghanistan.

Oil palm has a 'natural' bias towards vertical integration as oil palm fruits must be processed within hours of harvesting, leading either to strong institutional links between palm growers and palm oil producers or direct ownership of the former by the latter. In contrast, certain oilseeds are much less strongly amenible to vertical linkages. This particularly applies to oilseeds where non crushing utilization and/or direct human consumption are important, as is the case for coconuts. Since coconut producers often have a variety of market outlets available to them and since relative returns to products other than copra are usually significantly higher than for copra itself, little incentive exists for vertical linkages on the part of coconut producers.

5.3.2 Integration within the Public and Private Sectors

5.3.2.1 Private Sector Integration

In a perfectly competitive situation, integrating levels of production and processing might prove difficult. The oilseeds sector however is, as we have seen in Section 4.5.3, highly concentrated and heavily dominated by TNCs, with their enormous power and influence. Unilever with its vast number of subsidiaries and range of interests is an obvious and good example. This company controls all aspects of its operation, from the original research and development through training of personnel, production of raw material, crushing, and refining to the final marketing of the many by- and co-products. The company is virtually completely vertically integrated.

The Brazilian case where five TNCs accounted for 62 per cent of crush in 1977/78, has already been discussed. This is a clear case of horizontal integration. On the other hand there are industries where a particular firm or organisation controls levels of processing from plantation production through crushing, refining and modification while also controlling the by-product sectors of animal feed, soap manufacture and even perhaps fertilizer supply. The international activities of Unilever are a good example of this vertical integration. Clearly there are also cases where both vertical integration and horizontal integration exist together.

5.3.2.2 Public Sector Integration

The public sector can be employed in two ways. Firstly to re-organise and integrate existing units which are operating without contact and therefore without accruing maximum benefit. It may be that at relatively low cost the state can integrate these units into a whole, minimizing waste and maximizing value added. The agro-industry of the Pelotta region in Southern Brazil was reorganised in such a way on UNIDO's advice. The Government provided credit for a range of purposes:- the establishment of new and more efficient production; for mergers; for the purchase of modern equipment; for training to improve technical efficiency; and for advice on market potential.

A second type of approach which the State can organise is that of identifying a completely new project situation. That is arranging for production of raw materials and for the various steps through processing to marketing of new production. The market research should be carried out first and the production geared to the opportunities identified. Ideally the project should be organised around small modules which can grow with demand and as opportunities present themselves.

An example of this type of approach is a project in Mexico, where the Government in collaboration with UNIDO, identified some 40 opportunities to create food processing plants in two regions of the country. In recent years a number of Developing Countries have begun to establish soyabean production and processing industries following this approach.

Horizontal integration of the the crushing stage often runs counter to government objectives except where state controlled enterprise and/or control by nationals is envisaged. An example of the latter form of integration is provided by recent developments in the Malaysian oil palm industry. Controlling interests have been purchased by Permodalan (the national equity corporation) in TNCs such as Harrison and Crossfield, Guthrie, Barlow and Dunlop. The aim of such purchases is to increase participation by Malay nationals investing in unit trusts. This example also includes vertical linkages since TNCs used to operate both oil palm estates and oil extraction plants.

A further example of horizontal integration is provided by the Philippines where copra crushing capacity has increasingly come under the control of the United Coconut Oil Millers Incorporated (UNICOM). A major incentive in this case was the need to rationalise the industry in order to reduce surplus capacity. If must be noted that UNICOM, like most institutions operating in the Philippines Coconut sector, includes a strong element of private sector participation, and as such, its activities can only be regarded as quasi-public-sector.

Horizontal integration may also be promoted indirectly and/or unintentionally eg. where governments provide incentives to TNC's which may lead to a situation similar to that of the Brazilian case discussed above.

Public sector encouragement of horizontal integration is more common at the level of oilseed production, and may also be linked to vertical integration as in the Malaysian example quoted earlier. A range of initiatives are apparent ranging from relatively weak linkages in the form of small scale co-operatives to more centralised marketing boards, such as the Copra marketing boards established in most countries in the Asian and Pacific Coconut Community (APCC).

Encouragement of cooperatives may arise where governments do not wish to become directly involved in production, but seek to encourage an integrated approach. In India the success of the AMUL Dairy Cooperative prompted the Government to establish the Gujerat Cooperative Oilseeds Growers Federation (GCOGF) to improve and integrate the production, processing and marketing of oilseeds. Membership of the Federation has increased from 300 in 1980 to 70,500 in 1982. The Cooperative offers inputs of seed, fertilizer and other inputs at prices lower than were previously available; it also provides equipment for processing and is planning to build some processing units in addition to the two it currently owns and operates.

In any project, including those described above, the Government should also consider the most appropriate fiscal policy, the level and scope of its financial assistance, the extent to which it should become involved in promotion and its possible role in providing technical support.

5.3.3 Integration and vegetable oil surplus/deficit Developing Countries

Horizontal and vertical integration is often well developed in net exporting (ie oil surplus) countries. In such countries TNCs are usually well established as a result of the attractions provided by the export trade. Examples have already been referred to earlier eg. TNC involvement in Brazil and Malaysia, two of the largest Developing Country exporters.

Integration is generally less advanced in oil deficit countries. Most of such countries are confronted with problems in achieving growth rates in oilseed production sufficient to meet domestic consumption needs. Production is often characterised by fragmented distribution of small scale farmers and a similar pattern often applies to oilseed processors. Difficulties are especially acute in major countries eg. those in the Indian sub-continent as a result of the sheer scale of the sector.

Thus, whilst in India itself areas of integrated development exist within the sector, there is also much diversity, exemplified by the number of small scale crushers operating. In Bangladesh attempts have been made through vertical integration, to import products with low added value, eg. oilseed and crude oils, and to process oils domestically to add value and maximise foreign exchange savings.

In many cases public or quasi-public sector initiatives in deficit countries have taken the form of Government encouragement of co-operative enterprise discussed in 5.3.2.2 above. Where medium and larger scale processing units exist in the private sector, these have generally sought to ensure supplies by contracting arrangements with producers with few attempts at direct vertical integration into production itself.

5.3.4 Integration related to the scale and sophistication of the processing industry, and market demand for products

The scale of operation of an oilseed processing plant is crucial to its amenability to integration. Small scale operations will tend to be more geographically dispersed and hence more difficult to integrate than a more concentrated large operation. (The various levels of oilseed processing, from village level upwards are discussed in Section 4.3.3).

Larger scale enterprise lend themselves more easily to integration, partly because of the opportunities afforded by the wider range and greater sophistication of items which such companies tend to produce. The latter comment particularly applies to vegetable oils where the technical opportunities for further products in a sophisticated consumer economy are very large indeed. At the simplest level crushing companies may produce soap using the by-products of refining as part of the required feedstock and also manufacture hardened vegetable fats for inclusion in margarines and shortenings. The opportunities for further product development in both edible and inedible items is very considerable as illustrated, for example, by the range produced by Unilever: from reformulation pizzas to aerosol hair sprays.

It must be noted however that vertical (and horizontal) integration is by no means inevitable and varying economic and market conditions may produce widely diverging patterns of scale of enterprise and ownership. For example large scale manufacturers of food products may find it more financially viable to 'buy-in' specific vegetable oil product formulations from specialist firms for inclusion in end products, rather than manufacturing such items themselves.

5.4 The role of sector planning

Sector planning clearly plays a major role where governments choose to intervene to promote integration within the oilseed sector. Successful implementation of integration strategies will depend upon the effectiveness of such planning. This section provides an outline of requirements in relation to planning in the oilseed sector.

In the context of the policy objectives discussed earlier, the first task of sector planning is to set targets for production and consumption of vegetable oilseeds and their products. In the case of exporting countries, this will involve estimating the excess of production over consumption available for export, as well as consideration of the size of and potential for developing export markets. For importing countries target consumption levels need to be identified and, in relation to the domestic production potential, the required level of imports established.

Planning in the oilseed sector is relatively complex when compared with some other commodities. For example, target consumption levels of vegetable oils need to be established within the context of associated products, ie oilseeds and oil cakes, as well as in relation to substitutes, ie animal fats. This highlights the general need to ensure inter-sectoral compatability within the overall plan framework. Similarly vegetable oils may act as substitutes for each other, the choice between them depending on such factors as consumer preference and price. The increasing substitutability between vegetable oil products made possible by advances in technnology means that targeting has become an increasingly complex exercise.

Once the initial targets for supplies have been established, the sector plan must then be developed to consider how these targets are to be met. As the first step, development of oilseed production should be examined. The range of factors to be considered include the availability of land, suitability of soil, selection of seed varieties, the place of oilseeds in present farming systems and the profitability of production when compared with other crops. The next step is to examine the processing infrastructure. How much processing capacity is available at present and how much more investment will be required to handle the proposed future production? Answering this question is of course part of the purpose of this very study.

Any new projects would involve undertaking feasibility studies to examine the financial and economic returns to new investment. Within such studies it is necessary to consider available technologies and scales, establishment costs, working capital requirements, operating costs, management and staffing levels etc. To link the agricultural and industrial developments and subsequently to market the produce will entail the development of marketing systems. This will involve consideration of the physical infrastructure, ie roads and vehicles as well as institutional factors, eg the need for a marketing organisation, marketing regulations, pricing systems etc. In addition sector development plans need to consider the whole range of supporting services which will include credit facilities, training requirements, needs for technical assistance etc.

In undertaking the various planning steps outlined above certain constraints on the development of the sector will be identified. In the light of these constraints it may be necessary to amend the initial supply targets so that the final plan presents the most realistic estimates, taking into account all the available information. It is in failing to establish realistic estimates of the future supply/demand situation that developing countries have often been criticised in the past. Those with a declared policy of self sufficiency in vegetable oilseed products often only assess their import requirements annually. The result is that imports tend to be organised at comparatively short notice on an ad hoc basis and cover no more than the period between domestic crops. Such short term decision making almost always incurs a cost through the payment of higher prices than are strictly necessary. It also means that supplies are more likely to be bought from the large TNCs which have greater flexibility as suppliers, than from other Developing Countries. If, through more realistic planning, a long term programme for importing vegetable oilseed products could be worked out, the importing countries would

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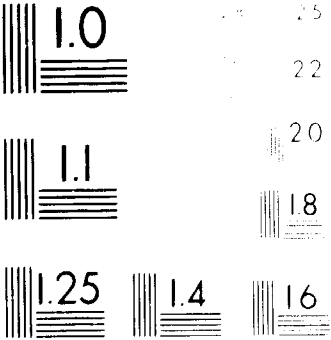

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almost certainly be in a position to arrange imports more cheaply and in larger quantities, as well as looking to other Developing Countries as suppliers.

This problem can be made worse by planners who, in the drive for self sufficiency, may project unrealistic increases in production totally out of proportion to historical performance. Commonly little significance is attached to the relative prices of domestic supplies and imports, and often the quite high foreign exchange costs associated with increasing domestic production in the form of imported fuel, fertilizer, machinery and equipment etc are not taken into account.

To a degree short-term planning is also characteristic of some exporters, especially when the crop grown is an annual one (tree crop production has the advantage of allowing greater accuracy of crop forecasting). Unpredictable growing conditions make annual fluctuations in production inevitable, but Governments must make a realistic assessment of their export potentials taking into account the levels of world market prices when compared to domestic costs of production.

A sound sector development plan alone will be insufficient to ensure that the general policy objectives set for the sector are met. It is the responsibility of Government to create the conditions to ensure that investment and hence development is stimulated.

5.5 Conclusions

Limitations in data and the complexity of the interaction of factors affecting integration preclude a detailed country by country consideration of integration in the oilseed sector, however, certain broad conclusions may be drawn from the foregoing discussion.

It is evident that no single integration strategy exists or is applicable to all Developing Countries. In practice a wide range of strategies are appropriate to different countries as a result both of differences in the production, processing and marketing matrix of the sector and in the range of objectives held by government.

Whilst it is not possible to generalise with regard to integration strategy, certain elements of the production, processing and marketing matrix tend to influence the potential for the more narrowly defined concepts of vertical and horizontal integration. For example certain oilseeds may be more 'naturally' amenable to vertical integration (eg. oil palm) and/or horizontal integration (eg. cottonseed). Further examples of both horizontal and vertical integration appear to be correlated with the scale and sophistication of the oilseed processing sector and the nature of demand for oilseed products, especially in net exporting countries where the role of TNC's is especially important.

An analysis of integration strategy can be undertaken effectively only in the context of individual country studies. The potential for integration will clearly vary between countries in relation to differences in the production, processing and marketing matrix in each case. Whilst the detailed concept of the matrix needs further refining certain broad comments can be made here to indicate the need and feasibility of further study, particularly to short list candidate countries where integration may be a feasible proposition.

It has already been noted that horizontal and vertical integration tend to be more advanced in the relatively small number of large scale net exporting countries. Certain of these countries, eg. Malaysia, have further developed an integration policy to draw together such developments in relation to percieved national objectives. Since most exporters have gone some distance towards achieving integration, the potential for further development is greater amongst net deficit/importing countries.

Further studies on integration might therefore be concentrated on the oil deficit group of Developing Countries. Within this group, a wide variety of conditions are experienced. At one end of the spectrum are the small scale producers (often island economies) which tend to cultivate a narrow range of oilseeds. (In many such cases coconuts are the sole oilseed produced). The possibilities for a broad integration strategy in these countries are clearly constrained. At the other end of the spectrum, some countries typified by those on the Indian sub-continent, have very large scale oilseed processing sectors and produce a wide range of seeds and derivatives. The need for an integration strategy in such cases is much greater although so also will be its complexity. Countries within this sub-group might therefore be the most suitable in which to carry out further research.

Further work is therefore required to refine the production, processing and marketing matrix for individual countries. From such matrices a short list of countries may be selected including those which exhibit the greatest potential gains from integration. Subsequent detailed country studies could then be undertaken in order to identify and promote appropriate integration strategies.

APPENDICES

List of Appendix Tables

Table 1

Crushings of selected[3] oil seeds by Country ('000 tonnes)

	Average 1970-71	Average 1976-77	Average 1981-82	% Increase 1976/7-81/2
Asia				
India	...	7,253	8,029	10.7
West Malaysia	...	296	968	227.0
Philippines	1,016	1,628	2,133	31.0
Taiwan	...	758	1,070	41.2
Pakistan	...	964	1,341	39.1
Turkey	...	1,089	1,205	10.7
Republic of Korea	...	317	411	29.7
Indonesia	...	1,114	1,063	-4.6
Sri Lanka	...	118	120	1.7
Sub Total	...	13,537	16,340	20.7
Africa				
Senegal	403	659	363	-44.9
South Africa	...	344	486	41.3
Algeria	...	59	44	-25.4
Morocco	...	9	6	-33.3
Benin	...	55	27[2]	-50.9
Nigeria	...	135	176[2]	30.4
Zaire	...	57	60[2]	5.3
Sudan	...	679	748	10.2
Egypt	...	657	484	-26.3
Sub Total	...	2,654	2,394	-9.8
Latin America				
Argentina	1,314	1,983	3,118	57.2
Brazil	3,104	8,618	14,335	66.3
Mexico	...	1,522	2,373	55.9
Venezuela	...	42	62	47.6
Sub Total	...	12,165	19,888	63.5
LDC Total	...	28,356	38,622	36.2

	Average 1970-71	Average 1976-77	Average 1981-82	% Increase 1976/7-81/2
Centrally Planned Economies				
USSR	8,747	9,937	9,443	-5.0
China[1]	...	6,715	13,232	97.1
Hungary[1]	...	216	567	62.5
Bulgaria[1]	...	416	463	11.3
Czechoslovakia[1]	...	239	379	58.6
GDR[1]	...	328	330	0.6
Poland[1]	...	745	561	-24.7
Romania[1]	...	1,090	1,284	17.8
Yugoslavia[1]	...	493	591	19.9
Sub Total	...	20,179	26,850	33.1
Developed Countries				
Australia[1]	...	67	98	46.3
Austria	2	2	3	50.0
Finland	106	132	188	42.4
Norway	252	256	348	35.9
Portugal	156	350	547	56.3
Sweden	185	221	206	-6.8
Spain	1,669	2,314	3,779	63.3
Switzerland	110	29	38	31.0
Belgium/Lux.	335	874	1,582	81.0
Denmark	548	444	252	-43.2
France	1,381	1,300	1,662	27.8
Greece	244	292	474	62.3
Ireland	7	12	7	-41.7
Italy	1,400	1,309	1,586	21.2
Netherlands	1,601	1,780	2,953	65.9
UK	533	1,395	1,669	19.6
West Germany	2,885	4,626	5,129	10.9
Canada	918	1,188	1,998	68.2
USA	24,325	26,331	33,820	28.4
Japan	3,382	3,687	5,096	38.2
Sub Total	40,039	46,609	61,435	31.8
GRAND TOTAL	-	95,144	126,907	33.4

Notes

1. These countries include in their total soyabean crush, which is an element in total crush, figures for the October-September year for 1976/7 and 1977/8 as the calendar year figures are unavailable.

2. The 1982 figure for these countries is not available and so this entry is for 1981 only.

3. Soyabean, cottonseed, groundnuts, sunflower seed, rapeseed, sesame seed, copra and palm kernel. Does not include oil palm.

... Not available

Source: Oil World

Table 2

World oil seed crushings, by seed, by available countries and by grouping 1979-82

	% of 1979	1979	1980	1981	1982	% of 1982
				('000 tonnes)		
A. Soya beans	100	65,556	73,036	71,411	74,426	100
1. Asia:	2.4	1,570	1,714	1,926	2,172	2.8
of which from						
India		217	319	380	436	
West Malaysia		23	85	163	179	
Taiwan		1,029	953	1,009	1,110	
Republic of Korea		301	357	374	447	
2. Africa:	0.2	110	109	111	135	0.2
of which from						
Egypt		110	109	111	135	
3. Latin America:	16.8	11,014	14,461	16,712	15,605	21.0
of which from						
Mexico		1,114	1,450	1,610	1,620	
Argentina		687	802	1,009	1,559	
Brazil		9,171	12,162	14,033	12,362	
Venezuela		48	47	60	64	
4. Centrally Planned Economies:	8.7	5,724	6,446	6,392	7,425	10.0
of which from						
USSR		1,486	1,747	1,473	1,710	
Rest of Eastern Europe		1,193	1,420	1,126	1,144	
China		3,045	3,279	3,793	4,591	
5. Developed countries:	71.9	47,138	50,306	46,270	49,099	66.0
of which from						
EEC		11,509	11,655	10,169	11,832	
Rest of Western Europe		2,901	3,763	3,749	4,211	
Canada		2,791	1,011	867	1,024	
USA		28,539	30,424	27,990	28,462	
Japan		3,398	3,453	3,495	3,570	

('000 tonnes)

		% of 1979	1979	1980	1981	1982	% of 1982
B.	Copra	100	3,716	4,084	4,120	4,200	100
1.	Asia:	86.0	3,197	3,605	3,699	3,680	87.6
	of which from:						
	India		378	384	382	387	
	Indonesia		932	1,128	945	951	
	West Malaysia		98	96	101	102	
	Philippines		1,670	1,920	2,165	2,100	
	Sri Lanka		119	77	106	140	
2.	Africa	-	-	-	-	-	-
3.	Latin America	3.8	140	140	143	144	3.4
	of which from						
	Mexico		140	140	143	144	
4.	Centrally Planned Economies:	0.5	19	17	12	20	0.5
	of which from						
	USSR		11	12	7	15	
	Rest of Eastern Europe		8	5	5	5	
5.	Developed Countries:	9.7	360	322	266	356	8.5
	of which from						
	EEC		235	195	126	204	
	Rest of Western Europe		71	60	68	70	
	USA		-	-	-	-	
	Japan		54	67	72	82	
C.	Palm kernels	100	895	1,132	1,120	1,337	100
1.	Asia:	50.2	449	657	685	940	70.4
	of which from						
	Indonesia		90	79	109	135	
	West Malaysia		459	578	576	805	
2.	Africa:	28.7	257	270	263	233	17.4
	of which from						
	Benin		26	37	27	27	
	Nigeria		188	183	176	156	
	Zaire		43	50	60	50	
3.	Latin America:	1.0	9	10	10	10	0.7
	of which from						
	Mexico		9	10	10	10	

('000 tonnes)

	% of 1979	1979	1980	1981	1982	% of 1982
4. Centrally Planned Economies:	4.9	44	45	42	43	3.2
of which from						
USSR		2	3	2	2	
China		42	42	40	41	
5. Developed Countries:	15.2	136	150	120	111	8.3
of which from						
EEC		121	123	101	94	
Rest of Western Europe		6	13	6	5	
Japan		9	14	13	12	
D. Sesame seed	100	828	777	732	806	100
1. Asia:	41.4	343	274	304	345	42.8
of which from						
India		343	274	304	345	
2. Africa:	13.4	111	84	75	65	8.1
of which from						
Sudan		111	84	75	65	
3. Latin America	5.9	49	77	55	27	3.3
of which from						
Mexico		49	77	55	27	
4. Centrally Planned Economies:	33.6	278	296	259	324	40.2
of which from						
USSR		7	11	9	9	
Eastern Europe		4	2	2	1	
China		267	283	248	314	
5. Developed Countries:	5.7	47	46	39	45	5.6
of which from						
EEC		9	9	-	-	
Japan		38	37	39	45	
E. Cottonseed:	100	15,882	17,316	17,453	18,895	100
1. Asia:	19.3	3,062	3,333	3,327	3,479	18.4
of which from						
India		1,612	1,614	1,593	1,696	
Pakistan		842	1,100	1,100	1,155	
Turkey		608	619	634	628	

('000 tonnes)

	% of 1979	1979	1980	1981	1982	% of 1982
2. Africa	5.7	905	912	950	979	5.2
of which from						
Egypt		685	746	778	721	
Sudan		220	166	172	258	
3. Latin America:	11.0	1,755	1,767	1,630	1,715	9.1
of which from						
Mexico		485	527	492	383	
Argentina		365	280	169	233	
Brazil		905	960	969	1,099	
4. Centrally Planned Economies:	39.5	6,271	6,833	7,617	7,997	42.3
of which from						
USSR		3,842	4,112	4,369	4,188	
Eastern Europe		10	10	8	9	
China		2,419	2,711	3,240	3,800	
5. Developed Countries:	24.5	3,889	4,471	3,929	4,725	25.0
of which from						
Western Europe		269	267	287	271	
USA		3,546	4,126	3,569	4,371	
Japan		74	78	73	83	
F. Groundnuts	100	6,214	5,755	5,058	6,401	100
1. Asia:	52.5	3,266	2,894	2,625	3,386	52.8
of which from						
India		3,235	2,865	2,606	3,370	
Taiwan		31	29	19	16	
2. Africa:	16.5	1,038	838	633	926	14.5
of which from						
Senegal		490	290	135	480	
South Africa		76	85	99	85	
Sudan		472	463	399	381	
3. Latin America:	10.3	638	522	269	307	4.8
of which from						
Mexico		20	16	18	23	
Argentina		383	200	89	128	
Brazil		235	306	162	156	

('000 tonnes)

		% of 1979	1979	1980	1981	1982	% of 1982
4.	Centrally Planned Economies:	14.3	889	1,151	1,236	1,375	21.5
	of which from						
	USSR		-	-	1	2	
	Eastern Europe		12	6	7	8	
	China		877	1,145	1,228	1,365	
5.	Developed Countries:	6.2	383	350	295	407	6.4
	of which from						
	EEC		168	122	88	118	
	Rest of Western Europe		52	23	45	89	
	USA		163	203	160	198	
	Japan		-	2	2	2	
G.	Sunflower seed	100	10,930	11,894	11,897	12,202	100
1.	Asia:	4.6	503	633	669	639	5.2
	of which from						
	India		21	25	59	108	
	Turkey		482	608	610	531	
2.	Africa:	3.5	386	395	450	372	3.0
	of which from						
	Senegal		1	1	27	4	
	South Africa		385	394	423	368	
3.	Latin America:	14.4	1,575	2,033	1,478	2,292	18.8
	of which from						
	Mexico		206	271	320	530	
	Argentina		1,369	1,762	1,158	1,762	
4.	Centrally Planned Economies:	57.9	6,330	5,952	6,282	6,425	52.7
	of which from						
	USSR		4,204	3,622	3,578	3,430	
	Eastern Europe		1,928	1,930	1,878	2,007	
	China		198	400	826	988	
5.	Developed Countries:	19.6	2,136	2,881	3,018	2,474	20.3
	of which from						
	EEC		1,178	1,490	1,428	1,081	
	Rest of Western Europe		600	782	825	935	
	USA		358	609	765	458	

('000 tonnes)

	% of 1979	1979	1980	1981	1982	% of 1982
H. Rapeseed	100	8,742	8,954	11,381	12,843	100
1. Asia:	21.7	1,899	1,494	2,202	2,559	19.9
of which from						
India		1,684	1,280	1,983	2,352	
Pakistan		215	214	219	207	
2. Africa:	1.0	85	66	50	43	0.3
of which from						
Algeria		64	52	45	36	
Morocco		21	14	5	7	
3. Latin America:	0.6	51	57	24	28	0.2
of which from						
Mexico		5	11	21	24	
Brazil		46	46	3	4	
4. Centrally Planned Economies:	31.8	2,783	3,164	4,128	5,487	42.7
of which from						
USSR		5	29	14	41	
Eastern Europe		880	907	1,111	1,027	
China		1,898	2,228	3,003	4,419	
5. Developed Countries:	44.9	3,924	4,173	4,977	4,726	36.8
of which from						
EEC		1,806	1,946	2,438	2,273	
Rest of Western Europe		270	277	283	367	
Canada		769	940	1,064	897	
Japan		1,079	1,010	1,192	1,189	

Source: Oil World

Table 3

Palm oil production 1981 and derived oil palm crush (ie. ÷ 0.25).

	Production	Crush
	'000 tonnes	'000 tonnes (FFB)
Benin	34	136
Cameroon	80	320
Ghana	21	84
Ivory Coast	190	760
Nigeria	675	2 700
Zaire	155	620
Colombia	88	352
Ecuador	42	168
China	190	760
Indonesia	722	2 888
Malaysia	2 822	11 288
Papua New Guinea	38	152
Total	5 057	20 228

Source: (i) FAO Production Yearbook 1981

(ii) Cornelius J.A. Processing of oil palm fruit and its products. TPI, G149 1983.

Table 4:

A Summary of Oilseed Processing: Asia

	a	b	c	d	e	f	g	h	i
	Crush capacity ('000 tonnes)	Actual crush ('000 tonnes)	Capacity utilisation (%)	No. of oil expeller mills	No. of solvent plants	Capacity of traditional sector	Refining capacity ('000 tonnes)	Actual refining ('000 tonnes)	No. of refineries
1. Malaysia	33,228	12,256	37	- see notes -		...	4,700	3,400	68
2. India	17,250	8,029	49	15,000	285	see notes	...	...	...
3. Indonesia	7,012	3,951	56	---452 ----		...	548	...	32
4. Philippines	3,173	2,133	67	----53 ---		...	644	...	19
5. Pakistan	1,937	1,341	69	553	14	...	90	20	...
6. Turkey	1,970	1,205	61	134	6	...	...	...	...
7. Taiwan	1,300	1,070	82	--- 87 ----		...	...	...	...
8. Republic of Korea	900	411	46	...	...	...	...	...	...
9. Bangladesh	418	177	42	460	2	...	53	49	10
10. Thailand	431	157	36	170	10	...	...	73	...
11. Sri Lanka	326	120	37	...	2	...	12	...	2
12. Papua New Guinea	60	51	85	1	nil	...	nil	nil	nil
13. Fiji	63	26	42	---- 4 ----		...	nil	nil	nil
14. Iraq	162	...	-	1	2	...	...	...	...
15. Afghanistan	112	...	-	7	nil	...	14	...	4
16. Saudi Arabia	nil	nil	-	nil	nil	...	nil	nil	nil
Sub Total *	68,068	30,927	45.4						
TOTAL	68,342	30,927	45.25						

Notes: ... not available

* see footnotes

Table 5:

A summary of oilseed Processing: Africa

		a	b	c	d	e	f	g	h	i
		Crush capacity '000 tonnes	Actual crush '000 tonnes	Capacity utilisation (%)	No of oil expeller mills	No of solvent plants	Capacity of traditional sector	Refining capacity '000 tonnes	Actual refining '000 tonnes	No of refineries
1	Egypt	— — —	877	—	— — —	See Notes	— — —	200	115	— — —
2	Ivory Coast	3,000	798	27	13	— — —	40	See notes	— — —	— — —
3	Sudan	1,203	748	62	100	2	— — —	— — —	45	— — —
4	South Africa	— — —	486	— — —	— — —	— — —	— — —	— — —	— — —	— — —
5	Senegal	950	363	38	4	— — —	— — —	See notes	— — —	— — —
6	Cameroon	See notes	306	—	See notes	— — —	33	20	4	— — —
7	Nigeria	1,000	181	18	13	— — —	470	— — —	— — —	— — —
8	Benin	— — —	163	— — —	— — —	— — —	— — —	— — —	— — —	— — —
9	Niger	— — —	126	— — —	— — —	— — —	— — —	— — —	— — —	— — —
10	Morocco	120	84	70	—	2	See notes	200	150	14
11	Tanzania	383	70	21	50	1	— — —	— — —	— — —	— — —
12	Zaire	400	60	15	— — —	— — —	196	— — —	— — —	— — —
13	Algeria	— — —	44	— — —	— — —	— — —	— — —	— — —	— — —	— — —
14	Somalia	102	11	11	See notes	—	8	8	— — —	2
15	Ghana	279	— — —	— — —	6	—	See notes	— — —	— — —	3
16	Kenya	150	— — —	—	10	1	— — —	See notes	— — —	12
17	Chad	60	— — —	— — —	— — —	— — —	— — —	— — —	— — —	— — —
	Sub Total*	7,213	2,315	32.1						
	TOTAL	7,702	4,317							

Notes — — — not available

[redacted] se [redacted]

Table 8

A Summary of Oilseed Processing: Latin America

	a	b	c	d	e	f	g	h	i
	Crush capacity ('000 tonnes)	Actual crush ('000 tonnes)	Capacity utilisation (%)	No. of oil expeller mills	No. of solvent plants	Capacity of traditional sector	Refining capacity ('000 tonnes)	Actual refining ('000 tonnes)	No. of refineries
1. Brazil	27,000	14,335	53	- see notes -		...	...	...	...
2. Argentina	6,832	3,118	41	44	26	...	...	...	34
3. Mexico	5,000	2,373	47	25	37	...	...	...	...
4. Colombia	542	304	56	...	...	...	...	...	...
5. Ecuador	...	164	...	...	...	...	...	...	...
6. Peru	300	140	47	...	...	...	220	...	...
7. Uruguay	252	89	35	11	5	...	-see notes -	...	...
8. Bolivia	408	84	21	4	3	...	52	31	6
9. Venezuela	202	62	31	...	...	...	-see notes -	...	...
10. Chile	...	26	...	...	...	...	-see notes -	...	...
Sub Total*	40,536	20,505	50.6						
	40,536	20,695	...						

Notes: ... not available

* see footnotes

Table 7:

A summary of oilseed Processing: Centrally Planned Economies

		a	b	c	d	e	f	g	h	i
		Crush capacity ('000 tonnes)	Actual crush ('000 tonnes)	Capacity utilisation (%)	No of oil expeller mills	No of solvent plants	Capacity of traditional sector	Refining capacity ('000 tonnes)	Actual refining ('000 tonnes)	No of refineries
1	China	___	13,992	___	← See notes →			___	___	___
2	USSR	11,392	9,443	83	← See notes →			___	___	___
3	Rumania	___	1,284	___	___	___	___	___	___	___
4	Yugoslavia	___	591	___	___	___	___	___	___	___
5	Poland	900	561	62	___	___	___	___	___	___
6	Hungary	___	567	___	___	___	___	___	___	___
7	Bulgaria	___	463	___	___	___	___	___	___	___
8	Czechoslovakia	___	379	___	___	___	___	___	___	___
9	German Democratic Republic	___	330	___	___	___	___	___	___	___
	Sub total *	12,292	10,004	81.4						
	TOTAL	12,292	27,610							

Notes ___ not available

* see footnotes

Table 8 :

A summary of oilseed Processing: Developed countries

		a	b	c	d	e	f	g	h	i
		Crush capacity '000 tonnes	Actual crush '000 tonnes	Capacity utilisation (%)	No of oil expeller mills	No of solvent plants	Capacity of traditional sector	Refining capacity '000 tonnes	Actual refining '000 tonnes	No of refineries
1	USA	39,000	33,820	87	---	---	---	---	---	---
2	Germany	6,400	5,129	80	---	---	---	---	---	---
3	Japan	8,000	5,096	64	---	---	---	---	---	---
4	Spain	4,000	3,779	94	---	---	---	---	---	---
5	Netherlands	2,800	2,953	*	See notes		---	---	---	---
6	Canada	1,300	1,998	*	---	---	---	---	---	---
7	UK	---	1,669	---	---	---	---	---	See notes	---
8	France	---	1,662	---	---	---	---	---	---	---
9	Italy	---	1,586	---	---	---	---	---	---	---
10 11	Belgium/ Luxembourg	---	1,582	---	---	---	---	---	---	---
12	Portugal	1,000	547	55	---	---	---	---	---	---
13	Greece	510	474	93	---	---	---	---	---	---
14	Norway	320	348	*	---	---	---	---	---	---
15	Denmark	---	252	---	---	---	---	---	---	---
16	Sweden	215	206	96	---	---	---	---	---	---
17	Finland	---	188	---	---	---	---	---	---	---
18	Australia	---	98	–	---	---	---	---	63	---
	Sub Total*	63,545	54,350	85.5						
	TOTAL	63,545	61,387							

Notes --- not available

[redacted]

Footnotes and sources to Tables 4 - 8

A. General

1. All "actual crush" figures are averages of 1981 and 1982 crushes as shown in Oil World unless otherwise stated (see Table 4). These however do not include oil palm crush. For the major producers of this commodity (Cameroon, Benin, Ghana, Ivory Coast, Nigeria, Zaire, Colombia, Ecuador, China, Indonesia, Malaysia, Papua New Guinea) the following procedure has been adopted: tonnage of palm oil production for 1981 has been extracted from the 1981 FAO Production Yearbook and a figure for crush derived by dividing by 0.25, the ratio given in Cornelius J.A. Processing of oil palm fruit and its products. TPI G149 1983 (see Table 9). This subsequent oil palm crush figure has been added to the figure from Oil World and where this has been done it is further noted in the footnotes.

2. --- = not available

3. Countries with populations of less than 5,000,000 have been excluded from consideration. The following countries with populations more than 5,000,000 have also been excluded due to a comlete lack of data:-

Asia:-	Iran, Nepal, Samoa
Africa:-	Uganda, Mozambique, Madagascar, Angola, Mali, Tunisia, Malawi, Upper Volta, Sierra Leone, Zimbabwe, Ethiopia.
Latin America:-	Paraguay, Guatemala, Dominican Republic, Haiti, El Salvador, Honduras, Puerto Rico, Panama.

B. Asia/Table 4

1. Malaysia

a. (i) 168 palm oil mills in 1981 with a combined capacity of 4,566 tonnes FFB/hr = 32,875,200 tonnes of oil palm per annum - Reuters Oil Seed Newsletter 28/1/82.

(ii) Installed copra crushing capacity, West Malaysia = 352,765 tonnes p.a. - Varnakulasingam: "Study of existing installed capacities of coconut processing plants in APCC member countries" - UNIDO 1981 (from here on described as APCC Study).

b. The 1981/1982 average crush figure for West Malaysia from Oil World = 968,000 tonnes. It does not include oil palm crush, (see general footnote 1).

The derived figure for oil palm crush for 1981 = 11,288,000 tonnes. Total crush = 12,256,000 tonnes.

There are 2 solvent extraction plants crushing soya beans and 3 plants crushing copra. No figure for oil palm.

g/h (i) "Actual" refining capacity = 4.7 million tonnes, but total "approved" refining capacity = 3.4 million tonnes. 16 new refineries are planned to bring total approved refining capacity to 4.1 million tonnes. Reuters Oilseed Newsletter 15/7/82.

(ii) Soya oil refining capacity expected in 1982 - USDA.

(iii) One of the largest Malaysian plantation processing operations is that of Sime-Darby, a British plantation company which has recently come under combined Government and local private-investor control. The company has become an integrated consumer-product processer as well as a diversified transnational during the past five years. - "Malaysia's Plantation-Grown Conglomerate", Fortune Magazine, 22 October 1979.

2. India

a. Varcie (UNIDO 1972) estimated 10,000 screw presses with capacity of 7-8 million tonnes. USDA (1982) estimates 15,000 expeller mills.

FAO/IGO (1982) estimated 285 solvent plants with capacity of 6 million tonnes of oil cake. The above figure was calculated as follows:

$(^{15}/_{10} \times 7.5 \text{ million}) + 6 \text{ million} = 17.25 \text{ million}.$

b. USDA (1982) put the average crush for 1981 and 1982 at 10,495,000 tonnes. The difference between this and the Oil World figure is probably the inclusion of some traditional sector crush.

f. FAO/IGO (1982) estimates there are 100,000 conventional oil presses. USDA (1982) puts the figure for village ghanis at 250,000 with an additional 50,000 electric power units, not including the 15,000 oil expellers.

3. Indonesia

a.

Copra capacity	=	1,658,122 tonnes
Oil palm capacity	=	5,227,200 tonnes
Palm kernel capacity	=	120,000 tonnes
Groundnut capacity	=	6,816 tonnes
		7,012,138 tonnes

- Varnakulasingan: Study on oils and fats situation in Indonesia. UNIDO 1980.

b. Oil World figure for actual crush = 1,063,000 tonnes, but does not include oil palm crush. This can be derived from FAO palm oil production figures (see General Footnote 1 and Table 9). Oil palm crush for Indonesia = 2,888,000 tonnes.

Total oil seed crush = 3,951,000 tonnes

d. 415 copra mills of which at least 91 not operating.

4 groundnut crushing factories.

33 oil palm and palm kernel mills.

g. 498,000 tonnes palm oil refining capacity 1980. USDA.
49,604 tonnes coconut oil refining capacity.
- Varnakulasingam. APCC Study UNIDO 1981.

h. 2 refineries for palm oil - Varnakulasingam: Indonesia Study 1980.
30 refineries for coconut oil - Varnakulasingam: APCC Study 1981.

4. Philippines

a. For copra only for 1981 - UCAP Annual 1981. A peanut oil factory is to be constructed, capacity 12,960 tonnes of oil, ie. 29,000 tonnes capacity, (UCAP).

Also said to be a soya bean crushing plant, capacity 390,000 tonnes, planned (Ibid).

d/e UCAP Annual 1981. (Varnakulasingam: APCC Study gives the figure as 63).

g. Coconut oil only - "Key Statistics of the Philippines Coconut Industry". UCAP 1981.

h. Ibid.

5. Pakistan

a. ITC (1980) estimate total expeller capacity as 4,750 tonnes per day. Days per year taken as 225.

For this paper 300 days assumed; annual capacity therefore being taken as 1,425,000.

Similarly 14 solvent plants identified (ITC 1980) with total daily capacity of 3,200 tonnes. Again although 160 working days assumed, this paper uses 300.

d. Fact Finding Mission on Vegetable Oil Industry in Pakistan. March 1979. Prepared by Manderstam Consulting Services for the ADB.

e. Only 12 functioning and only 7 operating regularly. (ITC 1980).

g. RC in the private sector only, for 1982, for edible oil only. USDA. Projects are afoot to boost this figure to 200,000 tonnes - Manderstam Services 1979.

h. USDA 1982.

6. Turkey

a. (i) 140 mills crushing cottonseed and sunflower seed, Total capacity = 1,970,000 tonnes
- "The production, utilisation and marketing of oil cakes in Turkey" - A.K. Gogus, from Animal Feeds of Tropical and Sub-tropical Origin. TPI Conference 1974.

(ii) Olive crush capacity not included although actual olive crush - 850,000 tonnes in 1982. USDA 1982.

b. (ii) Also excludes olive oil.

d/e A K Gogus, 1974.

g. Available figures indicate that existing plants have a total production capacity of 195,000 tonnes of breakfact margarines and 275,000 tonnes tonnes of shortening. - USDA 1982.

7. Taiwan

a. USDA 1982 capacity: days/year unknown.

d/e USDA

8. Republic of Korea

a. USDA 1982 capacity.

9. Bangladesh

a. Street et al: Proposals for the development of the oilseeds sector in Bangladesh. R1051A. TPI 1982.

Expeller mill capacity calculated at 146,292 tonnes for a 300 day year. 9 hour day. Using the standard 24 hour day, the figure is 390,112 tonnes. There are also two government controlled expeller factories each with a capacity of 6,250 tonnes, and a 15,000 tonne capacity solvent plant.

b. USDA

d. Street (1982)

e. Ibid

g. ITC (1980)

h. Street (1982): Actual refining is 90-95% of capacity.

i. Ibid

10. Thailand

a. (i) from Varnakulasingam "Study on fats and oil situation in Thailand". UNIDO 1981. Oil output figures converted back to seed capacity using ratios from UNIDO guidelines (1977) shown in Table 9.

(ii) New palm oil plant, capacity 26,000 tonnes FFB, planned.

d. USDA 1982

e. USDA 1978

h. 1978/9 Est. USDA

11. Sri Lanka

a. 1981 crush capacity, copra only. USDA

d/e 1978 - A total of 57 mills registered, only 42 operating.

- "An economic study of the coconut industry in Sri Lanka". Peoples Bank Research Department 1981.

g/i Varnakulasingam: APCC study 1981 - coconut oil only.

12. Papua New Guinea

a. (i) Copra only. Varnakulasingam: APCC Study 1981.

(ii) In Santhiapallai and Yeats: Vegetable Oils and Fats in the Pacific Region", UNIDO 1980, it is reported that a further 15,000 tonnes of copra milling capacity is soon to be installed.

b/c (i) 1978-1979 capacity utilisation for copra = 85%. Ibid.

(ii) There are no figures for oil palm crush capacity or actual oil palm crush. Using the procedure outlined in general footnote 1 however, oil palm crush in PNG can be calculated at 152,000 tonnes for 1981.

d. (i) Copra only. Varnakulasingam: APCC Study 1981.

(ii) It is reported that a new oil palm factory, capacity 120 tonnes FFB/day (and double that when a second processing line has been completed) has been constructed.
- UCAP Bulletin 30/10/80.

13. Fiji

a. Copra only. Varnakulasingam APCC Study. 1981.

b/c Average capacity utilisation 1978/9 = 42%. Ibid

d/e Ibid

g-i Ibid

14. Iraq

a. This capacity is based on cottonseed. If soya was to be used it would fall to 70,000 tonnes.
- ITC 1980.

d/c For cottonseed. Ibid

15. Afghanistan

a/g from J R Shaw and L D G Coward. "An appraisal of the cottonseed mill and oil refining industry in Afghanistan". TPI R680. 1977. This work covers only cottonseed and uses a 309 day year. The figures have therefore been altered to correspond to a 300 day year.

d/i Ibid

16. Saudi Arabia

There were plans to build a plant to produce 35,000 tonnes of refined oil p.a. presumably from largely imported oil - ITC 1980.

17. Sub Total: only includes countries with both capacity and actual crush figures.

C. Africa/Table 3

1. Egypt

a. Soyabeans crush capacity = 100,000 tonnes. However, as this is only a small part of total capacity, this figure has not been entered. - USDA.

b. This figures includes only cottonseed and soyabeans - USDA.

e. Six solvent extraction plants were reported as being installed in 1979, partly to replace an earlier six plants, which were designed to process cottonseed but are no longer operational.

- W Nichols and R Harris R819. "Report on a visit to Egypt to examine the oilseed processing industry", TPI 1979.

g. ITC 1980.

A new processing and refining plant was under construction in Alexandria in 1976, capacity 150,000 tonnes soyabean equivalent.

- ITC 1980.

h. Production of refined oil = 100,000 tonnes. 95% of it from cottonseed oil. (For conversion ratio back to crude, see Table 10).

- Nicholls and Harris 1979.

2. Ivory Coast

a. from the USDA Attache Reports quoted by UNIDO. Earlier USDA data gives oil palm crush as 1,400,000 tonnes.

b. 1979/80 palm oil only. - USDA

d. State-run mills for oil palm. - USDA

f. Estimated at 10,000 tonnes oil, 1981. - USDA

Assuming this is palm oil, the corresponding oil palm crush = 40,000 tonnes (see Table 9).

g. There is refining capacity for palm kernel oil, quantity unknown.

3. Sudan

a.

75	mills nominal capacity	648,000	tonnes for groundnuts and sesame.
25	mills nominal capacity	555,000	tonnes for cottonseed
100		1,203,000	

Days/year unknown

There were 106 new mills under consideration or construction; total crushing capacity = 978,000 - UNIDO 1979.

b. UNIDO 1979 estimates 1977/8 actual crush at 553,000 tonnes.

e. UNIDO 1979.

h. Some 40,000 tonnes semi-refined cottonseed oil is produced. It is assumed that the loss from crude = 12% (see Table 10 - UNIDO 1979).

4. South Africa

b. Oil World.

5. Senegal

a. USDA: groundnuts only, days/year unknown. 1980

b. USDA 1980.

g. There is capacity for refining but details are unknown - USDA.

6. Cameroon

a. Capacity for palm kernel crushing = 20,000 tonnes. Days/year unknown: Capacity for crushing other oilseeds unknown.
- UNIDO 1979.

b. (i) Actual crush:

Palm kernels	12,000 tonnes
Palm oil (66,000 tonnes oil)	264,000 tonnes
Cottonseed: in 1977/8 two out of the three producing regions crushed	26,000 tonnes
Groundnuts	4,400 tonnes
	306,400 tonnes

- UNIDO 1979.

(ii) Using the procedure outlined in General Footnote 1 to ascertain oil palm crush, actual crush of oil palm in Cameroon comes to 320,000 tonnes. (See Table 3). UNIDO figures is used however.

d. Only one cottonseed crusher operates - USDA.

f. Palm oil only. 1982. USDA.

g. Palm oil and palm kernel oil only. UNIDO 1979.

h. Production of refined oil:

Cottonseed	3,200 tonnes.	1979
Groundnut	225 tonnes.	1977/8

– UNIDO 1979. (See Table 3 for conversion ratios).

7. Nigeria

a. FAO Intergovernmental Group on Oilseeds. Jan 1983.

A lot of capacity is idle due to a shortage of groundnuts. Only 3% of capacity used for cottonseed. No of days/year unknown. The figure obviously does not include oil palm crush (see (b) below).

b. Actual crush for cottonseed and palm kernels in 1981 = 181,000 tonnes – Oil World (no figure for 1982). Using the procedure outlined in General Footnote 1 to determine oil palm crush from palm oil production, oil palm crush estimated at 2,700,000 tonnes (see Table 2).

Total actual crush = 2,881,000 tonnes. This is nearly 3x crush capacity and it is therefore assumed that the figure given for capacity does not include oil palm crush.

The figure for cottonseed and palm kernel is entered here.

d/e (i) Of 13 crushing mills, mostly in the North, only five are operating, some on imported soyabeans, others on refining imported groundnut oil.

– ITC 1980.

(ii) The Nigerian Palm Produce Board is to establish 48 Palm Oil processing and 160 palm nut crackers.

– FAO IGO. Jan 1983.

f. 1981/2 average "traditional" crush for groundnuts.

– USDA.

8. Benin

b. Oil World figure for 1981 (1982 figure unavailable), and excluding oil palm, = 27,000 tonnes. Using the procedure outlined in General Footnote 1, oil palm crush calculated at 136,000 tonnes. Total crush therefore = 163,000 tonnes.

9. Niger

a. 1971 production of crude groundnut oil = 56,000 tonnes. Therefore (see Table 9) Crush = 125,843 tonnes groundnuts.

10. Morocco

a. ITC 1980.

b/c Current capacity utilisation = 70%. (Ibid).

Oil World gives actual crush of only 6,000 tonnes; USDA 35,000 tonnes.

f. There were 5,000 'masras', ie village level olive oil extraction units in 1977 - USDA.

g-i ITC 1980.

11. Tanzania

a. Total crushing capacity of cottonseed = 217,500 tonnes @ 250 working days/year.

Total crushing capacity of copra (days/year unknown but assumed also 250)	=	19,100
		236,600
(Converted to a 300 day year	=	283,920 tonnes)
+ solvent extraction plant at Morogoro		45,000
+ 1 other mill capacity		9,000
		337,920 - UNIDO 1979

b. Average copra crush 1974-5 = 6,862 tonnes

Average cottonseed crush 1977-8 = 63,211 tonnes

70,073

- UNIDO 1979.

d. 11 copra mills.

39 cottonseed mills.

- United Republic of Tanzania: Price Policy Recommendations for 1980-81 Agricultural Price Review.

12. Zaire

a. - UNIDO, from USDA Attache Reports.

(ii) A new mill is to be built to crush oil palms with a capacity of 80 tonnes/day.

- Reuter Oilseed Newsletter. 5/5/82.

b. Oil World figure for 1981. (1982 figure unavailable). Includes only palm kernels.

Using the procedure outlined in General Footnote 1, oil palm crush can be derived from FAO production figures for palm oil (see also Table 3). In the case of Zaire oil palm crush calculated at 620,000 tonnes. However as capacity figures does not include oil palm, it has also been excluded here.

f. Palm oil production in the subsistence sector estimated at 44,000 tonnes in 1979 - USDA.

Oil palm crush therefore = 196,000 tonnes (see Table 9).

14. Somalia (UNIDO 1979)

a. (i) Capacity of Mogadishu state-run factory is 12,000 tonnes. (Utilisation 33%).

(ii) There are also 150 small Japanese mills with total capacity 100 tonnes per 8 hours = 90,000 tonnes

Total = 102,000 tonnes

b.	Average crush of Mogadishu factory	=	4,000 tonnes
	Production of private sector (1971) (excluding camel presses)	=	7,200
			11,200

d. One state-run expeller (see above). There are also the 150 small Japanese mills and an estimated 630 private camel presses which are assumed to be in the "traditonal" sector. These are believed to be very dilapidated.

f. 630 camel presses, capacity 40 kg/day, but very old.

g/i One small batch refiner, capacity 1,500 tonnes p.a.
One small deodouriser, capacity 6,000 tonnes p.a.

15. Ghana

b. A total crush figure could not be found. Using the procedure outlined in General Footnote 1 however a figure for oil palm crush of 84,000 tonnes has been derived. (See Table 3).

d. Two for oil palm, two for groundnuts, one for copra and one for copra and groundnuts.

f. Traditional crush estimated at 21,000 tonnes palm oil (= 84,000 tonnes oil palm) and 30,000 tonnes palm kernels - USDA 1980.

Traditional processing units with no mechanical devices were estimated to account for

70% coconut oil production
60% palm oil production
90% palm kernel oil production

There are also several small "village" mills with capacity ranging from 0.8 tonnes - 1 tonne/hour and the State Farms Corporation has three 1 tonne/hour mills.

- ITC 1980.

i. Two of the six crushing mills have facilities for refining and deodourisation and another has facilities for refining and decolouring.

- ITC 1980.

16. Kenya

a. There is over capacity.

g. ITC 1980: 12 refining installations with a total hourly capacity of 200 tonnes. ie. Annual capacity of 1.44 million tonnes. This figure is clearly too high and seems possible that hourly capacity may have been confused with daily capacity. Figure not shown.

i. ITC 1980.

17. Chad

a. 60,000 tonnes cottonseed or 15,000 tonnes groundnuts.

- Banque des Etats de L'Afrique Occidentale No 51

18. Sub Total

Countries with both capacity and actual crush figures only.

D. Latin America/Table 6

1. Brazil

a. (i) USDA 1982, 300 day year

(ii) Some 80% of capacity is for soyabeans - Brazil Trade and Industry, September 1981.

(iii) 2 new plants, total capacity = 600,000 tonnes p.a., under construction 1983, USDA.

(iv) The five leading transnational corporations in Brazil's soyabean sector - Bunge and Born, Unilever, Continental, Cargill and Anderson Clayton - have a combined crushing capacity of about 5 million tonnes per year out of a total of about 8.5 million tonnes. Most of the remainder is large-scale plants operated by one private and six co-operative firms. - Latin American Commodities Report. 17 December 1976.

(v) Total crush 1977/8 = 9,561,000 tonnes of which 5,564,000 tonnes accounted for by four of the companies listed. Their share of total TNC crush was as follows

TNC	% TNC crush
Bunge	33.4
A Clayton	15.5
Cargill	28.3
Continental	16.7

Source: G Muller 'Les Oleagineux et l'expansion recente du Soya du Bresil' in Transnational et Agriculture, cahier de recherche No 3, I. Centre de Recherche sur l'Amerique Latine et le Tiers Monde.

d/e (i) There are 180 processing companies in Brazil, largely in the centre and the South - Brazil Trade and Industry, September 1981.

(ii) Break down by type reported as:

continuous solvent	88%
non-continuous solvent	11%
mechanical	1%

- USDA

2. Argentina

a. USDA 1980 quotes a crush capacity figure of 7,515,000 tonnes for a 330 day year. This figure has been corrected to 300 days and includes some capacity for crushing linseed

d/e/i J J Hinrichsen S A Ltd. Publicity Document 1981

3. Mexico

a. USDA Attache Reports. Quoted by UNIDO.

b. Oil World.

4. Colombia

a. USDA Attache Reports. Quoted by UNIDO. TDRI have access to other USDA information which cites non-oil palm crush capacity as 391,000 tonnes. It is possible therefore that this figure includes oil palm crush capacity.

b. USDA 1982. This figure also excludes oil palm crush which, according to the procedure outlined in General Footnote 1, has been calculated at 352,000 tonnes.

5. Ecuador

b. Includes 93,000 tonnes oil palm - USDA.

6. Peru

a. ITC 1980. Oil Palm capacity currently 72,000 tonnes p.a. due to expand to 100,000 tonnes by 1986. There is also a plan to build a soya bean/cottonseed/groundnuts plant, capacity 35,000 tonnes.

b. USDA 1981/2 includes oil palm.

g. Includes fish oil - ITC 1980.

7. Uruguay

a. USDA 1979 Days/year unknown.

b. USDA 1981/2

d/e There are 16 factories equipped to extract vegetable oil. 5 handle largely linseed and another 6 do 95% of edible oil, - UNIDO 1979.

e. Soya extraction is done by solvent plants which have a total capacity of 300 tonnes/day - UNIDO 1979.

g. Most oil is probably refined - USDA.

8. Bolivia

a. Cottonseed crushing capacity	=	201,000 tonnes
Soyabean crushing capacity	=	207,000 tonnes
(300 per day)		408,000 tonnes
		- UNIDO information

b. USDA 1981/2.

d. One not operating due to financial difficulties - UNIDO 1979.

e/g Ibid

h. USDA 1981. Actual refining = 60% capacity.

i. UNIDO 1979.

9. Venezuela

a. USDA 1982

b. USDA gives 168,000 tonnes 1981/2.

g. There is refining capacity but quantity unknown - USDA.

10. Chile

b. USDA 1982.

g. At least 43,000 tonnes refined oil produced in 1980 - USDA. 1982

11. Sub total: Only countries with both capacity and actual crush figures.

E. Centrally Planned Economies/Table 7

1. China

b. Total Actual Crush = 13,232,000 tonnes (Oil World) and is made up of:

Soybeans	27%
Cottonseed	27%
Groundnuts	10%
Sunflower seed	7%
Rapeseed	27%

The figure does not include oil palm crush. However, using the procedure outlined in General Footnote 1, it is possible to derive a figure from FAO palm oil production figures (see Table 3).

Hence, Chinese oil palm crush = 760,000 tonnes
Total oilseed crush = 13,992,000 tonnes

d-f Oilseeds are crushed at the commune or production brigade level or in municipal or county factories. The machinery is old and extraction rates generally low, especially in the rural areas. There are solvent extraction facilities as solvent extraction prices are quoted - USDA.

2. USSR

a. (i) USDA 1982 puts Soviet crush capacity at 12 million tonnes. The number of days/year are unknown but the FAO Intergovernmental Group on Oilseeds, March 1977, reports a similar capacity based on the Soviet working year of 316 days. The above figure has been subsequently calculated according to a 300 day year.

(ii) Breakdown of capacity is as follows:

Sunflower seed	54%
Cottonseed	35%
Other (including soya)	11%

- FAO, IGO. March 1977.

d-f (i) In 1976 18% of total capacity was accounted for by simple presses.

(ii) Extraction methods accounted for

88% of cottonseed mills
94% of soyabean mills
80% of sunflower mills
45% of other seed mills

- FAO/IGO March 1977.

3/4/7 Rumania, Yugoslavia and Bulgaria

b. Crushing facilities are scheduled to expand and soybean imports likely to increase to fill otherwise underutilised new capacity.

- Foreign Agriculture. 20/2/78.

5. Poland

a. USDA Attache Reports. Quoted by UNIDO.

b. Crushing facilities are adequate to supply domestic feed requirements.
- Foreign Agriculture. 20/2/78.

6. Hungary

b. There has been excess production of oilseeds over crushing capacity and consequently whole oilseeds have been exported. A new plant was due to open in 1980 (capacity 1,000 tonnes of sunflower seed per day) to help alleviate this situation.

- FAO, IGO. April 1980.

10. Sub Total: Includes only countries with both capacity and actual crush figures.

F. Developed Countries/Table 8

Crush capacity figures for developed countries are scarce and difficult to compile. It is widely assumed that utilisation is some 75-80% of capacity.

1. The USA

a. Soyabean crush and seeds crushed at soya plants only.

- USDA 1980.

b. For the sake of consistency all actual crush figures are, where available, taken from Oil World. USDA figures for actual crush conflict somewhat in this case, probably because the Oil World figure is for all oilseeds while the USDA one is explicitly only for soyabean. The USDA quoted an actual crush figure for soybeans of 28 million tonnes, ie. 72% utilisation of soybean crush capacity.

2. Germany

a. Expected German crush for 1982 reported as 4 million tonnes, or 60-65% capacity utilisaition.

- Reuters Oilseed Newsletter. 19/8/82.

b. Some 80% of crush is of soyabeans, the remainder is rapeseed and sunflower.

- Reuters Oilseed Newsletter. 11/7/83.

3. Japan

a. USDA 1981. days/year unknown.

4. Spain

a. Foreign Agriculture. October 1980.

5. Netherlands

a. Crush capacity figure is for soyabeans only. As a consequence actual crush exceeds capacity. Related capacity utilisation figure for soybean is given as 86%.

- Reuters Oilseed Newletter. 8/10/82.

d/e The three major crushing companies are Unimills, Rotterdam; Central Soya, Utrecht; Cargill, Amsterdam.

The total number of plants is unknown although Unimills have two plants with total capacity 24,000 tonnes/week.

6. Canada

a. USDA 1981. days/year unknown.

b. Actual crush exceeds crush capacity.

USDA 1981 and the FAO Intergovernmental Group on Oilseeds (Feb 1983) both report recent increases in capacity which may have been omitted from the USDA's 1981 capacity figure.

The latter source mentions recent "increased crush capacity", the former states that two new plants, with total capacity 300,000 tonnes, are to be established within the next few years.

7. UK

h. Average UK production of refined deodourised vegetable oils 1980/81:

	tonnes
Groundnut oil	14,400
Sunflower seed oil	23,250
Rapeseed oil	122,950
Soyabean oil	155,000
Cottonseed oil	4,100
Palm oil	137,200
Palm kernel oil	44,100
Coconut oil	19,550
	520,550

- SCOPA Conference 1982

12. Portugal

a. USDA Attache Reports. Quoted by UNIDO.

13. Greece

a. USDA Attache Reports. Quoted by UNIDO.

14. Norway

a. USDA Attache Reports. Quoted by UNIDO.

16. Sweden

a. USDA Attache Reports. Quoted by UNIDO.

17. Australia

b. The Oil World figure refers only to soyabean crush. The crush for other oilseeds is unknown although Oil World reports total production of oilseeds other than soyabean in Australia as 356,000 tonnes.

Such production certainly helps to bring total crush up to the actual crush figure quoted by the USDA of 430,000 tonnes.

h. USDA 1980.

18. Sub Total: only includes countries with both capacity and actual crush figures.

Table 9

Seed/crude oil ratios

	% crude oil
Cottonseed	21.3
Groundnut	44.5
Rapeseed	40.0
Safflower seed	32.5
Sesame seed	47.0
Soya bean	18.0
Sunflower seed	42.0
Copra	63.5
Palm kernel	46.5
Oil palm (FFB)	25.0*

Source:- UNIDO - Guidelines for the establishment and operation of vegetable oil factories. 1977.

* The FFB of modern tenera fruit grown commercially in Malaysia will contain some 20-30 per cent oil at maturity. - Cornelius J A: Processing of oil palm fruit and its products TPI G149, 1983.

This yield will vary with the climate, with soil type, with plantation conditions and with the equipment used to crush it. The figure adopted is on the high side for the world as a whole and particularly so for West Africa but it has been used here for consistency.

Table 10

Refining loss

	Estimated percentage oil loss during refining*
Cottonseed oil	13%
Groundnut oil	7%
Palm oil	10%+

Source: TDRI data

* Estimated as twice the level of ffa in the oil plus 1% for bleaching loss

\+ Heat bleaching is assumed so bleaching loss ignored.

Table 11

NET EXPORTS OF OILS & OILSEEDS   ASIA

AVERAGE 1980-81
'000 TONNES   OIL EQUIVALENT

	TOTAL OILSEEDS OIL EQUIV.	TOTAL VEGETABLE OILS	TOTAL OILS & OILSEEDS OIL EQUIV.
INDIA	8	-1352	-1345
BANGLADESH	-7	-109	-116
PAKISTAN	-10	-405	-415
PHILLIPINES	69	968	1037
THAILAND	7	-65	-58
KOREAN REP.	-114	-44	-158
TAIWAN	0	0	0
IRAN	-2	-331	-333
AFGHANISTAN	4	0	4
SRI LANKA	6	8	15
NEPAL	0	-2	-2
MALAYSIA	-20	2601	2581
INDONESIA	23	360	383
P N G	63	73	136
FIJI	-1	8	6
SAUDI ARABIA	-7	-78	-85
IRAQ	0	-95	-95
TURKEY	1	-127	-125
SYRIA	-1	-15	-17

SOURCE   FAO YEARBOOK 1981

Table 11 (contd)

NET EXPORTS OF OILS AND OILSEEDS   AFRICA

AVERAGE 1980-81
'000 TONNES OIL EQUIVALENT

	TOTAL OILSEEDS OIL EQUIV	TOTAL VEGETABLE OILS	TOTAL OILS & OILSEEDS OIL EQUIV
NIGERIA	39	-145	-107
EGYPT	1	-301	-302
ETHIOPIA	3	-6	-3
ZAIRE	0	27	27
MOROCCO	-9	-159	-167
ALGERIA	-27	-216	-243
SUDAN	58	22	81
TANZANIA	2	-4	-1
KENYA	4	-87	-83
UGANDA	0	0	0
GHANA	0	-7	-7
MOZAMBIQUE	7	-8	-1
MADAGASCAR	-1	-10	-11
CAMEROONS	2	10	12
IVORY COAST	5	96	101
ZIMBABWE	1	1	1
ANGOLA	-3	-36	-39
MALI	4	7	11
TUNISA	-1	-22	-23
MALAWI	11	-1	10
UPPER VOLTA	2	-2	0
SENEGAL	-2	6	4

SOURCE   FAO YEARBOOK   1981

Table 11 (contd)

NET EXPORTS OF OILS & OILSEEDS CENTRAL & S AMERICA

AVERAGE 1980-81

000 TONNES OIL EQUIVALENT

	TOTAL OILSEEDS OIL EQUIV	TOTAL VEGETABLE OILS	TOTAL OILS & OILSEEDS OIL EQUIV
BRAZIL	156	1144	1299
ARGENTINA	474	437	911
COLOMBIA	1	-97	-97
PERU	-1	-54	-54
VENEZUELA	-12	-225	-237
CHILE	0	-69	-70
ECUADOR	0	-29	-29
BOLIVIA	0	-14	-14
PARAGUAY	78	18	96
URUGUAY	3	-4	-1
MEXICO	-271	-37	-308
GUATEMALA	6	1	7
DOMINICAN REPUB.	-6	-48	-54
HAITI	0	-22	-22
EL SALVADOR	2	-8	-6
HONDURAS	1	-6	-4
PUERTO RICO	0	0	0
JAMAICA	-10	-7	-17

SOURCE FAO YEARBOOK 1981

Table 11 (contd)

NET EXPORTS OF OILS & OILSEEDS CENTRALLY PLANNED ECONOMIES

AVERAGE 1980-81
'000 TONNES OIL EQUIVALENT

	TOTAL OILSEEDS OIL EQUIV	TOTAL VEGETABLE OILS	TOTAL OILS & OILSEEDS OIL EQUIV
USSR	-255	-297	-552
CHINA	-203	-112	-315
POLAND	-36	-77	-113
HUNGARY	36	108	145
CZECHOSLOVAKIA	-24	-16	-39
GERMAN DR.	-23	-86	-110
BULGARIA	1	13	14
ROMANIA	-32	73	41
YUGOSLAVIA	-54	-96	-150

SOURCE FAO YEARBOOK 1981

Table 11 (contd)

NET EXPORTS OF OILS & OILSEEDS DEVELOPED COUNTRIES

AVERAGE 1980-81
'000 TONNES OIL EQUIVALENT

	TOTAL OILSEEDS OIL EQUIV	TOTAL VEGETABLE OILS	TOTAL OILS & OILSEEDS OIL EQUIV
USA	4655	845	5500
JAPAN	-1347	-256	-1603
CANADA	536	126	662
AUSTRALIA	17	-73	-57
UK	-362	-354	-716
FRANCE	-52	-270	-322
GERMANY F.R.	-1238	-52	-1290
NETHERLANDS	-686	72	-614
BELGIUM&LUX.	-246	1	-246
ITALY	-345	-262	-607
DENMARK	22	-39	-17
IRISH REP.	-1	-36	-37
GREECE	-19	27	7
SPAIN	-588	427	-161

SOURCE FAO YEARBOOK 1981

Table 12

Vegetable Oil - Surplus and Deficit Countries*: Asia

'000 tonnes

Surplus		Deficit	
	"Mainland"		
Sri Lanka	15	India	1345
Afghanistan	4	Pakistan	415
		Korea	158
		Bangladesh	116
		Thailand	58
		Nepal	2
	South East		
Malaysia	2580		
Philippines	1037		
Indonesia	383		
Papua New Guinea	136		
Fiji	6		
	Middle East		
		Iran	333
		Turkey	125
		Iraq	95
		Saudi Arabia	85
		Syria	17

Notes: * Net imports and exports of oilseeds and vegetable oils expressed in oil equivalents. Totals may include some oilseed imported/exported for direct (non-crushing) utilisation.

Source: Original data from the FAO Trade Yearbook 1981.

Table 12 (contd.)

Vegetable Oil - Surplus and Deficit Countries*: Africa

Surplus	'000 tonnes	Deficit	'000 tonnes
Ivory Coast	101	Egypt	302
Sudan	81	Algeria	243
Zaire	27	Morocco	167
Cameroon	12	Nigeria	107
Malawi	10	Kenya	83
Mali	11	Tunisia	23
Senegal	4	Angola	39
Zimbabwe	1	Malagasy	11
		Ghana	7
		Ethiopia	3
		Mozambique	2
		Tanzania	1

Notes: * Net imports and exports of oilseeds and vegetable oils expressed in oil equivalents. Totals may include some oilseed imported/exported for direct (non-crushing) utilisation.

Source: Original data from the FAO Trade Yearbook 1981

Table 12 (contd.)

Vegetable Oil - Surplus and Deficit Countries*: Latin America

'000 tonnes			
Surplus		Deficit	
	South America		
Brazil	1299	Venezuela	237
Argentina	911	Colombia	97
Paraguay	96	Peru	54
		Chile	70
		Bolivia	14
		Ecuador	29
		Uruguay	1
	Central America		
Guatemala	7	Mexico	308
		Dominican Republic	54
		Haiti	22
		El Salvador	6
		Honduras	4

Notes: * Net imports and exports of oilseeds and vegetable oils expressed in oil equivalents. Totals may include some oilseed imported/exported for direct (non-crushing) utilisation.

Source: Original data from the FAO Yearbook 1981.

Table 13 Revenues, Assets and Employment of Leading Oilseed Processing Firms ordered by rank of 1976 food sales

Rank	Parent company	Home country	Food Processing Revenue ($US mill)	Total revenue 1976		Total assets 1976		Total employment 1976		Net income 1976	
				Amount ($US mill)	Proportion foreign (%)	Amount ($US mill)	Proportion foreign (%)	Number	Proportion foreign (%)	Amount ($US mill)	Proportion foreign (%)
1	Unilever Ltd	Neths/UK	7,900	14,800	71	5,978	36	331,000	44	1,277	51
5	Esmark Inc	USA	3,955	5,301	16	710	17	47,000	...	83	14
9	Ralston Purina Co	USA	2,366	3,394	24	766	14	59,000	20	126	14
11	United Brands Co	USA	2,130	2,277	26	499	69	48,000	...	16	...
13	Imperial Group Ltd	UK	2,071	5,790	12	1,486	...	96,700	10	132	...
14	Archer-Daniels - Midland Co	USA	2,066	2,119	27	415	...	4,873	...	61.4	...
16	Associated British Foods	UK	2,051	3,012	...	...	...	...	...	...	...
22	Rank Hovis McDougall	UK	1,801	1,861	13	721	...	58,300	9	95	20
23	Proctor & Gamble	USA	1,801	7,349	25	2,625	19	54,000	33	461	18
24	Nabisco Inc	USA	1,780	2,027	29	447	37	48,000	45	77	11
25	General Mills	USA	1,735	2,909	16	725	22	61,797	18	117	10
34	Anderson Clayton	USA	1,425	1,557	...	...	...	...	...	36	...
37	Cargill Inc	USA	1,400	10,800	...	...	...	...	...	...	...
39	Canada Packers	CAN	1,383	1,635	15	170	...	...	...	21	...
41	Central Soya Inc	USA	1,349	1,840	11	236	15	9,349	14	38	8
42	Mitsui & Co Ltd	JPN	1,321	12,993	...	558	...	...	...	10	...

Table 13 (contd)

Rank	Parent company	Home country	Food Processing Revenue ($US mill)	Total revenue 1976 Amount ($US mill)	Total revenue 1976 Proportion foreign (%)	Total assets 1976 Amount ($US mill)	Total assets 1976 Proportion foreign (%)	Total employment 1976 Number	Total employment 1976 Proportion foreign (%)	Net income 1976 Amount ($US mill	Net income 1976 Proportion foreign (%)
65	Continental Grain Co	USA	950	5,000	...	...	...	...	...	...	...
69	Det Ostasiatiske Kompagni	DNK	903	3,360	...	...	...	...	...	...	...
74	Ajinomoto	JPN	823	1,113	...	...	...	...	...	...	...
75	Staley A E Manufacturing	USA	819	819	...	...	...	...	...	...	...
77	Foremost McKesson Inc	USA	800	2,695	...	...	...	...	...	...	...
88	Castle and Cooke	USA	706	850	...	...	...	...	...	...	...
89	Bunge and Born	ARG	700	2,000	...	...	...	...	...	...	...
104	Gold Kist	USA	617	892	...	...	...	...	...	...	...
128	Compagnie Financiere Lesieur SA	FRA	517	620	...	...	...	...	...	...	...
146	Reckitt & Colman	UK	435	978	...	...	...	...	...	...	...
153	Showa Sangyo	JPN	413	426	...	...	...	...	...	...	...
168	Nishin Oil Mills	JPN	361	361	...	...	...	...	...	...	...

Notes

... not available

Source Transnational Corporations in Food and Beverage Processing. UN Centre on Transnational Corporations 1981

Table 14

Foreign firms' share of Brazilian industry, selected sectors, 1970 and 1977

(Percentage)

Sector	Fixed assets		Sales		Equity		Employment
	1970	1977	1970	1977	1970	1977	1977
Auto parts	58	57	63	54	63	50	46
Automobiles	100	100	100	100	100	100	100
Beverages	16	23	13	24	13	17	17
Chemicals	54	57	55	57	55	42	61
Coffee	43	8	15	13	15	12	19
Diverse food products	47	36	46	52	46	40	41
Domestic appliances	76	74	73	76	73	74	64
Drugs	83	82	30	84	80	74	79
Electrical products	81	86	81	79	81	84	83
Fishing	24	22	24	24	24	16	27
Grains	38	9	35	15	35	27	16
Leather	21	39	21	42	21	23	37
Meats	24	17	26	23	26	20	27
Office equipment	96	91	93	73	93	76	69
Paper	33	20	23	24	23	33	24
Perfumes	64	51	57	38	57	50	33
Rubber	67	62	71	81	71	68	70
Spinning and weaving	39	37	39	34	39	29	26
Tobacco	91	99	95	99	95	98	96
Tractors	83	83	80	84	80	61	69
Vegetable oils	5	52	4	59	4	52	45
All sectors	34	33	37	44	37	31	38

Source: Transnational Corporations in World Development
UN Department of Economic and Social Affairs. 1983

Table 15

Oils and fats processing: sales and foreign operations of leading firms, 1976

	Estimated sales in industry	Estimated foreign production in industry	Number of countries with investment in industry				
	(Millions of dollars)		Total	Developed market economies	Latin America	Africa West Asia	East Asia Pacific
North America							
Archer Daniels Midland, USA	900	200	4	3	1	-	-
Cargill, USA	900	300	6	3	2	-	1
Central Soya, USA	600	120	2	1	1	-	-
Esmark, USA	400	60	1	1	-	-	-
Anderson Clayton, USA	350	180	2	-	2	-	-
A E Staley, USA	300	30	3	2	1	-	-
Ralston Purina, USA	200	30	1	-	1	-	-
Gold Kist, USA	200	-	1	-	1	-	-
Continental Grain, USA	100	50	1	-	1	-	-
Nabisco, USA	100	-	-	-	-	-	-
United Brands, USA	100	50	3	-	3	-	-
Foremost-McKesson, USA	75	-	-	-	-	-	-
Castle and Cooke, USA	75	50	2	-	1	-	1

Table 15 (contd).

	Estimated sales in industry	Estimated foreign production in industry	Number of countries with investment in industry				
	(Millions of dollars)		Total	Developed market economies	Latin America	Africa West Asia	East Asia Pacific
Proctor and Gamble, USA	75	50	3	1	1	-	1
General Mills, USA	..	..	1	-	1	-	-
Canada Packers, CAN	..	..	3	2	1	-	-
<u>Europe</u>							
Unilever, UK/NLD	800	500	27	13	4	6	4
Compagnie Financiere Lesieur,	100	30	2	-	-	2	-
Reckitt and Coleman, UK	80	50	3	1	2	-	-
Rank Hovis McDougall, UK	..	..	1	1	-	-	-
Imperial Group, UK	..	..	2	-	-	1	1
East Asiatic Co., DNK	..	..	2	-	-	1	1
Associated British Foods, UK	..	..	1	1	-	-	-
<u>Japan</u>							
Nisshin Oil Mills	350	30	1	-	-	-	1
Ajinomoto	270	30	1	-	1	-	-
Mitsui	200	150	1	1	-	-	-
Showa Sangyo	150	-	-	-	-	-	-
<u>Other</u>							
Bunge and Born, ARG	300	250	2	-	2	-	-

Source: Transnational Corporations in Food and Beverage Processing, UN Centre on Transnational Corporations, 1981.

Table 16

Vegetable oil processing: sales and foreign operations of leading firms, 1976

	Number of firms			Revenues from vegetable oil processing		Foreign affiliates in vegetable oil industry		
	Total	With foreign operations		Total	Non-domestic			
		Total	Developing countries	(Millions of US dollars)		Total Affiliates	Developed market economies	Developing economies
All leading firms	28	24	19	6795	2310	74	32	42
Eight top firms	8	8	7	4300	1640	45	23	22
Home country:								
North America	16	13	12	4425	1150	32	13	19
Europe	7	7	4	1100	700	37	18	19
Japan	4	33	2	970	210	3	1	2
Argentina	1	1	1	300	250	2	0	2
Other firms	2	0	0	400	0	0	0	0

Source: Transnational Corporations in Food and Beverage Processing, United Nations Centre on Transnational Corporations, 1981.

Table 17

Distribution of transnational corporation investments in the primary vegetable oil processing and edible oil industries in host developing countries, by size of domestic markets, 1976

Number of TNC affiliates in country	Size of market for food-processing products a/ Small markets	Medium-sized markets	Large markets	Total number of countries	Total TNC investments
One firm	Cayman Is. Trinidad and Tobago Liberia b/ Malawi United Republic of Cameroon b/ Solomon Is. b/	El Salvador Jamaica Uruguay b/ Ghana b/ Senegal b/ Zimbabwe Sri Lanka	Iran Nigeria Turkey Hong Kong	17	17
Two firms		Chile Costa Rica b/ Honduras b/ Nicaragua b/ Panama Kenya Zaire b/ Singapore	Colombia b/ India b/ Pakistan b/ Thailand b/	12	24

Table 17 (contd.)

Number of TNC affiliates in country	Size of market for food-processing products a/ Small markets	 Medium-sized markets	 Large markets	Total number of countries	Total TNC investments
Three or more firms		Guatemala (4) b/ Peru (3) Malaysia (4) b/	Argentina (3) b/ Venezuela (3) b/ Mexico (6) Brazil (9) b/ Philippines (4) b/	8	36
Number of countries	6	18	13	37	
Number of TNC investments (27 parent firms)	6	34	37		77

Source: Transnational Corporations in Food and Beverage Processing
UN Centre for Transnational Corporations 1981

a/ Size of market defined as follows: Small markets, total processed food sales in 1975 less than $200 million; medium markets between $200 million and $1,000 million; large markets more than $1,000 million.

b/ Countries in which one or more transnational corporations have identified investments in vegetable oil processing (other than corn oil).