Economics of crops in developing countries No 2

The economics of oil palm

The series Economics of Crops in Developing Countries is the result of a research project undertaken by the Department of Development Economics of the Agricultural University, Wageningen. The monographs in this series are intended to fill the gap between agronomic documentation and aggregate data on production and trade. Four volumes are scheduled:

1. The economics of coffee: J. de Graaff, published 1986
2. The economics of oil palm: H.A.J. Moll
3. The economics of maize: J.A. Kool, in preparation
4. The economics of cotton.

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Part II

Foreword

In 1982, the Department of Development Economics of the Agricultural University of Wageningen embarked upon a project aimed at the production of a series of monographs on the economics of tropical and subtropical crops. Each monograph was intended to cover the aspects of production, processing and trade for a specific crop, with the intention to fill the gap between the existing ample agronomic documentation, and the generally broad and aggregate data on production and trade. The studies are based on information from professional publications and statistical sources, complemented by more detailed field studies in a selection of producing countries.

The first phase of the project covers four crops with different ecological and economic characteristics: coffee, cotton, maize and oil palm. Each study will devote attention to the following aspects:

- Ecology in various regions.
- Farm types, farming systems and production.
- The position of the crop in relation to other crops with either similar uses or similar ecological requirements.
- The stages of processing and marketing between farm gate and consumer or importer.
- Supporting services for production, processing and marketing.
- National institutions, programmes and policies.
- International trade.

We hope that this comprehensive approach will make the monographs useful as reference works for institutions and people involved in policy-making and field work.

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Agricultural University, Wageningen

Preface

The oil palm is the major oil crop grown in developing countries. This book describes and analyses the oil-palm sector and its role in the national economy of producing countries. Emphasis is given to micro-economic aspects of production, processing and marketing, and macro-economic aspects of the sector as a whole. In addition, attention is paid to physical and institutional factors that have a profound influence on the economic performance, such as ecology, organization of services and policy matters.

Eight countries in the three major production regions, South-East Asia, West Africa and Latin America, have been selected for analysis. Together, these countries offer a representative view of the situation in about thirty producing countries. For each of the selected countries, the oil-palm sector is reviewed and analysed in sections dealing with the following: general background; ecological conditions; availability of production factors; production, processing and marketing, with methods applied and costs; provision of supporting services and government policies. The findings in these eight countries provide the basis for conclusions about the possibilities and limitations of the oil-palm sector in producing countries.

The description of the actual situation in producing countries and the subsequent comparative analysis offer general and specific insights into the oil-palm sector to readers with different fields of interest. Specialists will find it useful to get a comprehensive picture of the sector as a whole and to compare specific situations in several producing countries; planners may use data and parameters on the various production stages for planning purposes; policy makers may compare the performance of one or more producing countries with the actual situation in their country and identify potential areas for improvement.

The book consists of two parts. Part 1, Chapter 1 provides a general review of the present state of knowledge about the oil palm and its products, and serves as an introduction for those who are not acquainted with the oil palm or with agricultural production in general. The comparative analysis based on the eight countries studied is presented in Chapter 2. The individual studies form the second part of the book, Chapters 3–10. These studies follow a standard outline to facilitate the comparison of specific aspects.

The data in this book refer to the situation in 1982. Prices and parameters will change with time. However the framework of analysis employed together with the relatively constant basic factors and technical coefficients mean that individual user can update sections according to needs.

Acknowledgments

A study like this requires a vast amount of information about the many aspects of production, processing and marketing. Therefore I am grateful to many specialists who were prepared to spend their valuable time in discussing the various aspects of oil palm and to the many institutions that made reports, studies, statistical and financial data available, most of which were not obtainable from libraries. Without their participation, this study would not have been possible.

In the first stage of the research, valuable assistance was received in establishing contacts and in collecting information from staff of various institutes in the Netherlands: Ministeries of Agriculture and Fisheries, Economic Affairs and Foreign Affairs; several semigovernmental institutes; consultancy firms; and several national and international organizations in other European countries. In particular I would like to thank Mr C.J. Breure of Harrisons Fleming Advisory Services Ltd.; Dr K.H. Friedrich of Institut für Grünlandwirtschaft, Brunswick; and staff of the Agricultural Services and the Commodity & Trade Divisions and the Investment Centre of FAO, Rome.

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Abbreviations

BANAFOM/BANADESA	– Banco Nacional de Fomento/Banco Nacional de Desarollo; National Agricultural Development Bank (Honduras)
BANASUPRO	– National Development Bank Food Marketing Acency (Honduras)
BNDA	– Banque National pour le Developpement de l'Agriculture (National Bank for Agricultural Development) (Ivory Coast)
BPPM	– Balai Penelitian Perkebunan Medan – Research Institute for Estate Crops (Indonesia)
CAA	– Caisse Autonome d'Amortissement (Ivory Coast)
CABEI/BCIE	– Central American Bank for Economic Integration
CAICESA	– Compania Agricola Industrial Ceibena S.A. (Honduras)
CCCE	– Caisse Centrale de Coopération Economique
CSSPA	– Caisse de Stabilisation et de Soutien des Prix des Productions Agricoles (Ivory Coast)
CDC	– Commonwealth Development Corporation (Honduras)
CDC	– Cameroon Development Corporation (Cameroon)
CFAF	– Communauté; Financière Africaine Franc – currency monetary unions of West Africa (Ivory Coast) and Central-Africa (Cameroon)
c.i.f.	– cost insurance freight
c.p.o.	– crude palm oil
COAPALMA	– Las Expresas Cooperativas Agroindustriales de Palma Africana de la Reforma Agraria (Honduras)
CONADI	– Corporación Nacional de Inversiones, National Investment Corporation (Honduras)
ECARAG	– Empresa Cooperativa Agroindustriale de la Reforma Agraria Guaymas (Honduras)
EIB	– European Investment Bank
FAO	– U.N. Food and Agricultural Organization
Fedepalma	– Federacion Nacional de Cultivadores de Palma Africana (Colombia)

FED	– Fonds Européen de Developpement (European Development Fund)
FELCRA	– Federal Land Consolidation and Rehabilitation Authority (Malaysia)
FELDA	– Federal Land Development Authority (Malaysia)
f.f.a.	– free fatty acids
f.f.b.	– fresh fruit bunch
FFAP	– Fondo Financiero Agropecuario (Colombia)
FMAWR	– Federal Ministry of Agriculture and Water Resources (Nigeria)
FMO	– Netherlands Development Finance Company
f.o.b.	– free on board
FONADER	– Fonds National de Developpement Rural (Cameroon)
GAPKI	– Indonesian Palm Oil Producers' Organization
GDP	– Gross Domestic Product
GNP	– Gross National Product
IBRD	– International Bank for Reconstruction and Development
ICA	– Instituto Colombiano Agropecuario, Colombian Farming Institute
IDB	– Interamerican Development Bank
IITA	– International Institute of Tropical Agriculture (Nigeria)
IMF	– International Monetary Fund
INA	– Instituto Nacional Agrario, National Agrarian Institute (Honduras)
IRA	– Institut de la Recherche Agronomique (Cameroon)
IRHO	– Institut de Recherches pour les Huiles et Oléagineux
ISP	– Incorporated Society of Planters (Malaysia)
JMO	– Joint Marketing Office (Indonesia)
KLCE	– Kuala Lumpur Commodity Exchange (Malaysia)
KLCCH	– Kuala Lumpur Commodities Clearing House Sdn. Bhd. (Malaysia)
L	– Lempira, Honduras currency
L	– Leone, Sierra Leone currency
LPP	– Lembaga Pendidikan Perkebunan–Estate Training Institute (Indonesia)
MEOMA	– Malayan Edible Oil Manufactures' Association
MEU	– Monitoring and Evaluation Unit, Federal Department of Agriculture (Nigeria)
MOPGC	– Malaysian Oil Palm Growers' Council

M$	– Ringgit, Malaysian currency
₦	– Naira, Nigerian currency
NAPCO	– National Produce Company (Sierra Leone)
NIFOR	– Nigerian Institute for Oil Palm Research
NPPB	– Nigerian palm produce board
NWCA	– North West Cooperative Association, Ltd. (Cameroon)
ONCPB	– Office National de Commercialisation des Produits de Base (Cameroon)
PEMSU	– Planning Evaluation Monitoring and Services Unit, Ministry of Agriculture and Forestry (Sierra Leone)
pesos	– Colombian currency
PNP	– Perusahaan Negara Perkebunan – state estate company (Indonesia)
PORAM	– Palm Oil Refiners Association of Malaysia
PORIM	– Palm Oil research Institute of Malaysia
PORLA	– Palm Oil Registration and Licensing Authority (Malaysia)
p.p.o.	– processed palm oil
PTP	– Perseroan Terbatas Perkebunan – state estate company with limited liability (Indonesia)
PPM	– Pusat Penelitian Marihat – Research institute for state estates in Siantar (Indonesia)
RISDA	– Rubber Industry Smallholders Development Authority (Malaysia)
Rp	– Rupiah, Indonesian currency
SBPN	– Staff Bina Perusahaan Negara – Advisory unit to the Minister of Agriculture on matters relating to state estates (Indonesia)
SIECA	– Secretariado de Integración Económica en America Central, Secretariat for Economic Integration in Central America (Colombia)
SLPMB	– Sierra Leone Produce Marketing Board
SNI	– Société National d'Investissement (Cameroon)
Socapalm	– Société; Camerounaise de palmeraies (Cameroon)
Sodepalm	– Société pour le Développement et l'Exploitation du Palmierà Huile (Ivory Coast)
s.p.o.	– Special grade palm oil (Nigeria)
TCPP	– Technical Committee on Producer Prices (Nigeria)
TK	– Team Khusus – Special unit in the Directorate General of Estates for foreign assisted projects (Indonesia)

Part I. Basic facts and economic analysis

1 Introduction to the oil palm

1.1 General aspects

1.1.1 origin and distribution

The centre of origin of the oil palm is the tropical rain forest region of West Africa. It was spread by man from Senegal to Angola in a wide belt along the coast and into the interior along the Congo River. Palm fruits were taken by the early slave trade in the 16th Century to the New World, where the oil palm became established in Brazil.

Oil palm grows and reproduces itself readily in forest clearings, and shifting cultivation practised in Africa and later in Brazil resulted in extensive areas of semiwild palm groves. Oil-palm seedlings were grown in European botanic gardens in the 18th Century and brought from there as ornamental tree to Calcutta, Mauritius, Java and Singapore. Regular trade in palm oil and palm kernels between West Africa and Europe started early in the 19th Century with the industrial revolution, partly as a replacement for the slave trade. Oil and kernels were produced by traditional extraction methods from fruits collected in the semiwild palm groves.

Table 1.1. World production of oil palm products (1000 t).

	Palm oil			Palm kernels		
	1961/63	1971/73	1981/83	1961/63	1971/73	1981/83
World	1294	2407	5874	1034	1343	2074
Africa	1011	1278	1372	778	861	739
Nigeria	520	654	695	408	425	355
Zaire	225	180	153	112	110	65
Central America[1]	21	32	64	47	36	18
South America[1]	7	59	165	147	226	302
Asia	255	1035	4184	62	220	984
Indonesia	145	272	881	33	59	151
Malaysia	110	720	3116	28	149	784
Oceania	–	3	89	–	–	31

1. Production data for palm kernels refer to babassu nuts and probably nuts of the cohune palm as well.
Source: FAO (1961-1983)

The first commercial plantings for production of edible oil were made in Sumatra and Malaysia in 1911 and 1917, respectively. In the Belgian Congo, plantings started in the 1920s. By 1938, there were 90 000 ha planted in Sumatra, 30 000 ha in Malaysia and 20 000 ha in Belgian Congo and British West Africa. After World War II, production increased considerably, especially in Malaysia and Indonesia where large areas of rubber plantations were replanted with oil palm in addition to new plantings in forest areas. In Central and South America oil palm received renewed interest around 1960 and many new plantations were started. Papua New Guinea started production in the 1970s and has reached a considerable production volume. Production in West Africa is still to a large extent based on the fruits from semiwild oil palms but the area with planted improved palms greatly increased in Ivory Coast, Cameroon and Nigeria in the 1970s.

The recent statistics on production of oil-palm products are listed in Table 1.1.

1.1.2 Botany

1.1.2.1 Classification

The oil palm, *Elaeis guineensis* Jacq., belongs to the subfamily Cocoideae of Palmae, which also includes the coconut. The fruits of oil palm vary widely. The following classification is based on variations of the internal structure of the fruit:

- Dura: shell 2–8 mm thick.
- Pisifera: shell-less.
- Tenera: shell 0.5–4 mm thick. The tenera fruit form is a hybrid of the dura and the pisifera forms, often stated as 'D × P'. A further classification can be made on the colour of the fruit:
- Nigrescens: unripe fruits deep violet to black, ripe fruits with brown or black cap.
- Virescens: unripe fruits green, ripening to reddish orange.
- Albescens: without reddish colour as carotenoids are absent.

Most commercially planted palms are tenera and the fruit type nigrescens is predominant.

The American oil palm, *Elaeis oleifera*, is another species in the genus *Elaeis*. It is also referred to as *Elaeis melanococca* or *Corozo oleifera*. The palm occurs in Central and South America, where the oils from mesocarp and kernel are used locally. The trunk becomes procumbent after several years and is slow growing. The palm as such is of no economic importance but could become useful for breeding purposes as hybridization between *E. guineensis* and *E. oleifera* presents no difficulties (Section 1.5.3).

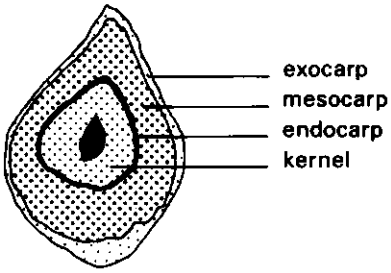

Fig. 1.1. Cross-section of oil-palm fruit (1/1).

1.1.2.2 Morphology

During the early growth of the oil palm, the lower internodes are formed into a basal cone or bole. Thousands of primary roots, 6–10 mm in diameter, arise from the bole and spread horizontally or descend into the soil. Secondary roots, 2–4 mm in diameter, descend or ascend from the primary roots. Tertiary and quaternary roots form a dense mat in the upper 30 cm of the soil. Most roots are to be found near the palm stem but a second concentration is found 1.5–2 m from the base. Oil palms have a single erect stem resting on the basal cone. The width of the stem varies from 25–75 cm. The annual increase in height is 35–50 cm and the palm may reach a height of 20–30 m. In plantations, the palms are cut down long before they reach such a height, as harvesting becomes more and more difficult with increase in height.

The palm has one terminal growing point and leaves are produced continuously. Annually, twenty to thirty leaves are produced under plantation conditions. In the axil of each leaf is a bud, which may develop into a male, female or occasionally in a hermaphrodite inflorescence. Female and male inflorescences occur on the same plant. The female inflorescence consists of several thousand flowers on 100–250 spikelets on the central rachis. After pollination by wind or insects, the fruit bunch develops in 5 to 6 months. A bunch may contain 500–2000 fruits with an individual weight of 3–30 g. A fruit consists of the outer exocarp or skin, the mesocarp or pulp and the seed consisting of endocarp or shell and kernel (Figure 1.1). Palm oil is produced from the mesocarp and palm-kernel oil from the kernel by a subsequent processing technique. The oil content is generally stated as oil-to-bunch ratio; in D × P palms, the ratio is around 25 % for mature palms. The kernel-to-bunch ratio is 4–5 %.

1.1.2.3 Propagation

Propagation is by seed. Most modern plantations are planted with hybrid material from selected dura × pisifera (D × P) parents. These D × P hybrids are tenera types with thin-shelled fruits. A recent development, which is still in the development stage, is vegetative propagation by tissue culture. Small pieces of tissue from root tips or other parts are induced to grow into plants in a laboratory.

This method of propagation opens new possibilities for the selection and development of clones; groups of uniform plants derived from a single parent palm with favourable characteristics (Section 1.5.3).

1.1.3 Uses and competitive products

Palm oil and palm-kernel oil are to a large extent interchangeable with other fats and oils of various origin. Palm oil is one of the major vegetable oils produced and traded (Table 1.2). Palm oil contains saturated fatty acids about 53 % and unsaturated fatty acids 47 %. In this, it differs from the vegetable oils listed under 'edible' which all contain higher proportions of unsaturated fatty acids. Palm oil, and its fractions after refining, can be used for edible purposes, such as manufacture of margarine and compound cooking fats, as well as for the manufacture of soap and candles. The improved quality of the oil and new technological developments result in a tendency to increase the proportion used for edible purposes. A new development is the use of palm oil as fuel for diesel engines. This application is still under development.

Table 1.2. World production and export of fats and oils (1000 t oil equivalent).

Type	Production 1981/83	Export 1981/83
Vegetable oils	45 330	17 510
edible	44 120	16 750
coconut oil	2 890	1 410
cottonseed oil	3 140	440
groundnut oil	3 090	610
olive oil	1 770	210
palm-kernel oil	720	450
palm oil	5 430	3 240
rapeseed oil	4 630	1 290
soya-bean oil	14 010	6 900
sunflower seed oil	5 690	1 640
other	2 750	1 320
industrial oils	1 210	760
Animal fats	16 920	3 160
edible	10 920	1 070
butter	5 960	670
lard	4 720	400
industrial		
tallow	6 240	2 090
Marine oils	1 140	710
Total	63 390	21 380

Sources: IASC in Oleagineux, FAO (1961-1983)

Plate 1. Germination of seeds in the electrically controlled germinator of the research institute in Marihat, Indonesia.

Plate 2. Seedlings in polythene bags in a nursery, Ivory Coast.

Plate 3. Oil palms in the first years of production, Indonesia.

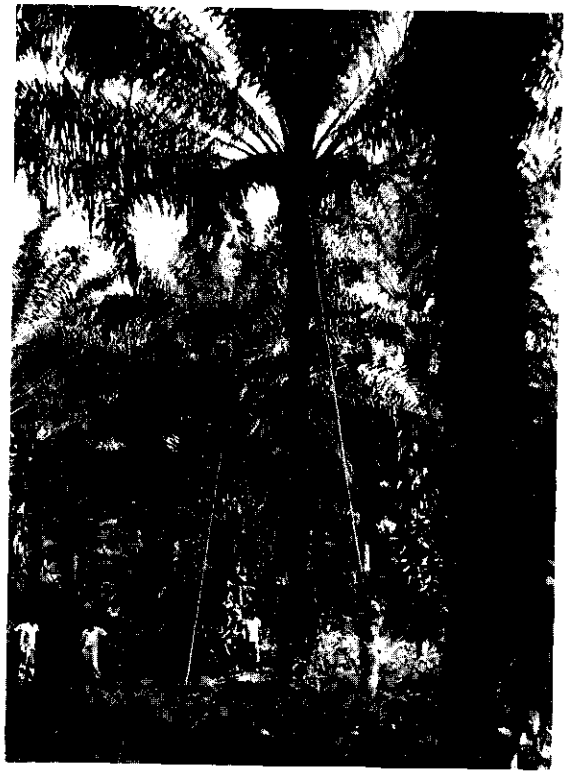

Plate 4. Harvesting bunches with a hook attached to a aluminium pole, Ivory Coast.

Palm-kernel oil consists for 85 % of saturated fatty acids. The oil is similar to coconut oil and both oils are used in edible fats, confectionery and bakery products, the preparation of ice-cream and mayonnaise, and in the manufacture of soaps and detergents. The presscake is used for livestock food.

In West Africa, palm oil produced by traditional methods is consumed directly without further processing. This palm oil contains a large proportion of free fatty acids and is rich in vitamins.

Palm wine can be produced, at the expense of bunch production, by cutting the inflorescence and collecting the sugary solution. Production of palm wine is of importance in West African countries.

1.2 Ecology

1.2.1 Climatic requirements

The oil palm requires a humid tropical lowland climate. The following requirements are stated:

- Rainfall. An average annual rainfall of 2000 mm or more, distributed evenly throughout the year is optimal. A period of three months with less rainfall than 100 mm is considered the maximum deviation acceptable.
- Temperature. Mean maximum temperatures of 29–33 °C and mean minimum temperatures of 22–24 °C are optimal. A mean minimum temperature below 18 °C is unfavourable as growth stops and yields at a later stage are reduced.
- Sunshine. At least 5 hours per day throughout the year.

Water supply, i.e. rainfall under natural conditions, is the major aspect of the oil palm's climatic requirements in present-day regions of oil palm. The effect of a temporary shortage of water has been clearly demonstrated by an irrigation trial set up by the Institut de Recherche pour les Huiles et Oleagineux (IRHO) in Grand Drewin, Ivory Coast (Table 1.3). Considerable areas in the oil-palm region of West Africa are affected by a dry period of 2–4 months per year and production in those areas is restricted by lack of water. There are two approaches to calculate the availability, or lack of, water. The first is calculation of the water deficit, expressed in millimetres per year. A water deficit occurs if the potential evapotranspiration exceeds the precipitation plus the soil water reserve in a certain pe-

Table 1.3. The yield without and with irrigation in a trial in Ivory Coast.

Treatment	Yield (t f.f.b./ha)	Irrigation water (mm)
Control, without irrigation	10.5	0
Abundant irrigation till 150 mm per month	23.5	1130
Controlled irrigation	22.0	650

Source: Ochs & Daniel (1976)

riod. Usually 10-day periods are taken to calculate the water balance and the total deficit over a year gives the annual water deficit. An average annual water deficit of 300 mm limits production and few commercial plantings are found in areas with water deficit of 400 mm and more. The second method, developed by FAO in the agro-ecological zones project (FAO, 1978) is also based on water balance. However the period is calculated during which there is sufficient water available for the plant to be productive. The period is called 'growing period' and it is expressed in days. Oil palm requires a growing period of 270 days or more.

Temperature in the tropics can be a limiting factor in areas at higher altitudes and in areas further away from the Equator than 13°N and 12°S latitude with a more pronounced colder season.

Sunshine, in general calculated as solar irradiance, is important as is shown by the negative effects of shade. Exact data on requirements are not available.

1.2.2 Soil requirements

Oil palms are grown on a wide range of soils. An adequate supply of soil moisture is more important than nutrient supply. The water-holding capacity of the soil becomes important as rainfall becomes only marginally suitable. Certain soils are unfavourable to the oil palm and must be avoided: poorly drained soils, lateric soils containing concretionary ironstone, very sandy coastal soils and deep peat.

The topography is especially important for oil palms as a great volume of harvested product, 15–25 t of fruit bunches per hectare, must be transported annually once the palms are in full production. So flat or gently undulating land is preferred, in order to minimize establishment costs for palms and a road system, and running costs of transport.

Oil palms tolerate periods of flooding provided they are not prolonged.

1.2.3 Suitable zones for oil palm

A general overview of suitable zones can be given on the basis of the classification of growing conditions developed by FAO. The system is based on two variables: temperature; growing period. By temperature, 14 major climates are distinguished under three headings: tropics, subtropics and temperate. The maps published by FAO, showing major climate areas and isolines for different growing periods, give a broad indication of the suitibility for different crops by region.

The requirements of the oil palm in terms of this system are 'warm tropics', 24-h mean daily temperature during growing period more than 20 °C, and a growing period of 270 days or more. These conditions exist in the following regions: Africa, the coastal belt in West Africa from Guinea to Zaire, the Congo River Basin and the east coast of Madagascar; Central America, the Caribbean coastal area from south Mexico to Panama except the Yucatan Peninsula; South America, extensive areas in the Amazon Basin in Brazil, Colombia, Ecuador and Peru, and

Fig. 1.2. Oil-palm areas in the world.

several other areas in these countries; South-East Asia, Malaysia, Indonesia including the islands of Sumatra, Kalimantan, and parts of Sulawesi and of Irian Jaya, and Papua New Guinea; South Pacific, the Solomon Islands (Figure 1.2).

1.2.4 Crops with similar ecological requirements

Several crops can be grown under the same ecological conditions as oil palm. These are tree crops like rubber, coconut and cocoa and root crops like cassava, cocoyam and yams and to some extents grains, rice and maize. Tree crops are more suited to the poor yellow and red podzolic soils in the humid tropics than annual crops. The continuous cover, similar to the original forest vegetation, protects the soil from erosion and soil degradation which are major problems when such soils are used for annual food crops. The major crops grown under similar conditions to oil palm are briefly discussed below.

Rubber requires a growing period of 330–365 days and temperatures of 25–30 °C. It requires soils with a good physical condition. In Malaysia and Indonesia, large areas of rubber have been replanted with oil palm in the past 20 years. Rubber production on a plantation scale is impossible in South America because of disease.

Coconut requires slightly less rainfall than oil palm. However for high production, it requires an even distribution too. The palm tolerates saline conditions not suitable for oil palm. In coastal areas, coconut and oil palm can be seen alongside one another provided the soils are suitable.

Cocoa requires a growing period of 270–300 days and somewhat lower temperatures than oil palm. The shorter optimum growing period, the requirement of a distinct dry season to induce flowering and the more specific requirements in soils generally result in cocoa-production areas which are bordering oil-palm production areas. In Indonesia and Malaysia, however, there is an increasing tendency to plant cocoa under coconut in areas where oil palms are planted as well.

Root crops, such as cassava, yams and cocoyams are staple foods in the forest zone of West Africa, the origin of oil palm. Cassava is a versatile crop that grows even under the most humid conditions. Yams have a shorter growing period, 210–240 days. They are planted at the start of the rains and harvested at the beginning of the drier period.

Bananas require conditions similar to oil palm but must be sheltered from wind, which damages leaves and reduces yield. This requirement often makes coastal areas less suitable for bananas.

Cereals require a distinct dry period for ripening and such a climate is only marginally suitable for oil palm.

1.3 Production of fruit bunches

Production of fruit bunches and the processing of fruit bunches into crude palm oil and kernels are generally integrated. Fruit bunches must be processed within 24 h of harvesting to avoid deterioration of quality. Crude palm oil and kernels are reasonably stable products, which can be stored before being processed into end-products. This section deals with production of fruit bunches, which includes all field operations from surveying the area to the delivery of bunches to the processing plant on the estate or at the collection point from where they are taken away for processing. The processing into crude palm oil and kernels is outlined in Section 1.4, and linkages and services are discussed in Section 1.5.

1.3.1 Production systems

Three basic production systems can be distinguished: production by smallholders collecting from semiwild oil palms; production by smallholders, cultivating improved oil palms in pure stands; production on estates.

Smallholders with semiwild oil palms. Extensive areas of semiwild oil-palm groves exist in West Africa and Brazil. These groves result from shifting cultivation in rain forests, resulting in clearings suitable for spontaneous establishment and growth of oil palms. In this extensive production, cultivators return to their former clearings to collect fruit from which oil is produced for their own needs and kernels for sale. Yields from these stands with generally less than 75 palms per hectare are 1–1.5 t bunches per hectare annually, resulting in 100–200 kg of kernels per hectare for sale. With increased population, fallow periods become shorter and as the forest becomes more open the number of oil palms per hectare in-

creases. Oil palm then becomes one of the activities of a more permanent type of agriculture. Bunch production is still low with a maximum of 5 t/ha each year for dense groves with 150 palms per hectare. Oil palm in the semiwild groves is primarily a food crop cultivated for the grover's own use or for local use. Kernels provide cash, as local technology for extraction of kernel oil is not available.

Smallholders with improved oil palms in pure stand. This production system often results from development schemes aimed to improve the income of the population. The introduction of modern production methods is combined with provision of comprehensive services, generally including transport and processing of fruit bunches.

Estates. Production of bunches is more systematic with correct spacing, selected planting material, adequate care and maintenance. This results in West Africa in yields of 10–15 t/ha in areas where groves produce 2.5–5 t/ha. Plantations in Malaysia and Indonesia reach yields of 20–30 t/ha, with optimum climate, a high level of management and intensive research. Plantations may vary in size from several hundred hectares to over 5000 ha.

1.3.2 Production stages and activities

Two production stages are distinguished: the establishment stage, a period of 3 to 4 years; the productive stage from the 4th or 5th year to the 25th or 30th year. The activities on estates are outlined as they give the most comprehensive picture of fruit bunch production.

Establishment stage. In this period, care and maintenance are aimed at obtaining a full stand of healthy palms with a high production potential. The physical work of establishment is done in the first year. The following activities are carried out.

- Land and soil survey: to determine layout of blocks, roads, drains and fertilizer requirements.
- Nursery: preparation field for nursery, seed treatment and raising of young palms in polythene bags.
- Clearing: felling of forest or a previous crop, burning and land preparation.
- Terracing: in undulating land.
- Planting: lining, holing and planting of seedlings and protection against pests. Normally 143 palms are planted per hectare.
- Laying of any drainage system.
- Road system: establishment of tracks for planting, and construction of footpaths for harvesters and roads for transport of bunches.
- Care and maintenance: establishment of a cover crop, weeding, fertilizing, replacing of palms as required.

Productive stage. The activities are grouped under two headings:

1. Care and maintenance.

- Ring weeding and path maintenance with a hand-hoe or with chemicals.

– Pruning of dead or green leaves to allow inspection of the ripening of bunches. There are several pruning systems but pruning of green leaves has proved detrimental to production.
– Fertilizing, requirements being assessed by foliar analysis.
– Pollination. In regions outside West Africa, pollination can be insufficient through lack of specialized insect species, so pollination is carried out by hand. Recently pollinating insects have been introduced to Malaysia from West Africa, so that hand-pollination is not longer necessary.
– Control of pests and diseases.
2. Harvesting.
– Finding and cutting ripe bunches in cycles of 9–14 days. Bunches are harvested when there is at least one loose fruit per 0.5 kg of bunch. This ensures the highest oil content and a still low proportion of free fatty acids, say 0.5 %. When the palms are still low, a chisel or hooked knife is used; later a hook attached to a pole is required.
– Collection of bunches and loose fruit, and transport to roadside or railway. Bunches can be carried by hand, transported with cart and buffaloes, by tractors, or with four wheel-drive vehicles.
– Loading into vehicles and transport to the mill. There are several systems, such as railway, lorry, dumptruck and tractor plus trailers. The loading operation is often mechanized: bunches are deposited on nets, the nets are lifted and emptied into lorries or trailers by means of a hydraulic crane mounted on the vehicle.

1.3.3 Production levels

Production of bunches per hectare and production of oil and kernels from these bunches after processing is to a large extent determined by biological factors, which were studied by Corley & Grey (1976, p. 77–86). The main factors are outlined below. The extraction efficiency of processing installations will be dealt with in the next section.

The two main components of the yield of oil per hectare are yield of fruit bunches and the oil-to-bunch weight ratio. Both components can be divided into subcomponents. The yield of fruit bunches depends on:
– Number of palms per hectare. Planting density is normally around 143 palms per hectare. The number of palms per hectare decreases through disease during the lifetime of a plantation.
– Number of bunches per palm. The number of bunches produced annually per palm decreases with age from 15–25 bunches in the 4th year to about 10 bunches in the 12th year. After that, the number of bunches declines slowly.
– Bunch weight. This increases with age of palm from 5 kg in the 4th year to 20–25 kg in the 14th year. The combined effect of the three factors is that production of fruit bunches in tonnes per ha per year increases rapidly to a maximum around the 10th year after planting, followed by a gradual decline to 60–80 % of

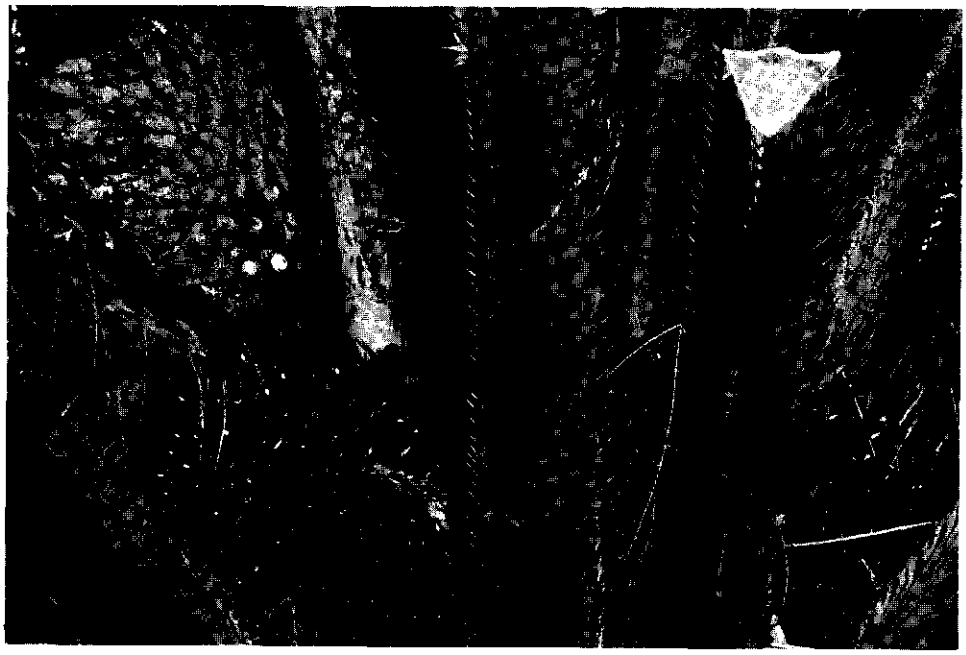

Plate 5. Fruit bunches and male inflorescence (top left), Indonesia.

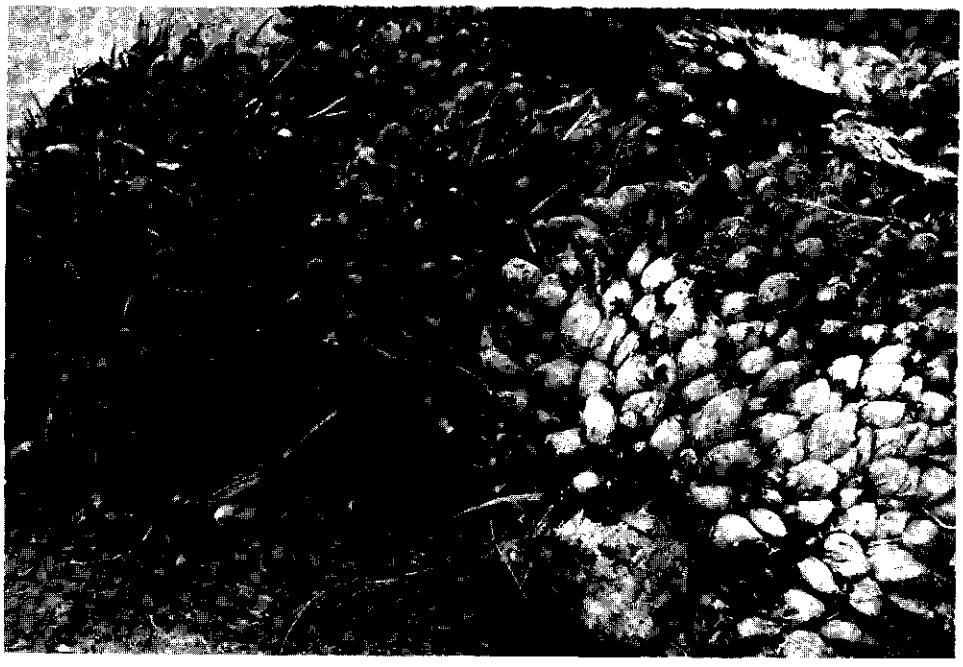

Plate 6. Fruit bunches from D × P palms, Indonesia.

Plate 7. Loading fruit bunches onto a truck for transport to a mill, Ivory Coast.

Plate 8. Unloading onto ramp of oil-mill, Indonesia.

the maximum yield in the 25th year.

The oil-to-bunch ratio is a product of the following components:

- Fruit-to-bunch ratio. The ratio depends on the efficiency of pollination. Ratios are 55–70 %.
- Mesocarp-to-fruit ratio. A factor mainly determined by genetic inheritance. The ratio varies for the various types: Dura palms 50–70 % and Tenera palms 75–90 %.
- Oil-to-mesocarp ratio. Depends on ripeness of the fruit. The ratio varies from 45–55 %.

Interactions exist among yield components and negative correlations are widespread. The oil-to-bunch ratio is an absolute ratio, indicating the amount of oil in the bunch. Under normal conditions, not all oil can be extracted and the oil-extraction rate often given is a product of oil-to-bunch ratio and extraction efficiency. In modern processing plants the extraction efficiency is 92–94 %. Production of kernels varies with the fruit-to-bunch ratio and the kernel-to-fruit ratio. The latter may be 7–15 %. The various main yield components for production on estates in an average physical environment in Malaysia as given by Williams & Hsu (1970) are listed in Table 1.4.

The wide range of management systems under which oil palms are grown is reflected in the wide range of yields. Yields under extensive management are generally quoted in tonnes of f.f.b. per hectare per year, without further information about oil-to-bunch ratio. This ratio varies widely, thus further enlarging the range of yields of oil. Yields from various parts of the world, grouped by production sys-

Table 1.4. Yields, yield components and production.

Year from planting	Production fruit bunches (t/ha)	Yield components		Production	
		oil extraction (%)	kernel extraction (%)	oil (t/ha)	kernels (t/ha)
1	–	–	–	–	–
2	–	–	–	–	–
3	–	–	–	–	–
4	11.3	12.0	4.0	1.4	0.5
5	17.5	12.0	4.0	2.1	0.7
6	21.3	16.5	4.0	3.5	0.9
7	23.8	18.0	4.0	4.3	1.0
8	24.5	19.0	4.0	4.7	1.0
9	25.0	20.0	4.0	5.0	1.0
10	25.0	20.5	4.0	5.1	1.0
15	22.5	20.5	4.0	4.6	0.9
20	21.3	20.5	4.0	4.4	0.9
25	20.0	20.5	4.0	4.1	0.8

Source: Williams & Hsu (1970)

tem are as follows.
- Semiwild palm groves. Hartley (1977) states yields from 2.8 t of f.f.b. per hectare per year in Sierra Leone to 6.2 t of f.f.b. per hectare per year in Nigeria and to 4.7 t of f.f.b. per hectare per year in Brazil. Purseglove (1972) gives a range for West Africa from 1.2–5 t of f.f.b. per hectare per year.
- Improved palm groves. Groves can be improved by clearing and felling unproductive palms. Hartley (1977) states yields of 6.8 t of f.f.b. per hectare per year in Ivory Coast and Purvis (1968) states 7.5 t of f.f.b. per hectare per year in Nigeria for improved groves.
- Smallholdings. Yields on smallholdings range from 8 t f.f.b. per hectare per year, Ruthenberg (1980), 9 t of f.f.b. per hectare per year in Cameroon, Thedinga (personal communication) to 20 t f.f.b per hectare per year on smallholdings in Malaysia.
- Estates, Africa. Surre & Ziller (1963) give yields of 16 t of f.f.b. per hectare per year for the 8th year after planting with an oil-to-bunch ratio of 20 % for good sites in Ivory Coast. Yields of 10 t of f.f.b. per hectare per year are stated for marginal areas (1200 mm of rainfall per year).
- Estates, Latin America. Breure (1981) states yields of 21 t f.f.b. per hectare per year in Colombia under irrigation. In Costa Rica, yields are estimated at 25 t of f.f.b. per hectare per year with an oil-to-bunch ratio of 25 % and a kernel-to-bunch ratio of 5 % (personal communication).
- Estates, Malaysia. A yield of 24.2 t of f.f.b. per hectare per year on Class 1 soils is stated by Pauwels (1979) with oil-extraction ratio of 22 % and kernel-to-fruit ratio of 4.5 %. Wood (1981) stated that yields in recent plantings reached 32.6 t per hectare per year with an oil-extraction ratio of 26 % (8.55 t oil per hectare per year).
- Trial, Papua New Guinea. Yields in density trials in Papua New Guinea reached 30 t of f.f.b. per hectare per year in the 6th year after planting with a normal density of 148 palms per hectare (Breure, 1982).

1.4 Processing

The various aspects of the processing of f.f.b. to the stage of crude palm oil and palm kernels will be described in this section.

1.4.1 Production of fruit bunches, scale of processing mill and technology

Transport cost of fresh fruit bunches to the mill is a major factor in the determination of site and size of the the processing mill. Oil and nuts represent only 20–30 % of the fruit bunches, so a mill should be situated amidst production fields to minimize transport costs. Fields with a low yield are a disincentive for large scale processing mills as the bunches for the mill must be transported further and further as the mill becomes larger and larger. There is a relation between scale of

the processing mills and level of technology, in the sense that small mills use simpler technologies than larger ones. In practice, we see that in areas with semiwild palm groves the processing mills are small, apply a simple technology and produce oil with a quality suitable for local consumption only. Large high-technology mills are situated in highly productive plantations and have an output of narrowly specified crude oil suitable for the world market.

1.4.2 Technologies

Non-mechanical extraction methods are widely used in West Africa, where the oil palm originated. Hartley (1977) describes two processes, one for soft oil and another for hard oil. For soft oil, the production stages are as follows:

- Storing. The harvested bunches are cut up and kept in heaps for 2–4 days. The heaps are sprinkled with water and covered with leaves.
- Boiling. The fruits are stripped from the bunch sections and boiled for several hours in oil drums or large pots.
- Pounding. The hot mass is pounded with wooden pestles in a wooden mortar.
- Separation. The pulp is immersed in water and the oil is skimmed off (the pulp may be squeezed between the hands to extract more oil), nuts are picked from the fibre mass and dried.
- Boiling. The oil is boiled, skimmed off again to remove remaining fibres and finally fried to remove the water.

The extraction efficiency is 30–50 % and the proportion of free fatty acids (Section 1.4.4) is 7–12 %.

For the preparation of hard oil the following stages apply:

- Storing of chopped up bunches as above.
- Fermentation. Fruits are heaped in pits or canoes, covered with leaves and left for several days.
- Treading and separation. The fermented fruits are trodden in a canoe and the oil is drained, water may be added and after a second treading, the oil is skimmed off.
- Boiling and drying as above. The proportion of free fatty acids is 30–50 % and the extraction efficiency is 20–30 %.

Since the 1920s, ways have been sought to improve extraction efficiency at local level in West Africa. This resulted in the introduction of several pieces of equipment aimed at improved small scale processing. The main innovations are as follows:

- Curb press or screw-press. This press was introduced in 1932 in Nigeria and it was estimated that 9000 presses were being used in Nigeria by 1953 (Nwanze, 1962). The press consists of a presscage, with a capacity of 40–100 kg of boiled fruit mass, and a threaded shaft attached to the centre of the cage along which a block is screwed down by hand. Oil is extracted from the heated fruit mass by two pressings, the second one after removal of the nuts from the cage. The other

stages are as described for soft oil. The maximum extraction efficiency is around 70 %; the proportion of free fatty acids depends upon the quality of fruits processed but can be as low as 5 %.

– Hydraulic hand-press. The hydraulic hand-press was developed in the 1950s by staff of the West African Institute of Oil Palm Research (WAIFOR, now Nigerian Institute of Oil Palm Research, NIFOR) and Stork, a Dutch company manufacturing large processing mills. The processing stages are as for the curb press. The extraction efficiency is 80–90 %. The proportion of free fatty acids depends upon the quality of fruit processed.

– Small scale processing mills. The capacity of the various hand-presses is 0.10–0.75 t of f.f.b. per hour. With traditional methods of fruit treatment, it was impossible to supply the presses with sufficient material for continuous operation. Auxiliary pieces of equipment were developed for sterilization, pounding and separation of nuts and several complete installations were designed and built with varying degree of mechanization. These processing plants, called village palm-oil mill, junior mill or minimill, generally have a processing capacity of 0.75–3 t of f.f.b. per hour. Extraction efficiency is around 85 % and the quality of oil is good for the local market but insufficient for export.

Modern, high-technology processing mills differ from the mills described in processing capacity, as the throughput is from 6 to 60 t of f.f.b. per hour and on several qualitative aspects. Firstly the application of heavy equipment with average pressures of 7.5 MPa, adapted to the ratio of nut to fresh pericarp in tenera fruit, is a main factor in obtaining extraction efficiencies of 90 % and more. Secondly the mills are self-sufficient in energy, as fibre and shells are used to produce all steam and electricity required. Thirdly, the processing can be much better controlled and this results in crude oil of high quality.

The processing stages are as follows:

– Sterilization of fruit bunches in autoclaves, using steam with a pressure of 290 kPa.

– Stripping of fruit from bunches in a drum-threshing machine.

– Digestion of fruits with heat and mechanical devices to break up the oil-carrying cells and loosen the nuts from the pericarp.

– Oil extraction. There are four methods of extraction but pressing with the screw-press is now the most widely used method. The capacities of the currently available screw-presses is 3 to 15 t of fresh fruit bunches per hour. Digested fruit enters a perforated shaft in which a screw rotates, pressing the mass and forcing the oil through the perforations. The pressed fibre and nuts leave the shaft at the other end. This is a continuous process. Hydraulic presses with capacities from 3 to 15 t f.f.b. per hour were widely used in the past. A cage with digested fruit is placed in the press and pressed with an average pressure of 7.5 MPa, one pressing takes 2–5 min. Centrifuge units are not efficient and no new centrifuges are being installed. Solvent extraction is a new process for the palm-oil industry which is not yet in operation. It is, however, used on a small scale in the laboratories to deter-

mine the amount of oil lost in waste material for the computation of the extraction efficiency.
- Clarification to minimize levels of moisture and dirt, important to minimize deterioration in oil quality during storage through oxidization.
- Storage of the crude palm oil. Storage tanks are available with a capacity of 2 to 4 weeks production.
- Kernel recovery. The kernels are separated from the press-residue, dried and cracked. After that, the kernels are separated, dried and bagged.
- Treatment and use of residues. The empty bunches are burned in an incinerator and the ash is used as fertilizer.

The fibre and the kernel shells are dried and used as fuel for the power supply of the mill. Sludge effluent results from the use of water, partly in the form of steam, in the production process. About 1.5 m^3 of water is required for the processing of 1 t of fruit bunches and considerable amounts of contaminated water leave the mill. Strict laws are being imposed in Malaysia on effluent disposal and new technology is being developed to deal with this in an orderly manner and to use part of the effluent as a feedstuff.

1.4.3 Stages in installation of mills

Mills with a capacity to 3 t of f.f.b. per hour are generally built in areas with a sufficient supply of bunches. The machinery can be installed in a period of a few months and operation can start. The management of such a mill generally buys the fruit bunches from the producer.

The situation is completely different for large estates where the processing mill is an integrated part of the enterprise. The mill is installed in several stages in line with the progress of production of bunches on the estate and the final capacity of the mill is based on production of bunches in the peak month of the peak year of the estate. The following factors determine production of bunches of the estate and thus the installed capacity.
- Yield expectations over the years.
- Rate of planting. Large estates can be planted in annual stages and this reduces production in the peak year of the estate.
- Production during the year. Seasonal fluctuations of climatic conditions result in an uneven production of bunches per month during the year. Even in areas with a fairly constant climate such as in West Malaysia it is estimated that 15 % of the annual production is produced in the peak month.

The first two factors result in the expected production of bunches throughout the years. The required installed capacity can then be calculated as follows:

Table 1.5. Development of production of fruit bunches on an estate and mill capacity.

Year	Planting (ha)	Expected yield (t/ha)	Estate production[1] (1000 t/yr)	Capacity mill		
				required (t/h)	stage (No.)	total (t/h)
1	2000	–	–	–		–
2	2000	–	–	–		–
3	2000	–	–	–		–
4		–	–	–		–
5		11	22	5.6	I	12.5
6		17	56	14.3	II	25.0
7		21	98	24.9		25.0
8		23	122	31.1	III	37.5
9		24	136	34.6		37.5
10		25	144	36.7		37.5
11		24	146	37.2		37.5
12		24	146	37.2		37.5
13		23	142	36.1		37.5
14		23	140	35.6		37.5
25		20	120	30.5		37.5

1. Production in peak month 14 % of annual production.

required installed capacity in tonnes f.f.b. per hour = $A \times B/C$

with
A, maximum annual production in tonnes f.f.b.
B, proportion of annual production in peak month
C, maximum operation time of a mill per month in peak periods, usually set at 500 h.

Processing of bunches in the first year(s) of production or processing of part of the peak production by third parties results in delayed installation and/or a reduced required maximum capacity of the mill. An example of estate development and stages of mill capacity is given in Table 1.5.

1.4.4 Composition and quality of crude palm oil and kernels

The main components of crude palm oil are listed in Table 1.6. The composition of 53 % saturated and 47 % unsaturated fatty acids sets palm oil between the vegetable oils from cotton, groundnut, soya and sunflower which all have higher proportions of unsaturated fatty acids and the oils from coconut and palm kernels, which consist of 85–90 % of saturated fatty acids.

The quality of crude palm oil produced for the international market is determined by several factors discussed by Bek-Nielson (1977).

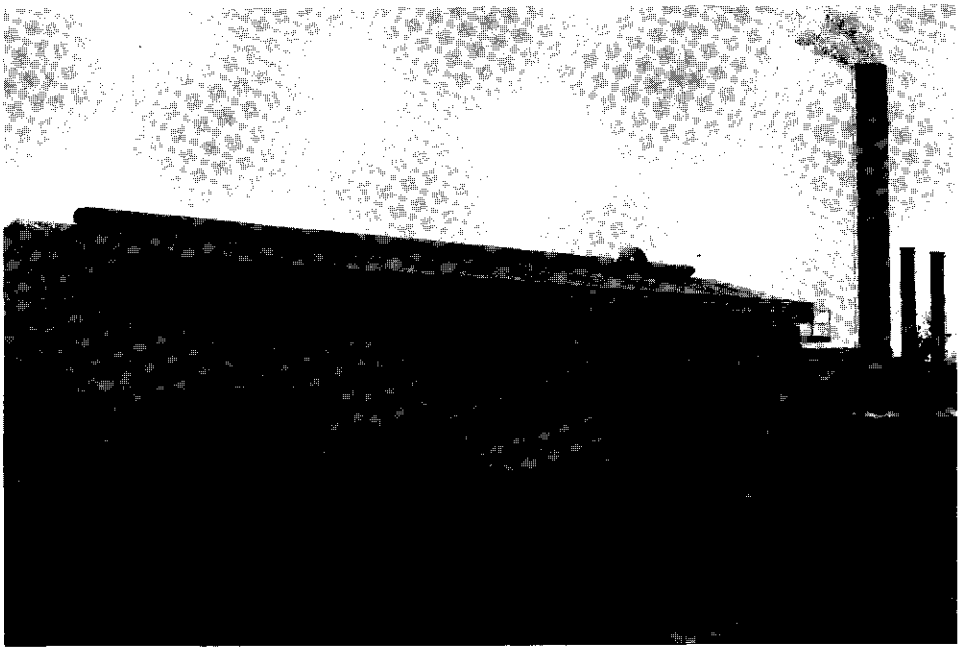

Plate 9. Modern medium-size oil-mill with incinerator for empty bunches (right), Indonesia.

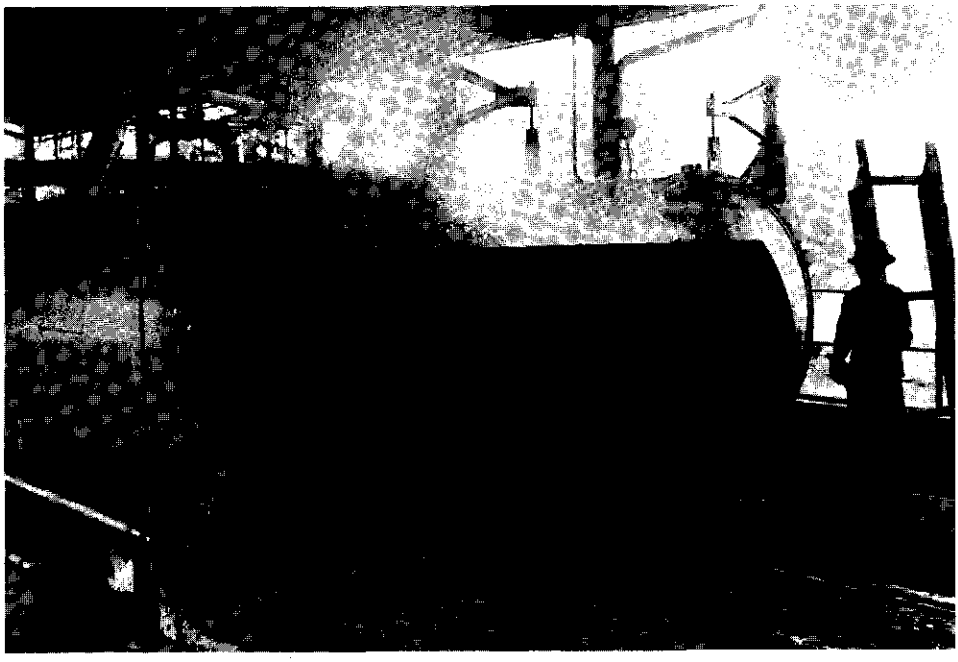

Plate 10. Cage with bunches leaving the horizontal sterilizer, Indonesia.

Plate 11. Pressing station with screw-press, Indonesia.

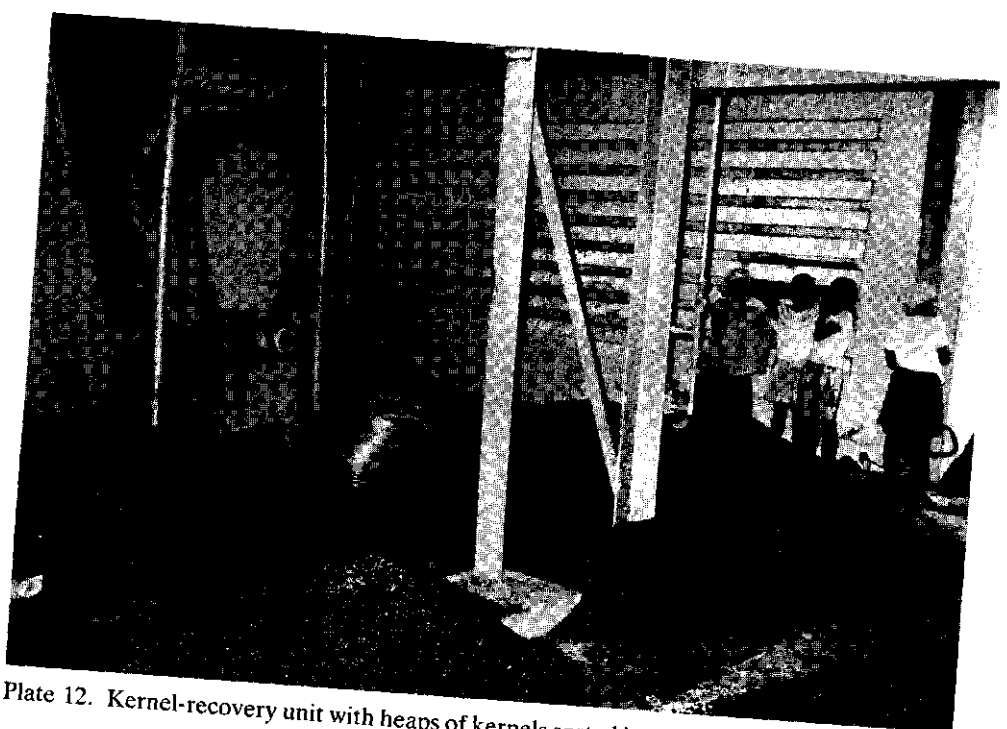

Plate 12. Kernel-recovery unit with heaps of kernels sorted by size, Indonesia.

Table 1.6. Composition crude palm oil.

	Range in share of weight (%)
Saturated fatty acids	
myristic	1- 6
palmitic	32-47
stearic	1- 6
total	about 53
Unsaturated fatty acids	
linoleic	5- 7
oleic	40-52
total	about 47
Carotenes	250-2600 ppm

– Content of free fatty acids. Free fatty acids are formed by enzyme action from the moment of harvesting when fruits are bruised, until sterilization or boiling. A low content of free fatty acids facilitates the refining of palm oil and end-products have a longer shelf-life.
– Oxidation. A low degree of oxidation is important for the refining process, as this improves bleachability and results in a better shelf-life of the final product. Degree of oxidation is expressed in peroxide value (PV) and (a235 + a270) both values refer to laboratory tests.
– Bleachability. Refined palm oil is used together with other fats and oils in manufacturing a variety of products and individual oils must be colourless before blending. Good bleachability of palm oil results in relatively low refining costs and it improves its competitive position over other oils. Several laboratory tests are in use to express the bleachability.
– Contents of moisture and impurities. A low content of moisture and impurities is important for the stability of the oil during storage.
– Contents of heavy metals. Metalic promotors of oxidation, such as copper and

Table 1.7. Quality characteristics of Malaysian palm oil.

	Standard quality	Special quality
f.f.a. (%)	3 ± 1	1.8 ± 0.2
Heat bleach	0.7 + 0.3	0.5 ± 0.3
Mixed bleach	1.2 ± 0.6	1.1 ± 0.2
Moisture (%)	0.1 ± 0.03	0.1 ± 0.03
Impurities (%)	0.01	0.01
Iron (ppm)	3.5 ± 1	3.5 ± 1
Copper (ppm)	0.2	0.2
PV (mEq/kg)	4.5 ± 2	3 ± 1
100 (A235 + A270)	15 ± 3	10 ± 2

Source: MPOPA (1973)

iron have a negative effect on the keeping quality of oil.
Internationally recognized quality specifications and standardized analysis methods have not yet been agreed upon and several grades such as Special Prime Bleach (SPB) and Special Quality (SQ) for Malaysian oil (Table 1.7) are in use, as well as the simpler specifications about free fatty acids, moisture and impurities.

Palm oil produced and consumed locally in West Africa does not generally comply with the above standards. Consumers prefer oil with a higher content of free fatty acids and carotenes, which is detrimental to bleachability, but useful from a dietary viewpoint.

The quality of palm kernels determines the quality of palm-kernel oil after crushing. A low content of free fatty acids is a major quality characteristic of palm-kernel oil. Kernels should have a low moisture content, about 7 %, a low proportion of broken kernels. They should be free from impurities and have a minimum of discoloration.

1.5 Linkages and services

Production of crude palm oil and kernels is linked with two types of activities: provision of services to the producer; the processing of crude palm oil and kernels into end-products. Both activities are to a large degree specialized on the oil palm and its products. People, firms and institutions engaged in these activities form together with the primary producers the oil-palm sector in the economy of producing countries.

1.5.1 Refining and fractionating of crude palm oil

Crude palm oil can be refined and then fractionated into palm olein and palm stearin or fractionated first and then refined.

Crude palm oil, palm olein or palm stearin are refined to obtain odourless and tasteless fats and oils which can be sold as standardized products such as cooking oil to consumers or which can serve as raw material for oleochemical industries producing soaps, lotions, detergents, cosmetics and pharmaceuticals. The refined product can be stored without deterioration of quality, this contrary to crude oil, especially the lower qualities. Refining comprises several stages:

- Degumming and neutralization, removal of free fatty acids, washing and drying. This removes phosphatides, protein fragments and free fatty acids, which are impurities resulting in inferior quality of products if left in the oil. The neutralized oil is further processed and the free fatty acids removed are usually sold as soapstock.
- Bleaching and filtration to obtain the lightest colour possible and to remove traces of soaps and nickel left from the previous treatment.
- Deodorization and polishing to remove odoriferous and flavoured substances, and to give the finished oil its sparkle.

The end-products of the refining process are soap-stock and RDB (refined, deodorized and bleached) palm oil or RDB palm olein and RDB palm stearin if fractionated components are refined. The proportion of soap stock is usually 5–7 % depending on the content of free fatty acids of the crude palm oil. The oil loss during refining of crude palm oil is 8–12 % depending on the technology.

Crude or refined palm oil is fractionated into palm olein and palm stearin, which are liquid and solid, respectively, at ambient temperatures. These products can be further fractionated to obtain specialized products. The proportions of the fractionated products and their specifications depend on the manner of fractionation. The losses during fractionation of crude palm oil are around 1 %.

The refined and fractioned palm oil, generally referred to as processed palm oil (p.p.o.), is processed into end-products such as cooking oil, margarine, soap and detergents.

1.5.2 Processing of palm kernels

Palm kernels are processed into palm-kernel oil and meal by the 'crushing industry'. The processing of palm kernels results in about 40 % palm-kernel oil and 55 % meal or cake. About 5 % is lost, mainly as moisture in the kernels. palm-kernel oil is similar to coconut oil (Table 1.8). The quality of palm-kernel oil is determined by the content of free fatty acids and the bleachability as for palm oil. The oil resembles coconut oil, but a generally higher content of free fatty acids and some other properties makes further processing slightly more expensive and prices of kernel oil are constantly below the prices for coconut oil.

Palm-kernel cake or meal contains 19 % protein which is less than coconut cake, 22 %, or groundnut cake, 52 %. Other components of the cake are: carbohydrates 48 %, fibre 13 %, water 11 %, oil 5 % and ash 4 %.

Table 1.8. Composition palm-kernel oil.

	Range in proportion of weight (%)
Saturated fatty acids	
caprylic	3- 4
capric	3- 7
lauric	46-52
myristic	14-17
palmitic	6- 9
stearic	1- 2.5
total	82
Unsaturated fatty acids	
oleic	13-19
linoleic	0.5-2
total	18

Palm-kernel oil can be refined, fractionated and further processed into end-products such as cooking oil or soap. The cake or meal is generally used in feedstuffs for poultry or pigs.

1.5.3 Supporting services

The supporting services in the various producing countries reflect production methods of fruit bunches and the method of processing. In West Africa, much attention is paid to the smallholder and his requirements, while in Malaysia, the estate is the focal point. Partly parallel to this dichotomy are public and private services. Smallholders are generally served by public services such as research, extension and credit services, whereas estates, especially the larger firms controlling several estates, may operate their own research stations and have direct access to national and international financial markets. In various countries, there are agencies offering a comprehensive package of services, including supply of inputs and processing to smallholders or to settlers who want to become smallholders. This is partly necessary because oil palm requires medium-term to long-term finance, which is beyond the scope of many smallholders and partly because of the national importance of palm oil for export. In general, services must be considered within the national context and this is done in the national studies (Part II). Several services, however, are internationally oriented.

Research is the major supporting service with an international scope. The main research institutes deal predominantly with production of fruit bunches and processing is of minor interest. Producers of processing equipment are the innovators in processing, though sometimes they collaborate with research institutes. The main research topics in production are as follows:

- Selection and breeding of high-yielding palms with good secondary characteristics such as low annual height increment, disease resistance, good oil quality.
- Tissue-culture techniques for vegetative propagation of oil palms, which allos quick propagation of practically unlimited numbers of plantlets from a single parent.
- Crossing *E. guineensis* with *E. oleifera*. This cross has several advantages: low height increment per year, resistance to some diseases (Margitez), oil of superior quality due to a higher content of unsaturated fatty acids. The yield, however, is still lower than the modern D × P palms.
- Insect pollination. Outside West Africa, pollination is below optimum due to the absence of specific insect species. In Malaysia, the weevil, *Elaeidobius kamerunicus*, has been introduced (Syed et al., 1982) and possible introduction to other countries is being studied.

Research in processing is directed to the efficiency of extraction, treatment of mill effluent, and oil quality. For intermediate technology, there is research on various types of hand-presses and auxiliary equipment.

Production of germinated or pre-germinated seeds from selected parents is gen-

erally an activity combined with selection and breeding of high-yielding palms on research stations. There is a considerable international demand for seeds as several countries in Latin America, the Far East and West Africa are increasing their production by planting programmes. Export of seeds from Malaysia is forbidden. Ivory Coast and Papua New Guinea are the main seed exporting countries.

Processing equipment for processing of fruit bunches on industrial scale is produced in Malaysia and to a lesser extent in Indonesia, countries with a large and modern oil-palm sector. Countries in West Africa and Latin America normally import either complete installations on a turnkey basis or they import the main components such as presses and turbines. The main producers of processing installations operating on the international market are in France, Luxemburg and the Netherlands.

Advisory services are provided by several private firms and institutions based in West European countries to palm oil producers around the world. The private firms were or are related to international plantation groups while the institutions are engaged into agricultural research.

1.6 International trade and consumption

Fats and oils of various origin are to a considerable degree interchangeable, so the international trade in oil-palm products must be reviewed within the context of the world economy of fats and oils.

1.6.1 Fats and oils

Fats and oils are grouped into three main categories on the basis of their source: vegetable oils; animal fats; marine oils. Within each category, there are fats and oils classified as 'edible' or 'industrial'. In practice, the division between edible and industrial is not absolute as certain fractions of edible oils may be used for industrial purposes and vice versa.

The greater part of the fats and oils produced and traded is derived from oilseeds. Crushing of oilseeds results in oil and meal, and the proportions of oil and meal vary widely from crop to crop (Table 1.9). The processing of most of the seeds results in 40 % or more oil; the presscake, called 'meal' or 'cake', is a by-product and the meal value of the seed is lower than the oil value of the seed. Soya bean is an exception as the seed contains 80 % meal with a very suitable composition for livestock feeds, the meal having a higher value than the oil. Soya bean is therefore primarily produced for meal and production is related to the demand for livestock feeds, in turn related to the demand for animal protein. Cotton seed is a by-product of the lint production and production is related to the demand for lint. In this section 'oil equivalent' refers to oil and the proportion of oil in unprocessed seeds and 'meal equivalent' refers to meal and the proportion of meal in unprocessed seeds.

Table 1.9. Oilseeds and proportions of oil and meal.

	Oil (%)	Meal (%)
Coconut: copra[1]	64	30
Cotton: cottonseed[2]	18	48
Groundnut[3]	45	55
Oil-palm products[4]	90	10
Rapeseed	45	.
Soya bean	18	80
Sunflower seed	40	30
Sesameseed	48	.

1. Copra is the input for the processing industry. One coconut gives about 0.2 kg copra.
2. Cottonseed is the by-product of cotton lint. The harvested product is seedcotton which consists of 35% lint and 65% cottonseed.
3. Shelled groundnut or kernel. The shelled groundnut is 70% of the harvested product.
4. The processing of the harvested product, fruit bunches, results in approximately 20% crude palm oil and 5% kernels. Kernels contain about 50% kernel oil. The proportions stated refer to the primary products; thus crude palm oil and kernel oil are stated under oil and kernel meal is stated under meal.

1.6.1.1 Production

Production of fats and oils increased by an average of 3.2 % per year in the period 1961–1963 until 1981–1983 (Table 1.10). The main production increase came from the vegetable oils, 4.2 % per year; animal fats increased by 1.4 % per year, whereas marine oils remained practically constant. This resulted in an increased share of the vegetable oils from 59 % per year in 1961–1963 to 72 % per year in 1981–1983 in the total fats and oil production. Of all fats and oils listed in Table 1.10 four edible vegetable oils had an average production increase of more than 3.2 % per year: palm oil 8.4, rapeseed oil 6.8, soya oil 6.2 and sunflower seed oil 5.5 % per year. Thus these four oils increased their relative share of the total world production of fats and oils. They became the major vegetable oils in the 20 years, giving a share of 67 % of the edible vegetable oil production or 47 % of the total fats and oils in 1981–1983. Soya oil is the major oil with a production increase of 10 million tonnes in the 20 years stated and a share of 32 % of the total production of edible vegetable oils.

Production of vegetable oils is concentrated in a few of countries and Table 1.11 gives the producers with a production of at least 100 000 t per year for one or more of the principal vegetable oils in 1981–1983. In total, 23 countries or groups of countries are listed. These countries produce 79 % or more of the world production of the individual principal vegetable oils and together cover 85 % of the world production of edible vegetable oils or 59 % of all fats and oils. The low-income and middle-income countries listed produce 51 % of the recorded total, the industrial countries with a market economy 39 % and the centrally planned countries 10 %.

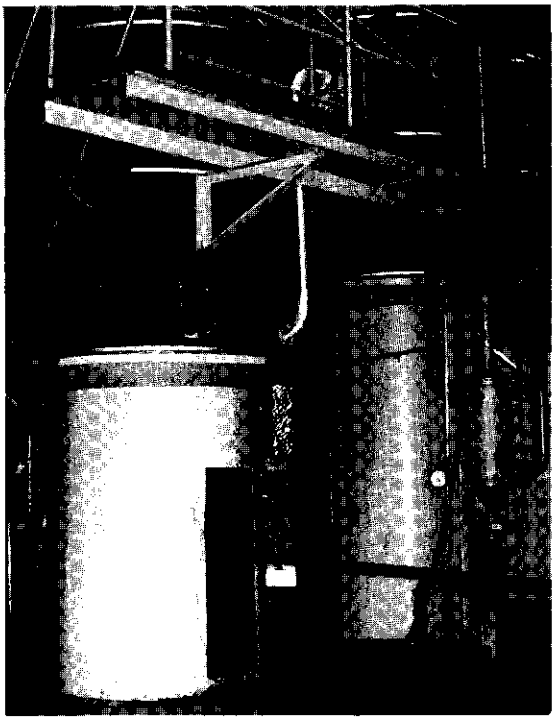

Plate 13. Clarification and sludge tanks.

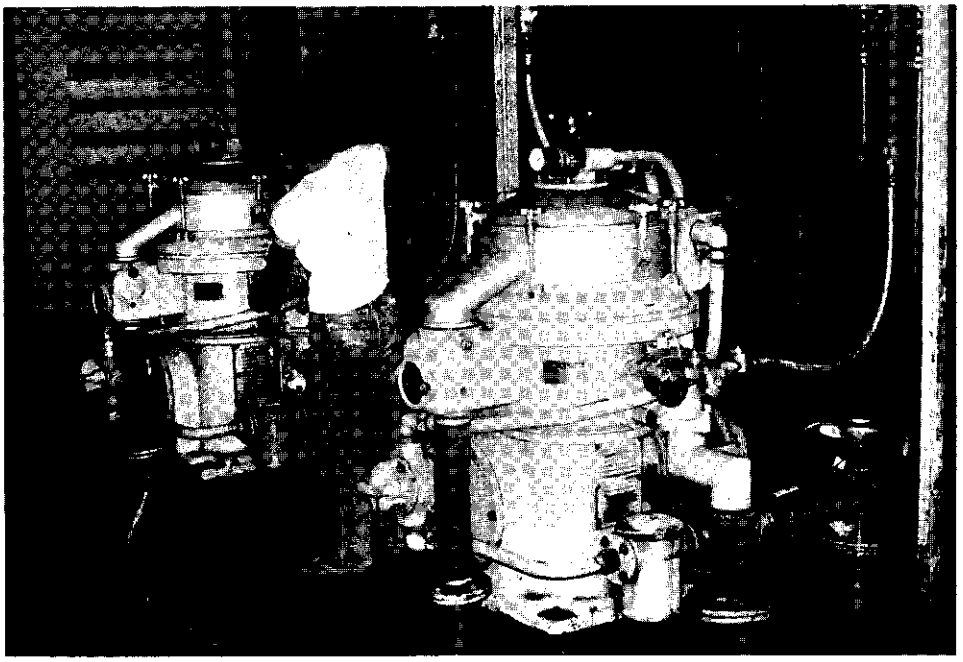

Plate 14. Centrifuges to remove dirt.

Plate 15. Steam boiler for fibre and nut shells.

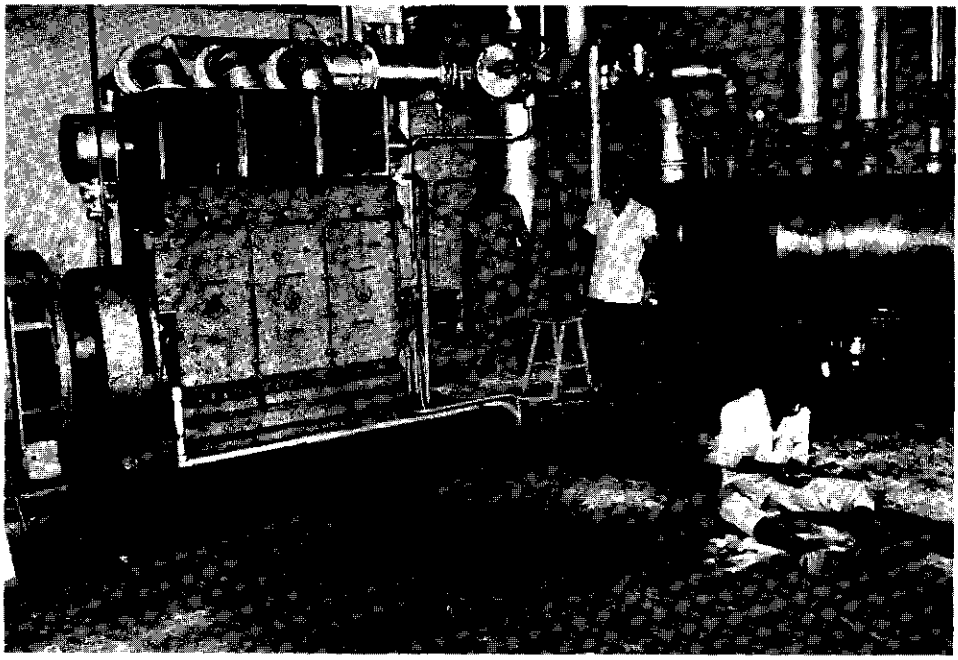

Plate 16. Power-house.

Table 1.10. World production of fats and oils (1000 t oil equivalent).

	1961/63	1971/73	1981/83
Vegetable oils	19 910	29 910	45 330
edible	18 240	28 460	44 120
coconut oil	2 140	2 330	2 890
cottonseed oil	2 290	2 760	3 140
groundnut oil	2 710	3 070	3 090
olive oil	1 270	1 580	1 770
palm-kernel oil	450	430	720
palm oil	1 080	2 080	5 430
rapeseed oil	1 250	2 240	4 630
sesame oil	520	730	690
soya-bean oil	4 170	8 450	14 010
sunflower seed oil	1 950	3 640	5 690
other[1]	410	1 150	2 060
industrial oils[2]	1 670	1 450	1 210
Animal fats	12 930	14 570	16 920
edible	9 100	9 380	10 680
butter	4 650	5 230	5 960
lard	4 450	4 150	4 720
industrial			
tallow	3 830	5 190	6 240
Marine oils[3]	1 080	1 150	1 140
Total	33 920	45 630	63 390

1. Mainly maize oil and babassu oil.
2. Mainly linseed, ricinus and tung oil.
3. Fish oil and baleen oil.

Sources: see Table 1.2

Production of meal runs parallel to production of vegetable oils. However the position of soya bean meal is even more prominent than the position of soya oil. Palm oil and olive oil are produced from fruits and the proportion of meal from the fruit is small for oil palm and zero for olive. Soya bean meal has a share of 62 % in production of meals from oilseeds and a share of 59 % of all meals produced (Table 1.12).

1.6.1.2 Trade

The export of fats and oils in the past 20 years is given in Table 1.13. The amount entering the international market increased by an average of 4.7 % per year, thus international trade grew faster than production. Exports reached 34 % of the world production in 1981–1983. The amount of vegetable oils traded in-

creased by 5.7 % per year, well above the increase of animal fats, 2.7 %, and marine oils, which declined by 0.7 % per year. The four vegetable oils with the largest increase in production (palm oil, rapeseed oil, soya oil and sunflower seed oil) booked also the largest increase in amount traded, with annual averages of 9.4 %, 12.2 %, 9.1 % and 12.0 %, respectively. Soya oil had the largest increase with 5.7 million tonnes per year between 1961–1963 and 1981–1983, followed by palm oil with an increase of 2.7 million tonnes per year, sunflowerseed oil with 1.5

Table 1.11. Main producers of principal vegetable oils[1], 1981/83 (1000 t oil equivalent).

	1	2	3	4	5	6	7	8	9
Low, Middle inc.	2280	970	2480	110	490	5100	2120	3960	1400
Argentina	.	.	70	.	.	.	.	590	680
Brazil	.	150	80	.	.	.	.	2460	.
Cameroon	.	.	.	.	.	100	.	.	.
China	.	450	580	.	.	200	1360	560	490
Egypt	.	100	.	.	.	.	.	.	.
India	230	270	1340	.	.	.	760	100	.
Indonesia	670	.	.	.	.	840	.	.	.
Ivory Coast	.	.	.	.	.	150	.	.	.
Malaysia	130	.	.	.	320	3110	.	.	.
Mexico	.	.	.	.	.	.	.	130	.
Nigeria	.	.	.	.	170	700	.	.	.
Pakistan	.	.	.	.	.	.	.	.	.
Paraguay	.	.	.	.	.	.	.	120	.
Philippines	1250	.	.	.	.	.	.	.	.
Senegal	.	.	210	.	.	.	.	.	.
Sudan	.	.	200	.	.	.	.	.	.
Turkey	.	.	.	110	.	.	.	.	230
Zaire	.	.	.	.	.	150	.	.	.
Industrial, market	.	760	200	1410	.	.	1690	9320	1210
Canada	.	.	.	.	.	.	760	130	.
West Europe[3]	.	.	.	1410	.	.	930	.	480
United States	.	760	200	.	.	.	.	9190	730
Centrally planned	.	800	.	.	.	.	430	.	2690
East Europe	.	.	.	.	.	.	430	.	800
Soviet Union	.	800	.	.	.	.	.	.	1890
Total	2280	2530	2680	1510	490	5100	4240	13280	5300
share of world total (%)	79	81	87	85	59	87	92	95	93

1. 1, coconut oil; 2, cottonseed oil; 3, groundnut oil; 4, olive oil; 5, palm-kernel oil[2]; 6, palm oil; 7, rapeseed oil; 8, soya-bean oil; 9, sunflower seed oil.
2. Palm-kernel oil is included as it is a by-product of palm oil.
3. The 12 EEC countries plus Norway and Sweden.

Sources: see Table 1.2

million tonnes per year and rapeseed oil with 1.2 million tonnes per year. These four oils plus coconut oil are now the main edible oils traded on the international market with a total market share of 83 % of all vegetable oils and 68 % of all oils and fats.

The countries with an average export of 100 000 t or more per year of one or more of the principal vegetable oils in the years 1981–1983 are listed in Table

Table 1.12. Production of meal and cake in 1981/83 (1000 t meal equivalent).

Oilseeds	98 760
copra	1 640
cottonseed	11 720
groundnut	3 950
palm kernel	820
rapeseed	7 280
soya bean	61 440
sunflower seed	8 190
other	3 720
Fish meal	4 510
Total	103 270

Sources: see Table 1.2

Table 1.13. World export of fats and oils from producing countries (1000 t oil equivalent).

	1961/63	1971/73	1981/83
Vegetable oils	5 830	9 740	17 510
coconut oil	1 250	1 330	1 410
cottonseed oil	270	330	440
groundnut oil	890	800	610
olive oil	190	310	210
palm-kernel oil	350	330	450
palm oil	540	1 070	3 240
rapeseed oil	130	770	1 290
soya-bean oil	1 200	3 150	6 900
sunflower seed oil	170	580	1 640
other	840	1 070	1 320
Animal fats	1 860	2 540	3 160
butter	470	620	670
lard	330	370	400
tallow	1 060	1 550	2 090
Marine oils	810	760	710
Total	8 500	13 040	21 380

Sources: see Table 1.2

1.14. The exports of the 12 countries or group of countries listed cover 84 % of the total world exports of vegetable oils. The data clearly show that the number of main exporters is restricted to one to three or for sunflower seed oil to five. So a few countries have a dominant position on the world market. The United States is

Table 1.14. Main exporters of principle vegetable oils[1], 1981/83 (1000 t oil equivalent).

	1	2	3	4	5	6	7	8	9
Low, Middle Inc.	1070	.	250	.	310	3060	.	1700	420
Argentina	.	.	.	.	.	.	.	510	420
Brazil	.	.	.	.	.	.	.	1190	.
China	.	.	130	.	.	.	.	.	.
Indonesia	.	.	.	.	.	300	.	.	.
Malaysia	.	.	.	.	310	2760	.	.	.
Philippines	1070	.	.	.	.	.	.	.	.
Francophone W. Africa	.	.	120	.	.	.	.	.	.
Industrial, market	.	300		120	.	.	1240	5070	860
Canada	.	.	.	.	.	.	680	.	.
West Europe	.	.	.	120	.	.	560	.	140
United States	.	300	.	.	.	.	.	5070	720
Centrally planned	.	.	.	.	.	.	.	.	300
East Europe	.	.	.	.	.	.	.	.	200
Soviet Union	.	.	.	.	.	.	.	.	100
Total	1070	300	250	120	310	3060	1240	6770	1580
share of world total (%)	76	68	41	57	69	94	96	98	96

1. 1, coconut oil; 2, cottonseed oil; 3, groundnut oil; 4, olive oil; 5, palm-kernel oil; 6, palm oil; 7, rapeseed oil; 8, soya-bean oil; 9, sunflower seed oil.
Source: see Table 1.2

Table 1.15. Imports of main traded vegetable oils in 1981/83 (1000 t oil equivalent).

	Coconut oil	Palm oil	Rapeseed oil	Soya-bean oil	Sunflower seed oil
Africa	30	290	260	490	250
N.C. America	470	150	30	390	310
S. America	10	–	–	540	60
Asia	300	1500[1]	650	2850	70
Europe	670	780	790	3620	1120
Oceania	20	20	20	50	10
Soviet Union	80	280	10	400	220
World	1580	3020	1760	8340	2040

1. Excluding Singapore.
Source: FAO (1983)

the leading exporter, with Malaysia, Brazil and Philippines as the other countries with exports of more than a million tonnes per year for one of the vegetable oils.

The import of the five major traded oils by region is given in Table 1.15. Sometimes part of the imports are re-exported, so that total imports are above the exports from producing countries listed in Tables 1.13 and 1.14. Comparison of the imports with the exports shows that North America and South America are net exporters, whereas Africa, Asia and Europe are the main net importing continents.

Trade in oil meals is largely the trade in unprocessed soya beans from the United States, Brazil and Argentina to the European Community, where the beans are processed into meal for the livestock feed industry. The exports of oilseeds expressed as meal equivalent reached 50.5 million tonnes in 1982.

1.6.1.3 Consumption

The regional consumption pattern of oils and fats reflect the production pattern. In North America, Europe and the Soviet Union, the annual oil seeds, soya beans, rapeseed and sunflower seed, are the main sources of oil. In tropical countries, oils from the perennials coconut and oil palm, and from groundnut are the main ones consumed. Coconut oil and increasingly palm oil are especially important in South-East Asia, palm oil and groundnut oil in West Africa. In India and China, oils from palms and several annual oilseeds are used because of the great

Table 1.16. Consumption of edible vegetable oils in 1982.

	Share of world consumption (%)	Consumption per person (kg oil equivalent)
Low Middle income countries	52	8.1
Africa	9	9.4
S.C. America	9	12.3
Brazil	4	
Asia	34	7.2
China	13	6.5
India	9	6.3
Industrial, market	37	23.4
N. America	15	30.4
United States	14	31.8
W. Europe	18	21.9
Japan	3	14.2
Centrally planned	11	14.0
Soviet Union	8	15.1
E. Europe	3	11.2

Source: World Bank (1984)

variations in climates in these countries.

Consumption of all fats and oils per person increased from 12.0 to 13.9 kg in the period 1972–1982. Edible vegetable oils accounted for the largest share of the increase, as consumption rose from 7.5 to 9.7 kg per person in the period. Consumption of vegetable oils by region and consumption per person show that consumption per person is strongly related to income (Table 1.16). In India with a GNP of $260 per person, consumption was 6.2 kg per person, whereas in the United States, with a GNP per person of $13 160, consumption was 31.8 kg. At low incomes levels the demand for oils and fats increases rapidly, income elasticities being above 1.0. At high incomes, roughly the levels reached by United States and some European countries, income elasticity is reduced to values close to zero and consumption per person levels off at about 30 kg per year. It is expected that the largest increase in consumption of fats and oils will take place in the low-income and middle-income countries through the income effect and the population growth.

1.6.2 Production and international trade in oil-palm products

Production and trade in palm oil has changed drastically during the past 20 years (Table 1.17). South-East Asia with Malaysia and Indonesia as main producing countries became the major production region, with an average production increase of 15 % per year. Production in African countries in total increased by 1.5 % per year, with great differences from country to country. Production in Central and South America increased considerably from very low levels and several countries now produce amounts comparable with those in African countries. New is production in Oceania, where Papua New Guinea and the Solomon Islands started a fast-expanding oil-palm estate sector.

Exports show even greater changes. Malaysia became the dominant exporter with a share of 86 % of all exports in 1981–1983. The export from African countries decreased from 31 % of production to 6 %, thus these countries are now mainly producing for the domestic market. The countries in Central and South America too are producing for their domestic requirements, whereas Papua New Guinea and the Solomon Islands are producing almost entirely for export.

The product exported until about 1975 was crude palm oil. Then Malaysia started developing a processing industry and other producing countries followed. Now, the bulk of the palm oil exported is processed palm oil.

Production of palm kernels and palm-kernel products increased with the increase in palm-oil production. The share of kernels from semiwild oil palms in total production is larger than the share of oil from semiwild palms in palm-oil production as the semiwild palms in Africa produce more kernels and less oil per bunch than the improved palms. In South America, especially Brazil, grows a wild palm, the babassu palm, *Orbignya*, producing kernels and production and export data refer partly to these kernels. The same applies to the kernels of the cohune

palm, *Orbignya cohune*, which occurs in Mexico. The export data (Table 1.18) refer to kernels to make production and export figures comparable. However the major part of the exports now consist of kernel products, oil, meal or cake, as the major producing countries established a kernel-crushing industry in the period reported.

Table 1.17. Producers and exporters of palm oil (1000 t)[1].

	1961/63		1971/73		1981/83	
	production	export	production	export	production	export
Africa	1011	316	1278	165	1372	78
Angola	19	16	74	7	40	–
Benin	36	10	42	10	34	3
Cameroon	39	–	58	3	99	7
Ghana	40	–	60	–	23	–
Guinea	11	–	38	–	44	–
Ivory Coast	23	–	75	43	152	58
Liberia	40	–	7	–	28	5
Nigeria	520	138	654	7	695	–
Sierra Leone	35	–	61	–	48	–
Zaire	225	149	180	90	153	4
Central America	21	–	32	–	64	–
Costa Rica	6	–	14	–	24	–
Honduras	1	–	7	–	30	–
South America	7	–	59	12	165	7
Brazil	–	–	7	–	16	5
Colombia	–	–	38	–	90	–
Equador	–	–	6	–	42	–
Asia	255	209	1035	924	4184	3070
China	.	.	40	–	150	–
Indonesia	145	109	272	235	881	260
Malaysia	110	100	720	689	3116	2800
Oceania	–	–	3	3	89	85
Papua New Guinea	–	–	3	3	67	66
Solomon Islands	–	–	–	–	22	19
Total	1294	525	2407	1104	5874	3240

1. The countries listed cover 98% of the production and 99.6% of the export in 1981/83; data of the countries not listed are included in the subtotals per region and thus in the total. Production and export figures may differ slightly from the figures in previous tables according to difference in sources.
Source: FAO (1961-1983)

Table 1.18. Producers and exporters of palm kernels (1000 t).

	1961/63		1971/73		1981/83	
	production	export	production	export	production	export
Africa	778	706	861	579	739	315
Angola	13	13	13	6	12	–
Benin	50	46	57	57	74	20
Cameroon	31	14	58	15	46	6
Ghana	12	1	38	–	30	–
Guinea	20	20	37	12	35	9
Ivory Coast	11	11	21	21	36	36
Liberia	8	8	16	7	8	4
Nigeria	408	398	425	275	355	146
Sierra Leone	58	58	50	46	45	11
Zaire	112	112	110	100	65	40
Central America[1]	47	–	36	3	18	2
Costa Rica	20	–	3	1	7	2
Honduras	–	–	3	2	7	–
South America[1]	147	8	226	8	302	15
Brazil	132	–	190	2	258	15
Colombia	–	–	10	–	19	–
Equador	7	–	6	–	8	–
Asia	62	54	220	180	984	838
China	–	–	10	–	48	–
Indonesia	33	32	59	46	151	24
Malaysia	28	19	149	117	784	780
Oceania	–	–	–	–	31	14
Papua New Guinea	–	–	–	–	28	11
Solomon Islands	–	–	–	–	3	3
Total	1034	768	1343	770	2074	1184

1. Production and trade data refer to palm kernels, babassu nuts, and probably nuts of the cohune palm.
Source: FAO (1961-1983)

1.6.3 Prices

The prices for fats and oils are determined mainly by market forces, although trade barriers are of some importance. The prices of oilseeds depend on market demand for vegetable oils and meal, and react to these forces according to their oil-meal ratio. The main relation between the markets for meal and vegetable oils is the soya bean as soya oil and soya bean meal are the major traded products in their respective markets. oil-palm products with a 90 % share of oil (83 % palm oil and 7 % kernel oil) and 10 % of meal are mainly effected by the market in vegetable oils.

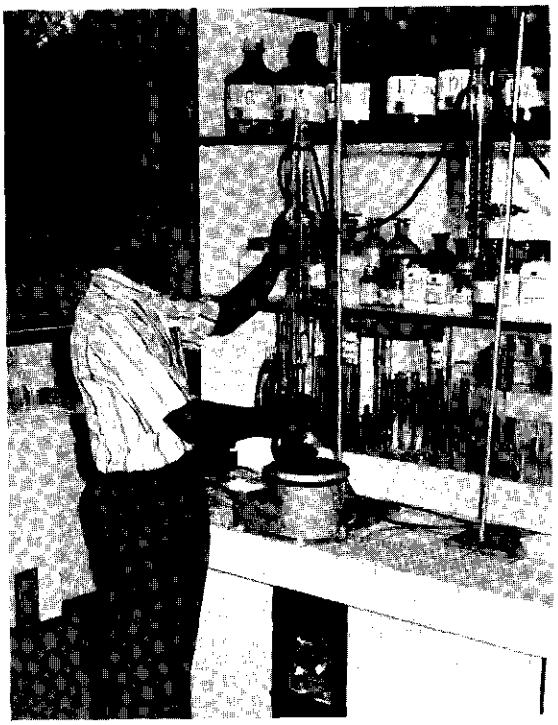

Plate 17. Quality control in laboratory of oil-mill.

Plate 18. Oil-storage tanks.

Plate 19. Non-mechanical extraction in Sierra Leone: boiling of fruit in petrol drums.

Plate 20. Non-mechanical extraction: pit in which the heated and pulped mass is dumped for separation of oil. Left the nuts picked out of the fibre.

Plate 21. Semiwild oil palms, Ivory Coast.

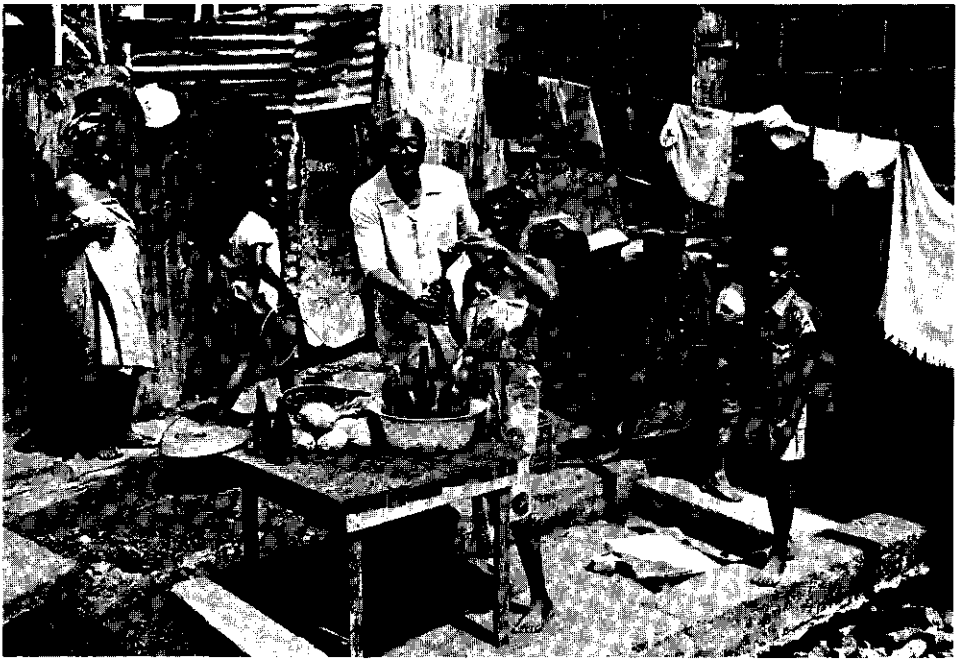

Plate 22. Sale of palm oil produced by non-mechanical extraction in Freetown, Sierra Leone.

Table 1.19. Prices of oil-palm products and soya-bean oil (in US$/t).

	Palm oil[1]		Palm kernels[2]		Soya-bean oil[3]		Fats and oils[4] constant
	current	const '83[4]	current	const '83	current	const '83	(1983 = 100)
1960	228	756	144	477	225	745	129
1965	273	876	179	576	270	868	148
1970	260	750	168	484	307	885	136
1975	434	619	207	295	619	882	105
1976	407	569	230	322	438	613	109
1977	530	686	326	422	576	745	126
1978	600	660	364	400	607	668	113
1979	654	647	500	495	662	655	116
1980	584	533	345	315	598	546	99
1981	571	544	317	302	507	483	99
1982	445	432	270	262	447	434	81
1983	501	501	362	362	527	527	100

1. Malaysian 5%, c.i.f. N.W. Europe.
2. Nigerian c.i.f. U.K.
3. Crude, Dutch, f.o.b. exmill.
4. Deflated by manufacturing unit value index, the index of manufactured exports from industrial to developing countries.

Source: World Bank (1984)

Within the group of edible vegetable oils, there are oils with considerable differences in composition. Sunflower seed oil has a large proportion of unsaturated fatty acids, whereas the 'lauric oils', coconut oil and palm-kernel oil, have a large proportion of lauric and myristic acids, both saturated fatty acids. The need for certain chemical components in a specific end-use, consumer preferences and the different costs for refining and processing of the various oils limit substitution within the group of edible vegetable oils and lead to price differences. The price of all fats and oils in constant terms has declined since 1960 by 1.2 % per year (Table 1.19). Palm oil and soya oil showed a slightly greater decline, 1.3 % per year. Palm-kernel prices, in constant terms as well, declined by 1.7 % per year. Palm oil belongs with soya oil, rapeseed oil and sunflowerseed oil to the medium-priced oils. 'Lauric' oils, which include coconut oil, palm-kernel oil, groundnut oil and cottonseed oil, are the highest-priced oils. Marine oils are the cheapest oils on the market. The technical improvements in the refining industry increased the interchangeability and resulted in replacement of higher priced oil by cheaper oils, which benefited palm oil and soya oil and narrowed the price differences among the vegetable oils.

Price projections by the World Bank (1984) show a slightly declining price for palm oil to $550 per tonne in 1990 and $535 per tonne in 1995, expressed in constant 1983 prices.

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2 Comparative analysis

2.1 Framework

2.1.1 Scope of analysis

The analysis of the economics of oil palm in producing countries requires a comprehensive approach including production stages from primary product to exported or domestically consumed product as well as aspects not directly falling under economics, such as organizational structure and policy matters. The object of analysis is thus the oil-palm sector, defined as those parts of the agricultural, industrial, trade and services sectors that deal with the oil palm and its products.

Ecology is included in the analysis, as ecological conditions in producing countries are the basis for oil-palm cultivation, and thus for the oil-palm sector, as well as the starting point in considering alternative crops or other agricultural enterprises.

The oil-palm sector has been studied in eight producing countries and these case studies provide the basis for the comparative analysis resulting in conclusions about resources, production, processing, marketing, services and policies, together with the relevant economic parameters such as costs, returns, value added, employment and foreign-exchange earnings.

2.1.2 Selection of countries

Eight producing countries were selected from the 20 producing countries listed in Table 1.17. The selected countries represent 96 % of production in South-East Asia, 74 % of production in Africa, 52 % of the production in Central and South America and in total 87 % of the world production. For international trade, the countries represent 96 % of palm-oil and 85 % of the palm-kernel exports. Together, they form a basis wide enough to allow general conclusions besides conclusions specific for a producing region or an individual country.

The principal producing countries in each of the three main producing regions of Africa, Central and South America and South-East Asia have been included (Fig. 2.1). In Africa, two countries were selected with a large modern production sector and two with a predominantly traditional production sector. The ranking of the countries below refers to the average production and export data in 1981–1983.

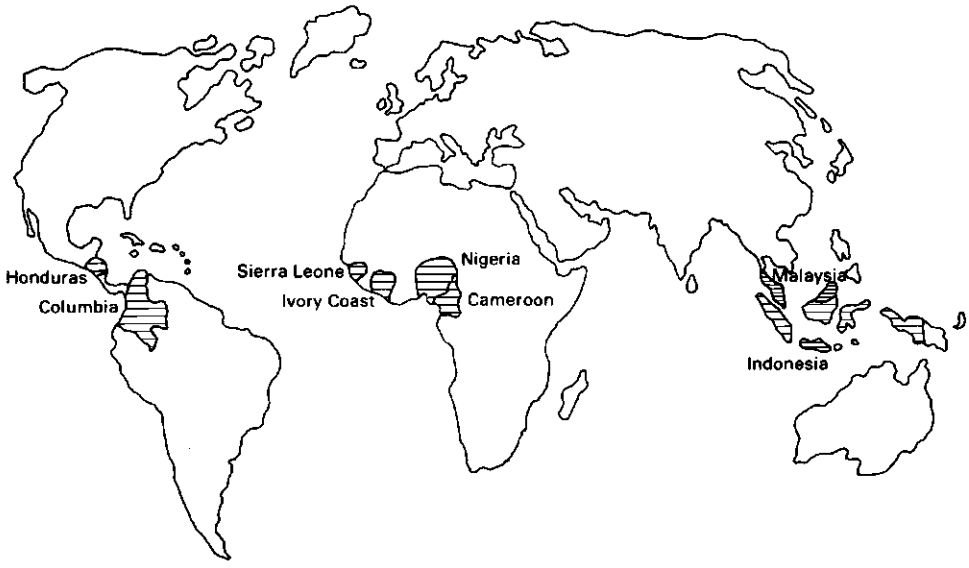

Fig. 2.1. Countries selected for case studies.

South-East Asia
Indonesia, second producer and exporter of the world
Malaysia, first producer and exporter of the world

Africa
Cameroon, 4th producer in Africa; mainly modern production sector
Ivory Coast, 3rd producer and principal exporter in Africa; modern production sector
Nigeria, main producer in Africa and third producer in the world with a predominantly traditional production sector
Sierra Leone, one of the minor producing countries in Africa with a traditional production sector

Central and South America
Honduras, one of the two main producers in Central America
Colombia, the main producer in South America.

Oceania is not represented as palm-oil production is a new enterprise there and data refer to the first part of a production cycle only.

The eight countries selected differ greatly in economic structure and in the relative importance of oil palm for the national economy (Table 2.1). Malaysia belongs to the upper middle-income countries, Sierra Leone to the countries with

Table 2.1. Oil-palm products in the national economies of the selected countries (1982).

	Ind.	Mal.	Cam.	Ivo. C.	Nig.	Sie. L.	Col.	Hon.
General indicators								
GNP per person (US$)	580	1860	890	950	860	390	1460	660
population (millions)	152.6	14.5	9.3	8.9	90.6	3.2	27.0	4.0
land area (million km²)	1.90	0.33	0.47	0.32	0.92	0.07	1.14	0.11
Role of agriculture (%)								
share of GDP	26	23	27	26	22	32	26	27
share of employment	58	50	83	79	50	65	26	63
share primary comm. in exports	13	44	64	82	.	.	70	83
Role of oil-palm products (%)								
production value as share of GDP[2]	0.5	7.1	0.9	1.2	0.6	3.4	0.1	0.7
exports as share of production value[3]	28	91	8	47	10	9	0	0

1. Primary commodities other than fuel, minerals and metals.
2. Average production of palm oil and kernels 1981-1983 at avarage world market prices as percentage of GDP 1982.
3. Average exports palm oil and/or kernel products 1981-1983.
Sources: World Bank (1984a), country studies (Chapter 3-10)

low-income economies and the other countries are classified as lower middle-income countries according to the World Development Report 1984 (World Bank, 1984). The size of the countries, expressed in either population or in land area, shows wide variation as well. Those countries not selected fit in the range, except Brazil, a minor producer of oil-palm products, and Togo which is somewhat smaller than Sierra Leone. Two of the eight countries, Indonesia and Nigeria, are major mineral-fuel exporters, Malaysia and Cameroon export much smaller amounts of fuel. Agriculture is a major economic sector in all countries but it is relatively more important in low-income countries and non-fuel exporting countries.

Oil palm is a major crop only in Malaysia, where it is one of the four major agricultural commodities together with rubber, rice, and logs or timber. In the other countries the contribution to agricultural production varies from less than 1 %, in Colombia, to 10 %, in Sierra Leone.

2.2 Basic factors

2.2.1 Ecology

Rainfall is the major ecological factor determining the level of production in the countries studied. The rate of rainfall in nearly all oil-palm cultivation areas is more than 1500 mm/year but the distribution over the year differs widely and dry

periods from 1 to 5 months occur. Rainfall data of one station per country, representative for the main production area in each country, are listed in Table 2.2. Besides precipitation for each month and per year, the number of months with rainfall less than 100 mm, and the sum of the differences between precipitation and 100 mm in these months are given as indicators of duration and severity of dry periods. These indicators are given, since information on water deficit or growing periods (Section 1.2.1) is not available for most of the stations mentioned. A precipitation of 100 mm per month is about the amount required for evapotranspiration in tropical lowlands and a monthly rainfall of less than that suggests water shortage. The rainfall data and the indicators show that amount and distribution are almost perfect in the areas in Indonesia and Malaysia. A dry period of limited severity occurs in Honduras and Colombia. In the African countries, the dry or drier period is longer and more severe.

Rainfall and yield data are given in Table 2.3. The yield data refer mainly to average actual production of modern D × P palms on estates but in three cases expected yields are stated, as the estates are still in the early years of development or, in Sierra Leone, as experience with improved palms is limited. The data in the table suggest a distinct relationship between yield and rainfall distribution and show that the dry period experienced in African countries limits produc-

Table 2.2. Rainfall (mm) for selected stations in the selected countries.

	J	F	M	A	M	J	J	A	S	O	N	D	Total	Indicators	
														months < 100 mm	total deficit of months < 100 mm (mm)
Indonesia															
Medan	185	60	116	139	163	143	136	181	202	268	175	170	1939	1	40
Malaysia															
K. Lumpur	173	145	225	295	198	133	125	146	185	269	265	234	2393	0	0
Cameroon															
Edea	43	63	150	238	280	256	231	337	470	370	161	42	2641	3	152
Ivory Coast															
La Mé	35	63	129	142	265	479	218	40	99	198	177	84	1920	5	179
Nigeria															
Owerri	22	45	123	198	270	303	350	310	423	273	73	20	2409	4	240
Sierra Leone															
Daru	8	68	177	354	262	295	314	338	407	321	180	38	2762	3	186
Colombia															
Barrancaber meja	71	81	135	243	312	269	186	280	347	446	295	121	2786	2	48
Honduras															
La Ceiba	432	229	170	72	92	153	154	138	193	414	443	368	2860	2	36

Sources: see Tables 3.2 to 10.2 in country studies

Table 2.3. Rainfall and yield in the selected countries.

	Rainfall			Yield f.f.b. improved palms (t/ha)	Remarks
	annual (mm)	number of months < 100 mm	total deficit of months < 100 mm (mm)		
Indonesia	1939	1	40	17	realized, estates
Malaysia	2392	0	0	18-22	realized, estates
Cameroon	2641	3	152	8-10	realized/expected, estates
Ivory Coast	1920	5	179	9-13.5	realized, estates
Nigeria	2409	4	240	.	–
Sierra Leone	2762	3	186	12.5	expected, estates
Colombia	2786	2	48	15	realized, estates
Honduras	2860	2	36	15-22	expected, coops, estates

Sources: see Table 2.2 and country studies

tion to 50–70 % of potential yield under conditions of continued, sufficient rainfall. This conclusion based on average national data is in line with the conclusions resulting from experiments with irrigation in West African countries (Ochs & Daniel, 1976; Chaillard et al., 1983) and with studies dealing with oil-palm physiology.

Other climatic factors such as temperature and radiation may limit production in certain sites in the present production areas of the countries selected but their effect is less known and almost certainly of less importance than the influence of rainfall rate and distribution.

Soil characteristics or topography may prevent oil-palm cultivation on specific sites in areas with a suitable climate in all producing countries but no information is available on how far these factors limit the area suitable for oil palm. A high water-holding capacity of the soil is especially of importance in West African, as this limits the negative effects of dry periods.

Pests and diseases occur in all producing countries. Only in Colombia and other countries in South America, there are two diseases, sudden wither and lethal spear rot, that seriously limit production in certain areas. Replacement of the oil palm by the American oil-palm, *E. oleifera*, or by hybrids between *E. guineensis* and *E. oleifera*, is so far the only solution to these disease problems.

2.2.2 Production factors

The availability and costs of the production factors land, labour and capital vary from country to country. Tables 2.4 and 2.5 summarize the situation for land and labour. Land is becoming a scarce factor in some major producing countries. In Nigeria, the population density in the oil-palm areas reaches more than 300 peo-

Table 2.4. Production factor land in the selected countries.

	Land available for extension oil palm area	Competing crops	Remarks
Indonesia	yes	rubber, coconut/cocoa	a number of areas outside traditional plantation area
Malaysia	yes, restricted in some areas	rubber, coconut/cocoa	most suitable areas already planted
Cameroon	yes, especially south of Douala	rubber	population density 6-20 people per km^2
Ivory Coast	yes, restricted	foodcrops	population, density about 20-60 people per km^2
Nigeria	restricted	foodcrops	population density in most suitable areas more than 300 people per km^2
Sierra Leone	yes	–	population density approximately 30 people per km^2
Colombia	yes	–	present land-use forest or extensive pasture
Honduras	yes	–	cost of land development high

Source: country studies (Chapter 3-10)

Table 2.5. Production factor labour in the selected countries.

	Labour available for estates	Labour costs in 1982 (US$)	Remarks
Indonesia	yes	2.40	–
Malaysia	restricted	5.30	increasing shortage
Cameroon	yes/restricted	3.80	high turn over labour force
Ivory Coast	yes	2.70	mainly migrant labourers
Nigeria	restricted/no	8.90	–
Sierra Leone	yes	2.90	–
Colombia	yes	5.10	–
Honduras	yes	10.00	–

Source: country studies (Chapter 3-10)

ple per square kilometre and under these circumstances semiwild oil palms are cut down to make way for food crops. Replanting with improved D × P palms is not economic as food crops give a higher return per hectare and only the larger farmers can afford to become oil-palm smallholders with several hectares of pure stand of oil palm. In the southern parts of Ivory Coast and West Cameroon, population density is increasing fast because of high fertility and immigration, and it will become increasingly difficult to find large unused areas for estate development.

Smallholders in these areas will eventually change to crops with a higher return per hectare if land becomes more and more scarce. In Malaysia, the situation is different; virgin forest is still available but the most suitable areas have been developed in the past 25 years and expansion of the oil-palm area will mean higher production costs. Sabah and Sarawak, East Malaysia, still have a great potential to be developed. The same situation exists in Indonesia too, where there are ample opportunities for expansion outside the traditional estate area around Medan. The countries in Central and South America still have large areas of suitable land to be developed.

The availability of labour poses problems in several countries. In Malaysia, there is strong competition for labour from the urban sector, resulting in a rising real wage rate and thus rising production costs. In Nigeria, the oil boom resulted in a massive flow of young male labourers to urban centres. So estates were abandoned, or only partially maintained and harvested through lack of labour. The availability of labour for estates in Cameroon is restricted by a high turnover rate of the working force. The estate companies spend considerable efforts in recruitment. Living conditions on estates, the discipline required and job opportunities in urban areas are mentioned as causes for the high turnover.

The costs of estate labour in United States dollar per day reflect the availability and in general the GNP per person. The wages in Nigeria reflect the oil boom in that country and probably an overvalued Naira. In Honduras, wages are exceptionally high through a strong labour organization.

Capital for the expansion of oil-palm cultivation in the past 20 years has been supplied mainly by governments, specialized development institutions in producing countries and by international institutions like the World Bank, the European Investment Bank, the Caisse Central de Cooperation économique and regional development banks. In Malaysia and Colombia, private financing by banks or by estate companies from their own resources have played a major role in addition to the institutional financiers. The relative importance of international institutions is diminishing in Malaysia and Indonesia, where agencies and government-owned companies can provide capital for expansion.

The decision by governments, institutions, private firms and individual people whether to provide capital for expansion, replanting or rehabilitation of oil-palm estates or smallholdings is influenced by the comparison of the oil palm with other crops.

2.2.3 Competition with other crops

Competition of the oil palm with other crops is briefly mentioned in the previous section but the subject needs a review in a wider context. Of central importance is the efficiency of the oil palm to produce palm oil and kernels relative to the efficiency of other crops grown under the same ecological conditions and relative to oil crops in general. The efficiency of production depends on the quantita-

tive input–output relationship, the prices of inputs resulting from availability of production factors and other market forces, and the prices of the outputs in domestic and world markets. The conclusions drawn from the comparison of performance of the oil palm and other crops may differ according to the preferences of the (potential) producers. Three types of (potential) producers, each with their own preferences, can be distinguished: smallholders, estates and governments. A review of developments in oil-palm cultivation during the past 25 years shows the background to the decisions in the selected countries.

The ecological conditions in areas suitable for oil-palm cultivation limit the range of crops that compete with oil palm for the production factor land. In practice, the competing crops are coconut with or without cocoa as intercrop, root crops such as cassava, yams and cocoyams, bananas and, for countries in South-East Asia and West Africa only, rubber (Section 1.2.4). The oil crops with which oil palm competes in the domestic markets in the selected countries are coconut in South-East Asia, groundnuts and, to a limited extent, cotton in West Africa, and in Colombia cotton and soya bean. In a broader sense, the oil-palm products compete with all edible fats and oils on the world market (Section 1.6).

Oil-palm smallholders are found as independent farmers using their own land and labour resources mainly in West Africa, where the oil palm is indigenous. Smallholders generally optimize their most scarce production factor and tend to produce their own food. In the densely populated southern part of Nigeria, land is the scarcest resource and there is a continuous drive to grow more root crops as the returns per hectare per year are higher than those of semiwild palms as well as of modern D × P palms. The result is a declining production from semiwild palms and only a limited success of projects aimed at planting modern palms in pure stand. If land is no constraint, as in parts of Cameroon, Ivory Coast and Sierra Leone, and if labour is available, oil palm can be attractive for smallholders. To achieve what is possible depends, however, largely on the availability of supporting services, which are often a matter of government policy. The expansion of oil-palm cultivation by smallholders in Ivory Coast results from existing availability of labour and land and from provision of supporting services by a parastatal organization.

Private estates generally operate on large areas of land which is sometimes owned but which are usually obtained on lease from the government. The size of an estate makes it necessary to grow crops for which there is a large domestic or international market. Estates are at an advantage over individual farmers to grow crops requiring some form of processing, because of their access to finance, management capacity and modern technology. Crops meeting the requirements of an estate crop are bananas, coconut, oil palm and rubber. Return on investment is the major consideration in choice of crops to be planted and long-term price prospects play a major role. In the early 1960s, the costs and returns for oil palm and rubber, both established estate crops, were compared in Indonesia and Malaysia. These comparative studies showed higher expected returns for palm oil than for

rubber and these expectations resulted in a switch from rubber to oil palm in both countries. In Indonesia, private estates rose from 35 000 ha to 100 000 ha and in Malaysia from 55 000 ha to 646 000 ha between 1960 and 1982. Much of this expansion was at the expense of rubber. In Honduras, private estates replaced bananas with oil palms, as hurricanes and drainage problems depressed the yield and quality of bananas. But the area involved was only a few thousand hectares.

Governments look upon the oil palm as a producer of basic food for the domestic market, as an export commodity or as a combination of both. In the first case, the efficiency of palm oil production in terms of resources used per tonne product must be compared with the efficiency of other oil crops such as coconut, groundnut or soya bean. In the second case, emphasis is on the efficiency in terms of resources used per unit of foreign exchange earned or saved as compared with other activities. In Malaysia, the basic factors labour and land were available in the early 1960s and as oil palm was expected to be a better earner of foreign exchange than rubber, government policy was directed towards oil-palm production. Domestic policy played a major role in establishment of settlement projects on a large scale but oil palm was selected as the main crop on the basis of available resources and expected efficiency. In Indonesia, the government, as a large owner of estates, developed a similar policy towards the oil palm as an export commodity; emphasis has recently shifted to production for the domestic market as production of coconut oil, mainly by smallholders, declined. In Cameroon and Ivory Coast, the oil palm was considered the most suitable crop to be grown in the forest zone to supply oil to the domestic market and to earn foreign exchange. In Ivory Coast, a limited area of coconut was established along the coast, the most suitable area for this crop. In Colombia and Honduras, the governments chose oil palm because land not used for other purposes was, and is, available and because oil palm was considered an efficient crop to produce oil to replace imported vegetable oils. In Colombia, the government promoted private estates. In Honduras, the government initiated settlement projects with a cooperative structure.

In the past 25 years, the oil palm compared favourably with other crops in most countries for a variety of reasons. Major ones were availability of land in ecologically suitable areas, an increasing domestic demand for vegetable oils and favourable expected returns for palm oil production. The input-output relationship and other characteristics of the oil palm, important for its relative position to other crops, will be discussed in Sections 2.3–2.4.

The competitiveness of oil palm in the future will be positively influenced by the introduction of clonal oil palms. The tissue culture technique, which allows production of clonal palms, opens new ways of selecting single parent palms with favourable characteristics. A high yield, an evenly spread production throughout the year, and adaptation to special ecological conditions are selection criteria that will result in increased yield, lower investment costs per hectare for transport and oil mill, and an increase in the potential area where oil palms can be cultivated.

2.3 Production

2.3.1 Producers and production systems

Within the three production systems mentioned in Section 1.3.1, further distinction can be made between estates owned by private people or groups of people and estates owned by state or parastatal organizations, and further between smallholders with improved palms who are integrated in an organization providing comprehensive services and those who are independent. The result of this subdivision is five types of producers using three production systems. The areas cultivated by each type of producer for each producing country are given in Table 2.6 as far as statistical categories used in the respective countries allow. The total area of improved oil palms on estates and smallholdings is 1 900 000 ha; most of this area was planted after 1960 on virgin land or on land previously cultivated with other crops. The scarce data about the semiwild oil palm in the African countries point to a generally decreasing area. This means that in a period of 25 years the two production systems based on cultivation of improved oil palms in pure stand have become dominant. The traditional production system based on the harvesting of semiwild palms has become of minor importance for world production and most probably that type of production has deseased in absolute terms.

In the same period, oil palm has become a major oil crop in Indonesia, Malaysia and countries in Central and South America. In other countries in South-East

Table 2.6. Production area per producer and production system in the selected countries (1982) (1000 ha).

	Estates		Smallholders		
	state	private	improved palms		semiwild palms[3]
			integrated	independent	
Indonesia	259	101	6	–	–
Malaysia	–	646[1]	580[2]	–	–
Cameroon	37	14	–	3	100
Ivory Coast	52	11	38	–	100
Nigeria	70	85[4]		–	1650
Sierra Leone	9	2	5	–	500
Colombia	–	50	–	–	–
Honduras	–	6	14	–	–

1. Including the estates owned by state governments.
2. Including a small proportion independent smallholders.
3. Reliable estimates are not available for the four production countries and the data given are either direct estimated areas or estimates derived from estimated production data.
4. Private estates and smallholdings.

Source: country studies (Chapter 3-10)

Asia and in Oceania, oil palm cultivation has started in recent years.

Cultivation of oil palm is predominantly an estate enterprise for the eight countries in total and for each of the individual countries, except Honduras. Smallholders growing improved palms are of importance in three countries, Malaysia, Ivory Coast and Honduras. In the first two of these countries smallholders are integrated in an institution providing comprehensive services, such as planning of smallholder schemes or projects, provision of inputs, transport and processing of fruit bunches, and marketing. In Honduras, smallholders organized in primary cooperative societies produce fruit bunches and secondary cooperatives take care of transport, processing and marketing. Although the organizational structure is different in the three countries, the combination smallholders and institution always resembles production on estates.

The share of independent smallholders is small, though somewhat bigger than shown in the table, because a small proportion of the figures mentioned for Malaysia and Colombia under integrated smallholders refers to independent smallholders and because the coverage of integrated smallholders by official statistics is more complete than for independent smallholders.

The division between state and private estates shows that governments, either direct or through parastatal organizations, dominate the estate sector in 5 countries, leaving Malaysia, Colombia and Honduras as countries with mainly private estates. The role of the government in the organizations providing support to integrated smallholders is substantial in Indonesia, Malaysia and Ivory Coast.

The emergence of estates and smallholders integrated in supporting institutions as main producers of palm oil and kernels is the result of technical causes.

- Production and processing of fruit bunches must be close together as the fruits are perishable and as transport costs should be minimized. The harvested product is bulky, 10 to 20 t of f.f.b. per hectare per year, and processing results in products which are about 25 % of the weight of the harvested product.
- Production, transport and processing must be planned and implemented in an integrated way. In the planning stage, the expected produce from a certain area must be combined with the correct transport and processing capacity to ensure optimum utilization of investment. In the productive stage, integrated operation from harvesting to milling is necessary for a smooth production process and to maintain quality of oil and kernels.
- The combination of production of fruit bunches and processing results in a large enterprise if compared with the production of rubber (smoked sheets), copra, green coffee or food crops. The capacity of the mill determines the area of oil palms under given agronomic conditions. A small medium-technology mill with a capacity of 0.75 t f.f.b. per hour requires an input of 1500 t f.f.b. per year (2000 processing hours), which requires 100–150 ha of oil palms. The smallest high-technology mill now available has a capacity of 6 t f.f.b. per hour and thus requires an area of 1000–1500 ha to supply fruit bunches.

The technical requirements result in a large-scale and complex activity with de-

mands on finance, management and expertise outside the scope of individual farmers.

The important role of the government as a producer of palm oil in most of the countries listed is related to the fact that large-scale agricultural enterprises are subject to a higher degree of government control than small-scale agriculture. The allocation of large areas of land, the use of large amounts of capital for investments, and the supply of a basic food item as cooking oil to the domestic market are clearly government matters in addition to the control of imports, exports, prices and taxation, which apply to agriculture in general. It is only a small step for a government to decide to participate in production. Structural government influence may well deter private investors.

The form of government participation differs from country to country, reflecting history and policy decisions. In Indonesia, Dutch-owned estates were taken over in the 1950s and have been run since then as government enterprises under the Ministry of Agriculture. In Malaysia, the focus of the government involvement was directed towards the establishment of smallholder settlement schemes through parastatals. In Ivory Coast, the private sector participates in the parastatal 'Palmindustrie' which deals with estates as well as smallholders. The country studies provide more detailed information about how governments participate.

2.3.2 Costs and returns

The comparison of costs and returns in the countries studied is inevitably hampered by several restrictions. Firstly, the available data varies from fairly comprehensive in some countries to fragmentary in other countries. This restriction caused the exclusion of two countries from the analysis, Nigeria and Sierra Leone, where insufficient data were available. Secondly, various cost items may cover different cost components in the individual countries. The comparison is therefore restricted to broad categories of activities and to cost items comprising the same costs in all or most of the countries. Finally, costs and returns are all expressed in United States dollars ($) using the official exchange rates in 1982 for the conversion of the national currencies. The exchange rates are adjusted from time to time in all six remaining countries and great deviations requiring shadow pricing do not seem to exist. However the adjustments are made periodically only and this may lead to differences in the real value of the various currencies at the time of comparison. Because of the restrictions outlined, the comparison of costs and returns results in conclusions of a general nature only.

The costs outlined below refer to estates, except in Honduras, where data from primary and secondary cooperatives are given. For Malaysia, two cases are stated, estates on inland soils and estates on coastal soils, where production costs are different.

2.3.2.1 Investment costs

The investment costs are grouped under four headings:
- Field establishment: all costs made from the start of development of the plantation to the productive stage.
- Oil mill: all costs of oil mill, auxiliary equipment, storage and laboratory.
- Vehicles: for transport on the estate.
- Buildings: offices, houses for staff and work force, and schools, church and clinic required on estates. The investment costs for a new estate are made during about the first 8 years (Table 1.5).

The field establishment costs per hectare vary considerably for the six countries under review (Table 2.7). This is partly due to differences in the period from land preparation to the first production. In Indonesia and Malaysia, this period is 3–3.5 years; in the other countries 4–5 years. Land preparation costs range from zero in Indonesia, where oil palm is planted after rubber (Chapter 3), to $1216 per hectare in Ivory Coast where clearing is done mechanically. The costs for planting and maintenance up to first production are very high in Colombia, where fertilization and general upkeep, including pest and disease control, are the main items of cost under this heading. The general charges cover different costs in the respective countries. Comprehensive data for Honduras are not available and the total given is an estimate of the costs made for and by primary cooperatives.

The costs of oil mills depend on many factors, different from country to country and from site to site. The costs listed in Table 2.8 serve only as a rough guide for the situation in the respective countries. The costs per tonne of installed capacity are derived from mills with a capacity of 20–40 t of f.f.b. per hour. The costs in Indonesia, Malaysia, Cameroon and Colombia are around $200 000 per tonne of f.f.b. Details about the costs in Ivory Coast are lacking; the high costs in Honduras are at least partly due to some additional costs not made for other mills, such as pre-operative costs and costs for complementary facilities. The costs of the oil mill per hectare estate depend on expected maximum yield, the distribution of the yield over the year and the number of operating hours in the peak month. Ex-

Table 2.7. Field establishment costs in six of the selected countries (US$/ha).

	Ind.	Mal.		Cam.	Ivo. C.	Col.	Hon.
		inland	coastal				
Land preparation	–	360	450	365	1216	811	.
Roads and drains	–	150	190	48	94	173	.
Planting and maintenance	1512	1470	1320	819	1155	3426	.
General charges	756	450	450	2067	903	418	.
Total	2268	2430	2410	3299	3368	4828	2500

Source: country studies (Chapter 3-6 and 9-10)

pected yields in Indonesia, Malaysia, Colombia and Honduras vary from 16–20 t of f.f.b. per hectare and in Cameroon and Ivory Coast from 10–12 t of f.f.b. per hectare. The distribution of yield over the year, expressed in proportion of annual production in the peak month, is estimated at 12 % in Indonesia, 15 % in Malaysia, Cameroon, Ivory Coast and Colombia, and 15–18 % in Honduras. The maximum time of operation in the peak month is 450–500 h in all countries.

The investment costs per hectare of vehicles for transport on the estate and between estate and oil mill are $100–200, the smallest cost item. The amount spent for buildings depends on the proportion of the work force living on the estate and the standard of housing required. No general conclusion can be made except that the standard of housing and other facilities is comparatively high in Malaysia.

The total investment costs per hectare are lowest in Indonesia and Malaysia, about $4000 (Table 2.9). Both countries have a considerable body of experience built up in their estates and estate companies. Moreover the oil-palm sector is comparatively large in these two countries, and there are specialized consultancy firms and suppliers of machinery and equipment. This experience and competition among consultants and suppliers are probably the main reasons for the low investment costs. The costs in both African countries are below those in the Latin America but expected yields, important for the costs per hectare of vehicles, oil

Table 2.8. Investment costs of oil-mill in six of the selected countries.

	Cost installed capacity (US$ per tonne f.f.b. per hour)	Cost per hectare (US$)
Indonesia	225 000	842
Malaysia	170 000	714
Cameroon	198 000	659
Ivory Coast	377 000	1131
Colombia	182 000	1092
Honduras	483 000	2786

Source: country studies (Chapter 3-6 and 9-10)

Table 2.9. Total investment costs in six of the selected countries (US$/ha).

	Ind.	Mal.	Cam.	Ivo. C.	Col.	Hon.[1]
Field establishment	2268	2420	3299	3368	4828	2500
Vehicles	110	96	81	207	190	110
Oil-mill	842	714	659	1131	1092	2786
Buildings	604	733	355	529	312[2]	475
Total	3824	3963	4394	5235	6422	5871

1. Smallholders organized in cooperatives.
2. Cost for infrastructure.

Source: country studies (Chapter 3-6 and 9-10)

mill and buildings, are considerably lower than in Colombia and Honduras.

The relative distribution of the investment costs shows a broadly similar pattern in all countries except Honduras, which has a special organizational structure for smallholder production. Honduras is excluded from the comparison in this paragraph. Field establishment is the main investment with 59–75 % of the total investment per hectare. The oil mill requires 15–22 % of the investments and vehicles and buildings about 3 and 5–18 %, respectively. In Indonesia, and Malaysia the relative costs for field establishment are lower and for buildings higher than in the other countries.

The effect of investment costs expressed per hectare on production costs per tonne of product depends on the expected lifetime of the various assets and the parameters: yield, oil-extraction ratio and kernel-extraction ratio. The expected lifetimes used in this study are: 25 productive years for oil palms; 5 years for vehicles; 12.5 years for the oil mill; 40 years for buildings. These lifetimes result in depreciation rates of 4, 20, 8 and 2.5 % per year, respectively. Linear depreciation with a zero-rest value is applied and the resulting annual costs per hectare are converted into costs per tonne of product with the same parameters as used in the following Section on operating costs.

The method of depreciation and the expected lifetimes used in this study may differ from the actual methods and lifetimes used in the various producing countries. The effect of the resulting deviations on the production costs is, however, limited: the lifetime of the main investment of field establishment is around 25 years in all countries and the residual value is of course zero; the lifetime of the oil mill, the second largest item of investment, is more than the 12.5 years used but technical developments and increasing costs of repair and maintenance with age generally result in a complete overhaul, requiring considerable new investment between the 10th and the 15th year.

2.3.2.2 Operating costs

Operating costs are the variable costs made in production stages from field maintenance to delivery of crude palm oil and kernels, the overhead costs for plantation and mill (listed as 'general charges') and the costs of interest on capital invested including working capital. The operating costs are divided into five items used or distinguishable, in most of the selected countries.

Production of fruit bunches is the first item and it includes all costs for the three main activities: upkeep and cultivation of the plantation, harvesting, and transport of fruit bunches to the mill. The main cost components of upkeep and cultivation (Table 2.10) are labour and fertilizer. Labour costs are the lowest in Indonesia mainly because of lower wages per day. The fertilizer rate is comparatively low in the two African countries and correlates with the lower yields. The total costs of upkeep and cultivation per hectare vary widely but the variation is reduced when average yields are taken into account for the calculation of costs per

Table 2.10. Production costs fruit bunches in six of the selected countries.

	Ind.[1]	Mal.[2]		Cam.	Ivo. C.[3]	Col.	Hon.
		inland	coastal				
Upkeep and cultivation							
labour (d/ha/per year)	15	20	20	–	23	–	–
labour (US$)	36	94	94	–	61	–	–
fertilizer (kg/ha/per year)	975	965	550	125	210	820	–
fertilizer (US$)	106	139	81	23	38	140	–
other (US$/ha/per year)	12	34	34	70	20	–	–
subtotal (US$/ha/per year	154	267	209	93	119	675[4]	–
average production (t/ha/per year)	19	18	22	8.3	9.2	15	–
total (US$/t)	8.10	14.80	9.50	11.20	13.00	45.00	–
Harvesting f.f.b.							
labour (d/t)	1.7	1.3	1.3	2.3	1.9	–	–
labour (US$)	4.20	7.50	7.50	8.70	5.00	–	–
other (US$/t)	0.30	0.20	0.20	0.20	2.80	–	–
total (US$/t)	4.50	7.70	7.70	8.90	7.80	13.50	–
Transport to mill (US$/t)	2.90	2.60	2.60	2.90	4.80	–	–
Total (US$/t)	15.50	25.10	19.80	23.00	25.60	58.50	45.00[5]

1. Group of estates with yields above national average.
2. Estates on inland soils and coastal soils, see country study.
3. Data refer to production on estates.
4. Amount includes general charges and transport.
5. Price received by primary cooperatives.

Source: country studies (Chapter 3-6 and 9-10)

tonne of fruit bunches. The costs in Colombia are exceptionally high, but general charges are included in upkeep and cultivation. The costs of harvesting shows variation between countries with differences in amounts of labour used and in wages. The distribution of the total costs for the three activities is about 55 % for upkeep and cultivation, 35 % for harvesting, and 15 % for transport. The total costs per tonne of fruit bunches are lowest in Indonesia and on coastal soils in Malaysia with low labour costs in Indonesia, and higher yields and lower fertilizer requirements on coastal soils in Malaysia.

The processing costs, the second item of operation costs, include labour, spare parts and materials, and other costs. But as details are only available for some mills in Indonesia and Malaysia, the average total processing costs for the six countries are listed in Table 2.11. The costs per tonne input of fresh fruit bunches, are fairly similar in all countries except Honduras, where the total costs of the secondary cooperative is given. The milling efficiencies, expressed in oil and kernel extraction ratios, show differences of 1–3 proportion points. This results in processing costs per tonne of product, the total output of crude palm oil and ker-

Table 2.11. Processing costs in six of the selected countries.

	Ind.[1]	Mal.	Cam.	Ivo. C.	Col.	Hon.[2]
Cost (US$/t f.f.b.)	8.6	7.3	8.4	10.5	8.5	43.0
Oil-extraction ratio (%)	21.6	20.0	19.0	19.7	20.0	19.4
Kernel-extraction ratio (%)	4.3	6.0	3.0	5.1	4.5	3.4
Cost (US$/t product)	33.3	28.0	38.1	41.9	34.8	189.0

1. Cost of one mill as example in country study.
2. Total cost of secondary cooperative.
Source: country studies (Chapter 3-6 and 9-10)

nels, showing greater relative differences than the costs per tonne of fruit bunch. Malaysia shows the lowest costs per t fruit bunch and the highest mill efficiency, 26 %, and thus the lowest costs per tonne of product. Indonesia and Colombia follow with costs of $33–35 per tonne of product. Ivory Coast and Cameroon have costs around $40 per tonne.

Forwarding and distribution is included in production costs as estates generally take care of the transport of oil and kernels to refinery or port of export.

Three parameters are used for the conversion of costs per hectare into costs per tonne of fruit bunches and the conversion of costs per tonne of fruit bunches into costs per tonne of product: yield (t/ha), oil-extraction ratio and kernel-extraction ratio. These parameters determine also the weight of general charges and interest costs on the total operating costs per tonne of product.

General charges are the overhead costs for estate, oil mill and, if applicable, the headquarters of the estate company. Staff salaries, maintenance costs for buildings, provision of electricity and water to the estate houses and consultancy fees are cost items listed under this heading. General charges are usually expressed as a fixed amount per hectare estate.

Table 2.12. Operating costs (US$/t product) in six of the selected countries.

	Ind.	Mal.		Cam.	Ivo. C.	Col.	Hon.
		inland	coastal				
Production fruit bunches	59.9	96.6	76.1	104.1	171.0	239.0	197.0
Processing	53.0	27.9	27.9	28.1	41.9	34.8	189.0
Forwarding distribution	.[1]	5.6	5.6	11.2	9.4	.[1]	.[1]
General charges	42.4	27.4	22.4	174.4	36.8	.[2]	.[3]
Interest	42.7	46.3	37.9	.[4]	123.7	94.2	86.0
Total	198.0	203.8	169.9	327.8	382.8	368.0	472.0

1. Average processing cost includig forwarding and distribution.
2. Included in production of fruit bunches.
3. Included in processing.
4. Included in general charges.
Source: country studies (Chapter 3-6 and 9-10)

Interest is calculated at a standard rate of 10 % applied to half the investment costs as an approximation of the average book value and to a quarter of the annual operating costs as approximation of the required working capital. Actual costs are probably lower in Cameroon and Ivory Coast, where various financial institutions provided loans on favourable terms. In Colombia, however, interest costs are generally higher because of an inflation rate of 20 % or more per year in recent years.

Total operating costs (Table 2.12) show a range from $170 to $472 per tonne of product. Indonesia and Malaysia are producers with the lowest costs, $170–204. Cameroon, Ivory Coast and Colombia have operating costs about 90 % higher at $328–383. Costs in Honduras are 150 % higher than in Indonesia and Malaysia, and the cost structure reveals that the three cost items distinguished, production of fruit bunches, processing including general charges, and interest, are all higher than in almost all other production countries.

2.3.2.3 Production costs

Production costs of crude palm oil and kernels are the sum of the operating costs outlined above and the fixed costs derived from the amounts invested per hectare, as given in Section 2.3.2.1.

The importance of yield and extraction ratios for the weight of investments in total production costs is clearly demonstrated by Table 2.13: the investment costs per hectare in Cameroon and Ivory Coast are a quarter above those in Indonesia and Malaysia (Table 2.9) but the costs of depreciation per tonne of product is 220 % higher. Total depreciation is lowest for Indonesia and Malaysia; 150 % higher in Colombia and Honduras, countries with high investment costs per hec-

Table 2.13. Production costs of oil-palm products (US$/t) in six of the selected countries.

	Ind.	Mal.		Cam.	Ivo. C.	Col.	Hon.
		inland	coastal				
Operating cost	198.0	203.8	169.9	327.8	382.8	368.0	472.0
Depreciation investments							
field establishment	18.5	18.7[1]		72.2	54.8	52.5	27.0
vehicles	4.6	3.7		9.0	21.6	10.0	6.0
oil-mill	13.8	11.1		29.0	47.1	23.8	61.0
buildings	3.1	3.6		4.8	6.8	4.5	7.0
subtotal	40.0	37.1		115.0	130.3	90.8	101.0
Total	238.0	240.9	207.0	442.8	513.0	458.8	573.0

1. Average cost of estates on inland soils and coastal soils.
Source: country studies (Chapter 3-6 and 9-10)

Table 2.14. Relative importance of production cost items (%) in six of the selected countries.

	Ind.	Mal.		Cam.	Ivo. C.	Col.	Hon.
		inland	coastal				
Operating cost							
production fruit bunches	25	40	37	23	34	52	34
processing	22	12	13	9	8	8	33
forwarding distribution		2	3	3	2		
general changes	18	11	11	39	7		
interest	18	19	18		24	20	15
subtotal	83	84	82	74	75	80	82
Depreciation							
field establishment	8	8	9	16	11	12	5
vehicles	2	2	2	2	4	2	1
oil-mill	6	5	5	7	9	5	11
buildings	1	1	2	1	1	1	1
subtotal	17	16	18	26	25	20	18

1. See Table 2.12.
Source: country studies (Chapter 3-6 and 9-10)

tare and yields slightly below those in Indonesia and Malaysia; and the highest in Cameroon in Ivory Coast, countries with low average yields.

The total production costs show great differences: $207–241 in Indonesia and Malaysia, $443–513 in Cameroon, Ivory Coast and Colombia and $573 in Honduras. The relative importance of operating costs and depreciation is shown in Table 2.14. Operating costs account for 80 % of production costs and depreciation for the remaining 20 %. Production of fruit bunches is the dominant item under operating costs with 25 to 40 % of production costs. Processing, general charges and interest are of varying importance in the countries but differences in accounting make comparison difficult. Field establishment is the main item under depreciation with about half the total depreciation or 10 % of production costs. The oil mill is the other important item under depreciation.

2.3.2.4 Inputs

Estate data mostly refer to costs per activity, but labour and fertilizer inputs could be isolated. In addition to these, the non-factor costs such as materials, equipment and services obtained from outside the estate or estate company are estimated (Table 2.15). The labour input for the total estate is often expressed as land area divided by work force. Of the total work force, 80 % is occupied with upkeep and harvesting, 10–15 % works in the oil mill, and 5–10 % is engaged in jobs of a general nature, such as repair of buildings and upkeep of roads. The number of staff employed, not included in the area per labourer,is about 2.5 % of the work force. The staff consists of estate staff (manager, assistant managers and

Table 2.15. Input quantities for the production of palm oil and kernels in six of the selected countries.

	Ind.	Mal.[1]	Cam.	Ivo. C.	Col.	Hon.
Labour						
(ha/man)	4.5-5	4.5-5	5	5.5	3	4.5[2]
(d/t product)	12.7	11.4	25.0	22.7	22.0	19.0
Fertilizer						
(kg/ha)	975	760	125	210	820	350
(kg/t product)	234	165	62	85	215	91
Non-factor inputs						
(US$/t product)	91	80	118	147	127	132

1. Average of estates on inland and coastal soils.
2. Estimated for member of primary cooperative society.
Source: country studies (Chapter 3-6 and 9-10)

office and store staff) and the oil mill staff (engineer, assistants and laboratory staff). A more precise indicator for the labour input is the number of days of work required per tonne of product. This indication shows that the labour input in Indonesia and Malaysia is half of those in the other countries listed. The difference must be attributed to the highly experienced work force and to discipline and overall management, which have been developed over the years in both countries.

Rate of fertilizer and the yield are clearly positively related (Tables 2.15 and 2.16). Division of fertilizer rate by total yield of product gives the input per tonne of product. In Indonesia, Malaysia and Colombia, countries with high yields, considerably more fertilizer is used per tonne of product than in the countries with relatively low yields. So returns on fertilizer diminish with increasing rate, within the range of yields and fertilizer rates given. Under these circumstances, the current practice to base fertilizer recommendations on foliar analysis could lead to fertilizer applications that are not justified from a financial point of view. Determination of the physical relationship between fertilizer rate and yield followed by the financial comparison of the costs of fertilization with the expected additional

Table 2.16. Average yields for areas in production in six of the selected countries (1982).

	Ind.	Mal.	Cam.	Ivo. C.	Col.	Hon.[1]
Fruit bunches (t/ha)	17.5	17.8	8.9	8.4	15.4	7.7
Crude palm oil (t/ha)	3.6	3.6	1.7	1.7	3.1	1.6
extraction-ratio (%)	20.5	20.5	19.1	20.4	20.0	20.0
Kernels (t/ha)	0.6	0.9	0.3	0.4	0.7	0.3
extraction-ratio (%)	3.5	5.3	3.7	4.5	4.5	4.1
Total product (t/ha)	4.2	4.5	2.0	2.1	3.8	1.9

1. Large proportion of the area is in the first years of production.
Source: country studies (Chapter 3-6 and 9-10)

returns would lead to optimum fertilizer rates.

Total non-factor inputs constitute a major proportion, 23–39 %, of total production costs. So production of palm oil and kernels has considerable effects on other sectors of the economy. Viewed from an other side, we can say that producers are dependent on the supply of a range of spares, materials, equipment and services required in the production process. It should be noted that mineral fuels constitute only a small proportion of the non-factor inputs. All energy required for the processing of fruit bunches into crude palm oil and kernels is generated in the power and steam station of the oil mill, where kernel shells and presscake fibre are used as fuel for the boilers.

2.3.2.5 Returns

Yields. Aggregated production data for all producers with improved palms are available for the six countries under review (Table 2.16). Crude palm oil and kernels are the output of one production process and both products are added to form the total product. This product consists for 80–85 % of crude palm oil and 15–20 % of kernels according to the oil and kernel extraction ratios. Production may differ up to 10 % from year to year but the data for 1982 provided show clearly the differences among production regions (Section 2.2.1). The yield and processing parameters may differ slightly from those used in the previous section, as national averages were not available for each country for the cost calculations.

Domestic prices for crude palm oil and palm kernels are usually quoted at refinery or at port of export and the terms used are 'locally delivered' or 'delivered basis'. The domestic prices of crude palm oil show considerable differences from country to country and the relation with price movements of palm oil on the world market is for most countries weak or non-existent (Table 2.17). This situation is due to national policies in price regulation, control of export or import of vegetable oils and the taxation system (Section 2.4.2). The domestic prices in 1982 for crude palm oil, palm kernels and the weighted average price per tonne of product (Table 2.18) are the lowest in Indonesia and Malaysia, the countries with consid-

Table 2.17. World market prices and domestic prices of crude palm oil in six of the selected countries (US$/t).

	World market[1]	Ind.	Mal.	Cam.	Ivo. C.	Col.	Hon.
1970	260	181	.	223	.	336	.
1975	434	357	.	467	.	506	.
1980	584	354	393	692	.	692	.
1981	569	396	412	566	.	735	.
1982	445	378	354	486	532	874	625

1. Malaysian 5 %, c.i.f. N.W. Europe.
Sources: World Bank (1984), country studies (Chapter 3-6 and 9-10)

Table 2.18. Domestic prices in six of the selected countries (1982) (US$/t).

	Crude palm oil	Kernels	Product
Indonesia	378	151	345
Malaysia	354	182	319
Cameroon	486	191	444
Ivory Coast	532	182	469
Colombia	874	296	768
Honduras	625	200	554

Source: country studies (Chapter 3-6 and 9-10)

erable exports. In Cameroon and Ivory Coast, countries with some exports, the prices for palm oil are 1.4 times as high, whereas in the countries importing vegetable oil, Colombia and Honduras, the prices of palm oil are 2.4 and 1.7 times as high, respectively, as the prices in Indonesia and Malaysia. The prices of palm kernels show less variation except in Colombia, where the price is 1.5–2 times as high as in the other countries.

Prices of palm oil on the world market are of direct importance to producers in exporting countries. Malaysia exports 90 % of its production and the domestic price is directly related to the world price. The situation is different in Indonesia and Ivory Coast, where 30–40 % of the total production is exported. In both countries, the price received by the producers for exported crude palm oil was below the controlled domestic price in 1982 because of the low prices on the world market in that year. In Indonesia, the price for exported palm oil was $325/t; in Ivory Coast, the price was $376/t and there the difference from the domestic price was considerable. The average price received by the producers in these two countries was thus somewhere between the domestic price and the price received for exported crude palm oil.

2.3.2.6 Review costs and returns

The review of costs and returns for each country from the viewpoint of the producer requires some caution, because cost data are computed for part of the producers only in some countries, while yields and prices are national averages and because uniform assumptions are made about depreciation and interest.

Production costs in Indonesia and Malaysia are well below domestic prices per tonne of product (Table 2.19). We can conclude that production of palm oil and kernels is a profitable enterprise in both countries. The fact that in Indonesia, part of the crude palm oil has been sold at export prices which were below domestic prices reduces the margin but does not alter the conclusion about profitability. The situation is different in Cameroon and Honduras: production costs and prices per tonne of product are close to each other, and production of palm oil and kernels is an enterprise operating close to the break-even point. The results of indi-

Table 2.19. Production cost and domestic prices in six of the selected countries (US$/t product).

	Ind.	Mal.[1]	Cam.	Ivo. C.	Col.	Hon.
Production cost	238	224	443	513	459	573
Domestic price	345	319	444	469	768	554

1. Average estates on inland and coastal soils.
Source: country studies (Chapter 3-6 and 9-10)

vidual estates in these countries may show profits or losses, depending on actual interest paid and the depreciation method followed. Production costs in Ivory Coast are well above the domestic price while the average price for palm oil and kernels received is even lower, about $420/t, because part of the crude palm oil is exported at the price of $376/t. The margin between production costs and prices received is wide. Though actual interest costs may be lower than the costs calculated in this study, it is doubtful whether sufficient reserves, can be made to continue operations. Costs and returns in Colombia show a wide positive margin. However the high rate of inflation may result in actual interest costs for individual producers considerably higher than those computed in the country study. Nevertheless it seems probable that palm-oil production is profitable in Colombia.

2.4 Processing, marketing and services

2.4.1 Development of processing industries

The capacity to process crude palm oil (c.p.o.) into processed palm oil and end-products increased rapidly since 1975 in the countries producing palm oil. Malaysia started exporting processed palm oil (p.p.o.) in that year and in 1982 the refining industry had a capacity exceeding the national production of c.p.o. (Table 2.20). Indonesia started some years later. In 1982, 77 % of the total production was processed into refined or fractionated palm oil. The rapid development of the processing industry in both countries was, and still is, stimulated by the respective governments through differential tax rates for crude and processed palm oil. The size of the processing industry producing end-products such as cooking oil, margarine, shortenings, candles, soaps and detergents, depends on the size of the domestic markets in both countries.

The need for refining, fractionating and further processing capacity is less apparent in West African countries, as the consumers are used to, or even prefer, the crude 'red' palm oil. Nevertheless demand for products such as margarine and colourless cooking oil is increasing and processing industries, generally covering all stages from crude palm oil to end-product, are being built or expanded. Colombia and Honduras are both net importers of crude vegetable oils and the capacity of the processing industry exceeds the domestic production capacity of vegetable oil.

Table 2.20. Processing of crude palm oil in the selected countries (1982).

	Production c.p.o. (1000 t)	Processing c.p.o. into p.p.o.		Processing p.p.o. into end-products	
		(1000 t)	as share of production (%)	(1000 t)	as share of production (%)
Indonesia	970	750	77	600	62
Malaysia	3510	3380	96	316	9
Cameroon	105	–[1]	–	–	–
Ivory Coast[2]	145	107	74	107	74
Nigeria[3]	700	.	.	.	.
Sierra Leone	48	–	–	–	–
Colombia	87	87	100	87	100
Honduras	32	32	100	32	100

1. Refinery complex under construction.
2. 1981, processing c.p.o. and processing p.p.o. in one large plant is combined.
3. Processing industry based on imported crude oils.

Source: country studies (Chapter 3-10)

The situation in 1982 of existing and planned processing capacity leads to the conclusion that 80 % of the crude palm oil produced is processed in the producing country and that the proportion will increase rapidly to 85 % of world production, about the proportion of crude palm oil produced by modern technology. A consequence for importing countries is that crude palm oil will soon be completely replaced by processed palm oil in the international trade.

The change from export of crude palm oil to processed palm oil resulted in a change in export destination as well. Malaysia, the leading exporter, exported 69 % of the c.p.o. and p.p.o. to West European countries and the United States in 1975: these countries imported only 22 % of the Malaysian exports in 1982, also a decline in absolute terms (Table 4.25). The countries in Asia and the Soviet Union were the main importers in 1982 with 63 % of the total Malaysian exports. (Exports from Malaysia to Singapore are excluded from the proportions given as Singapore exports the greater part of the imported oil to the same destinations.)

The palm-kernel crushing industry in the major producing countries has a capacity which is sufficient to deal with the total production (Table 2.21). The actual amounts crushed are less than the potential amounts, based on production and installed capacity, in several countries. Incidental exports of kernels (apparently because of attractive prices), technical breakdown in the milling installation, and problems of purchasing sufficient amounts of kernels produced by smallholders by the marketing boards in Nigeria and Sierra Leone are the main reasons for the under-utilization of crushing capacity. Kernel oil and meal are processed into end-products in all producing countries; existing and planned capacity is based on the domestic market. Exports are for the major part products of the crushing indus-

Table 2.21. Processing of palm kernels in the selected countries (1982).

	Production kernels (1000 t)	Crushing		Processing oil and meal into end-products (1000 t)
		capacity as share of production (%)	quantity crushed (1000 t)	
Indonesia	147	100	134	134
Malaysia	905	100	905	.
Cameroon	46	75	34	29
Ivory Coast	34	80	13	13
Nigeria	355	100	190	120
Sierra Leone	45	44	14	4
Colombia	19	100	19	19
Honduras	7	100	7	7

Source: country studies (Chapter 3-10)

try: palm-kernel oil and kernel meal.

Crude palm oil and kernels are in general processed by specialized enterprises. In Indonesia, there are some larger estate companies with a refinery attached to the estate oil mill and a crushing mill is attached to the oil mill in some other cases; these are, however, exceptions. Integration of estates and processing plants in one holding company is widespread in Malaysia and Honduras, but estates and processing plants operate as separate enterprises in this situation too.

Data on costs, returns and value added of the processing industry are not available. The differential taxation system for exports of intermediate products such as RBD palm oil and RBD olein in Malaysia and Indonesia disturbed price relations between crude palm oil and the processed palm oil products. So international prices cannot be used to estimate the value added by the processing industry.

2.4.2 Marketing

2.4.2.1 Marketing channels, functions and costs

The marketing of crude palm oil produced through non-mechanical extraction or intermediate-technology mills differs from the marketing of crude palm oil produced by estates with high-technology mills. In the first case, small amounts of palm oil are bought by private traders and sold to local retailers or to wholesale traders, who sell to urban centres. This type of marketing is found in West Africa, where the semiwild oil palm and the traditional processing methods are part of the total oil-palm sector. In none of the four West African countries under review were data or descriptive material available about this type of marketing.

About 85 % of the world production of crude palm oil is produced by high-technology mills and the marketing is characterized by several technical features:

– Palm oil production is a large enterprise and the amounts sold per transaction are large. An estate of 4000 ha may produce 8000–12 000 t of oil per year, which can be sold monthly or fortnightly.
– The specifications of the product can be determined by the producer on the basis of standard tests.
– Production and trade is a continuous activity although there are seasonal peaks.
These features result in short marketing channels. Large producers are often in direct contact with the local processing industry or with internationally operating broking firms in export. Licensed brokers and dealers operate in Malaysia in the chain producer-refiner-exporter/importer.

The marketing costs for palm oil locally delivered, being the transport costs from estate to refiner or port of export, are included in the cost price of the estate under 'forwarding and distribution'. For export, there are additional marketing costs for storage and handling under different names (Table 2.22). The transport costs for locally delivered palm oil is fairly similar in the four countries listed but there are sizeable differences among the estates, within each country depending on their site. Marketing costs for exported oil vary considerably; the low costs in Cameroon and Ivory Coast are probably because the estate companies are directly selling to overseas buyers and because the costs are listed under general charges.

The marketing of palm kernels has a dichotomy as well. The kernels produced by estates are sold in gunny bags to the crushing industry with procedures similar to those for palm oil. The cost of bags are high in Cameroon and Ivory Coast and this results in marketing costs for locally delivered kernels of $30/t and $15/t, respectively. The costs for local delivery in Indonesia and Malaysia are about the same as those of crude palm oil.

In West Africa, the palm kernels produced from semiwild oil palms were, and in several countries still are, one of the cash crops for the rural population and an export commodity for the country. Marketing efforts are aimed at the collection of kernels throughout the forest and savanna zones and at transport towards the harbour. At present, 75 % of the kernels produced in West Africa are still from

Table 2.22. Marketing cost palm oil in four of the selected countries

	Ind.	Mal.	Cam.	Ivo. C.
Transport estate to harbour or refiner[1]	8.20	6.00	7.00	8.20
In case of export				
bulking charges	4.20	6.00	–	–
other harbour charges	15.10	1.60	8.20	4.00
brokerage		5.90	–	–
subtotal	19.30	13.50	8.20	4.00

1. Included in production cost.
Source: country studies (Chapter 3-6)

Table 2.23. Marketing palm kernels in Nigeria and Sierra Leone.

	World market[1] (US$/t)	Producer price (US$/t)		Quantities bought (1000 t)	
		Nig.	Sie. L.	Nig.	Sie. L.
1970	168	80	78	265	55.5
1975	207	216	163	274	44.3
1980	345	329	167	209	14.1
1981	317	326	139	194	14.0
1982	270	342	131	189	10.2
1983	362	318	186	.	.

1. Nigerian c.i.f. European port (World Bank, 1984).
Source: country studies (Chapter 7-8)

semiwild palms and in the two countries with a large traditional oil-palm sector included in this study, Nigeria and Sierra Leone, marketing boards operate. In Nigeria, the board deals exclusively with palm oil and palm kernels, whereas the board in Sierra Leone deals with palm oil, kernels, other export commodities and food crops. In both countries, producer's prices are fixed annually and the boards buy either directly or through authorized dealers. The boards have a monopoly for the export of kernels and kernel products. The policy on guaranteed producer prices and on marketing costs are key factors for the marketing boards. The producer price for kernels in Nigeria was close to or above the c.i.f. price for kernels in recent years. Despite these prices, the amounts bought decreased (Table 2.23). In Sierra Leone, the producer price was half the c.i.f. price and the amounts bought in recent years are 20–30 % of the quantities bought around 1970. The marketing costs in Nigeria are extremely high, $333/t in 1982, and exports are heavily subsidized. The costs in Sierra Leone are $79/t (1981/82) and the average result since 1970 was positive for the board, although exports in 1982 resulted in a loss, borne by the stabilization fund.

2.4.2.2 Prices

The governments of seven of the eight countries under review intervene in the price of crude palm oil or kernels (Table 2.24). The interventions must be viewed in relation to basic differences between countries or groups of countries: in Malaysia oil-palm products are export commodities; in Indonesia, Cameroon and Ivory Coast, oil-palm products are mainly for domestic consumption but a proportion of production is exported; Nigeria and Sierra Leone are exporters of kernels but importers of vegetable oils; the total production of Colombia and Honduras is for domestic consumption, and additional imports of vegetable oils are required to meet the domestic demand.

The price and export controls in Indonesia are aimed at securing a sufficient

Table 2.24. Market intervention oil-palm products.

	Crude palm oil				Palm kernels	
	fixation domestic price	price agreement	control export	control import	fixation domestic price	monopoly export
Indonesia	yes	–	yes	–	yes	–
Malaysia	–	–	–	–	–	–
Cameroon	yes	–	yes	–	–	–
Ivory Coast	–	yes	yes	–	–	–
Nigeria	yes[1]	–	–	–	yes	yes
Sierra Leone	yes[1]	–	–	–	yes	yes
Colombia	yes[1]	–	–	yes	–	–
Honduras	–	yes	–	–	–	–

1. Fixed domestic price not effective.
Source: country studies (Chapter 3-10)

supply of cooking oil at low prices to the domestic market. Indonesia is a low-cost producer and the fixed prices were at or below corresponding prices on the world market since 1975. Malaysia is the major exporter of palm oil and palm-kernel products and no direct price intervention is undertaken. The fixed domestic prices in Cameroon were above corresponding prices on the world market since 1975 and the prices set enabled producers to continue operations, although their cost price was well above cost prices in Malaysia and Indonesia. The same most probably applies to Ivory Coast but price series are not available. There the domestic price is settled between main producer and major refiner, each having a dominant position. The guaranteed producer prices at which marketing boards purchase crude palm oil in Nigeria and Sierra Leone are set below market prices and amounts purchased are zero in Nigeria and very small in Sierra Leone. In both countries the respective boards can purchase palm kernels at the fixed prices (Section 2.4.2.1). Colombia is a large importer of vegetable oils and import licensing and taxation of imported oils guarantee a high domestic price. The base price set by the pricing committee is below actual market prices and is thus not effective. Honduras is a small net importer and prices are agreed upon between a few producers and three processing enterprises. The government establishes maximum retail prices based on the costs of processing.

Border price equivalents are computed to allow comparison of domestic prices with prices on the world market. The price delivered basis is used as standard; the border price equivalent for exporting countries is the world market price minus all marketing costs to the point of delivery: the border price equivalent for countries importing vegetable oil is the world price plus all marketing costs to the point of delivery (Table 2.25). The ratio between domestic price and border price equivalent, the nominal protection coefficient, is close to 1 in Indonesia and Malaysia,

Table 2.25. Domestic prices with border price equivalents in the selected countries (1982) (US$/t).

	Domestic price			Border price equivalent			Nominal protection coefficient product
	c.p.o.	kernels	product	c.p.o.	kernels	product	
Exporting countries							
Indonesia	378	151	345	351	174	325	1.06
Malaysia	354	182	319	378	182	338	0.94
Cameroon	493	191	444	378	206	350	1.27
Ivory Coast	532	182	469	384	208	352	1.33
Importing countries							
Nigeria[1]	.	507	.	.	200	.	2.54[2]
Sierra Leone[1]	.	172	.	.	200	.	0.87[2]
Colombia	874	296	768	462	285	429	1.79
Honduras	625	200	554	457	280	427	1.30

1. Importing vegetable oil; exporting kernels.
2. For palm kernels only.
Source: country studies (Chapter 3-10)

and the domestic prices in these countries are in line with prices on the world market. In the other countries, the respective price interventions resulted in nominal protection coefficients of well above 1.0 and exporting was less attractive than domestic sale to producers in Cameroon and Ivory Coast. Imports (without tax) would have been more attractive than purchase from local producers to processing enterprises in Colombia and Honduras. The domestic price of kernels in Nigeria is far above the border price equivalent and exports are subsidized (Chapter 7). The price of kernels in Sierra Leone allows export to the world market.

The world market price in the year of comparison, 1982, was low compared with the previous and the following year and a comparison of domestic prices and border prices in 1980 and 1981 would have resulted in border price equivalents above domestic prices in Indonesia, Malaysia, Cameroon and Ivory Coast. The domestic price in Colombia is such that only with extremely high prices on the world market will the nominal protection coefficient be less than 1.0. Honduras will start exporting palm oil soon, so that producers will receive considerably less for exported palm oil than for palm oil sold on the domestic market unless the world market price reaches levels of $600–700/t.

2.4.2.3 Taxation, export and domestic consumption

The exported oil-palm products are taxed in all exporting countries, except Nigeria where the export of palm kernels is subsidized (Table 2.26). In most countries, an export tax of 2–10 % of the f.o.b. price is levied on palm oil and kernels. In Cameroon, a tax of 9.5 % for crude palm oil and 10.8 % for palm kernels is levied on the 'mercurial value', a fixed amount of $152/t in 1982 for both products,

Table 2.26. Taxation on exported products in five of the selected countries (1982).

	Crude palm oil			Palm kernels and products		
	name	rate (%)	basis	name	rate (%)	basis
Indonesia	export duty	5	f.o.b. price			
Malaysia	ad valorum export duty		f.o.b. price	export duty	5	f.o.b. price
Cameroon	custom duty	9.5	fixed amount	custom duty	10.8	fixed amount
Ivory Coast	custom duty	2	f.o.b. price	custom duty	4	f.o.b. price
Sierra Leone	–			export duty	10	f.o.b. price

Source: country studies (Chapter 3-6 and 8)

which is well below the f.o.b. prices for palm oil and kernels. In Malaysia, an ad valorum export duty is in operation. Taxation starts when the gazetted f.o.b. price reaches Mf500/t, $214/t, which is about production cost of crude oil, and the excess is taxed with a progressive rate starting at 30 % and reaching 45 % when the gazetted price reaches 1000/t.

Malaysia uses a system of tax exemption to stimulate the domestic processing industry and to promote production in Sabah and Sarawak. The processed palm oil is classified into 5 grades according to the rate of processing. The more processed the oil the more duty is exempted, with no duty payable on the most processed grade. Crude palm oil from Sabah and Sarawak receives a rebate of 30 % on the export duty payable. Indonesia introduced a differential export tax system in 1984 by imposing an additional export tax of 37.18 % on crude palm oil and 26.1 % on processed products.

In Sierra Leone, the price of palm kernels is fixed annually and a price stabilization fund is maintained to reduce the impact of heavy price fluctuations in the world market on farmers' receipts. In the period from 1970/1971 to 1981/1982, palm kernels made a net contribution to the fund of Le 4 million or 7 % of the average f.o.b. price per tonne. There are no direct benefits to the producers of palm kernels during the period of 11 years for which data are available and the operations of the stabilization fund result in a net taxation.

Data on the total receipts from export taxes are not available for recent years for Indonesia and Malaysia, the major exporters. Differential tax rates in Malaysia and exemption from export tax for government-owned estates in Indonesia make direct computation from amounts exported impossible. A variety of other taxes are applicable to estates and refiners, such as corporation tax and sales tax, but these are not specific for the oil-palm sector and are not included in this review.

The destination of the palm oil produced changed considerable since 1970 in several countries (Table 2.27). Indonesia was and is a major exporter, but the proportion of total production exported declined to 25–30 % in recent years. The static production of coconut oil and the increasing domestic demand persuaded

Table 2.27. Destination palm oil in the selected countries (1970 and 1982).

	Production (1000 t)		Destination (%)				Market share palm oil on domestic market vegetable oils		Other main vegetable oils on domestic market in 1982
			share of export		share of domestic market				
	1970	1982	1970	1982	1970	1982	1970	1982	
Indonesia	217	874	73	30	27	70	10	48	coconut oil
Malaysia	431	3511	93	90	7	10	.	.	coconut oil
Cameroon	54	105	15	11	85	89	.	.	groundnut oil
Ivory Coast[1]	61	160	18	30	82	70	.	.	coconut oil/ groundnut oil
Nigeria	540	700	1	–	99	100	72	56	imported oils/ groundnut oil
Sierra Leone	51	48	–	–	100	100	.	81	imported oils/ groundnut oil
Colombia	27	87	–	–	100	100	18	27	imported oils
Honduras	.	32	–	–	100	100	48[2]	88	kernel oil

1. Improved palms only.
2. In 1975.

the government to allocate an increasing part of the palm oil produced to the domestic market. Oil palm overtook coconut palm as major oil crop in 1969 and the market share of palm oil increased to 48 % in 1982, despite exports of palm oil. Inclusion of kernel oil results in a market share of 52 % for both oils. Malaysia became dominant on the world market and 90 % of production is exported. (There is a loss of volume of several percentage units during processing.) Palm oil, kernel oil and coconut oil are the major vegetable oils on the domestic market. Although details about other vegetable oils on the domestic markets in some countries of West Africa are not available, palm oil is certainly the major vegetable oil in all West African countries as the oil equivalents of groundnuts and cottonseed produced are less than palm-oil production. Increase in production in Cameroon and Ivory Coast is mainly absorbed by the domestic markets; it is expected that exports in Ivory Coast will decline with increasing domestic demand. Nigeria was a major exporter of palm oil as well as groundnut oil in the 1960s. But production of groundnuts declined drastically and no palm oil has been exported since 1971. Around 1975, Nigeria became a net importer of vegetable oil. Oil palm became the major domestically produced oil-crop in Colombia and Honduras in the period since 1970; Colombia imported 56 % of the domestic needs in 1982; production in Honduras will soon exceed domestic demand.

In summary, palm oil became or remained the main vegetable oil produced in all countries reviewed. In Malaysia, production was and is destined for export: in the other countries the increased production is mainly absorbed by the domestic

markets and the market share of palm oil rose in all countries except Nigeria.

The export of palm kernels and derived products is a somewhat different picture. Malaysia is again the major exporter, exporting the bulk of production, but Ivory Coast, Nigeria and Sierra Leone export 30 to 80 % of their production. In the last two countries, kernels from semiwild palms are major agricultural exports. In the remaining countries, kernels are processed into consumer products for the domestic market.

2.4.3 Supporting services

Production, processing and marketing of oil-palm products require a considerable amount of inputs, which are supplied by specialized firms, organizations or individuals. Together, they form the supporting services of the oil palm sector. The supporting services can be divided into two sections:

- The supply of physical inputs.
- Provision of advisory services.

Physical inputs are either produced in the country or are imported. Advisory services are based upon the availability of technical knowledge. Technical knowledge is to some extent international but the existence in a country of research institutes dealing with agronomic, processing, marketing or economic topics leads to priorities in line with national problems and possibilities; such an infrastructure is in the first place a national asset. Advisory services can be provided by consultancy firms for specific purposes to specific producers or, in a wider sense, they can be provided by organizations of producers through periodicals, seminars and other methods of exchange.

The organization of the supply of supporting services depends upon the type of producer. Estates and estate companies are in direct contact with suppliers of physical inputs and consultancy firms, whose services are obtained as and when required. Integrated smallholders receive all services required from one organization. Such an organization is in charge for all oil-palm smallholders in a project and the services provided are comprehensive: land clearing; provision of young palms; supply of fertilizers and other inputs; credit facilities; technical advice; collection and processing of fruit bunches. The organization is in contact with suppliers and consultancy firms in the same way as estate companies. Independent smallholders obtain their inputs from local suppliers and sometimes they have a formal contract with a nearby estate for the sale of fruit bunches.

The origin of the main physical inputs and the availability of technical knowledge shown by the existence of research institutes, periodicals and organizations of the various participants in production, processing and marketing gives a broad picture of the width and depth of the supporting services in the producing countries (Table 2.28). Physical inputs are produced or assembled in Indonesia and Malaysia only. Indonesia has an large fertilizer industry mainly geared to produce nitrogen fertilizers for paddy production; the potassium, phosphorus and magnesi-

Table 2.28. Origin of physical inputs and availability of technical knowledge in the selected countries.

	Physical inputs[1]			Technical knowledge[2]		
	fertilizer	vehicles	processing equipment	research institutes	periodical	organizations producers etc.
Indonesia	40% prod.	assembl.	partly prod.	several	–	one
Malaysia	10% prod.	assembl.	prod.	several	two	several
Cameroon	imp.	imp.	imp.	several	–	–
Ivory Coast	imp.	imp.	imp.	one	–	–
Nigeria	imp.	imp.	imp.[3]	one	–	–
Sierra Leone	imp.	imp.	imp.[3]	–	–	–
Colombia	40% prod.	imp.	imp.	one	one	one
Honduras	imp.	imp.	imp.	–	–	–

1. Prod. is produced; assembl. is assembled; imp. is imported.
2. The existence of domestic research institutes etc. is stated.
3. Modern high technology mills; small scale processing equipment is domestically produced.

Source: country studies (Chapter 3-10)

um fertilizers used on oil palm are imported. The fertilizer industry in all other countries is small in relation to domestic use or is non-existent. Vehicles of various types are assembled in Indonesia and Malaysia with imported and domestically produced components. Production of oil-mill equipment is related to domestic demand. Malaysia has an extensive industrial sector producing equipment as well as complete mills. In Indonesia too, there is specialized industrial activity but imports are of more importance. No information is available about production of processing equipment for the refining industry but the domestic industrial activities probably resemble those described for production of oil mills.

The availability of technical knowledge is closely related to the volume of production. Malaysia is in the leading position with several well known research institutes, two periodicals: 'The Planter' and 'Porim Bulletin', and several organizations of planters, producers of palm oil, refiners and kernel crushers. There are several other organizations too, and government institutions such as the Statistical Department pay special attention to the oil palm. Indonesia is well equipped with research institutes but a periodical is not published. The organization of producers is still in its first years of operation. Apparently the need for public organizations is less in that country, because of the dominant position of government-owned estates. Research stations exist in the other countries, except Sierra Leone and Honduras, both relatively small producers. In Colombia there is an active organization of producers which also publishes a quarterly 'Palmas'. Voluntary organizations of producers in general exist only in countries with a considerable number of private estates.

2.5 The oil-palm sector in the national economy

Production, processing and marketing of crude palm oil and palm kernels plus the supply of services are related activities, each contributing to the domestic product. The sum of these contributions is the total effect of the oil-palm sector on the national economy. The effect can be measured in domestic prices or in internationally comparable prices, which are derived from the prices on the world market. The emphasis here lies on the internationally comparable prices which allows comparison of the contribution of the oil-palm sector in the producing countries. Reliable and comparable data on the processing industry producing intermediate products and end-products are not available and the analysis is thus restricted to production and marketing of crude palm oil and palm kernels plus the supporting services required for these activities.

Production costs of crude palm oil and palm kernels analysed in Section 2.3.2 are based on input prices paid by producers. Subsidies and taxes may distort the real costs and the effects of some major distortions are taken into account. In several countries, production has been assisted with loans from national and international sources at interest rates below prevailing rates. To cope with the resulting distortions, an interest rate of 10 % has been used throughout this study to calculate the costs of capital. Inputs are not generally subsidized and fertilizer prices paid by the producers vary between \$0.16–0.20 per kilogram (1982). Indonesia is an exception as domestic fertilizer prices are heavily subsidized and production costs in Table 2.29 are adjusted. The possible distorting effects of taxes on imported inputs in several countries could not be estimated due to the variety of rates and rules of application and exemption. The effects on the cost price will, however, be limited as imported inputs account for an estimated 15 to 20 % of production costs. The major distorting factor affecting primary production is the domestic price of crude palm oil, which deviates widely from the border price equivalent in four of the six countries (Table 2.25). Comparison of production costs and border price equivalents shows that only Malaysia and Indonesia produced at costs lower than corresponding prices on the world market in 1982, a year with low market prices (Table 2.29). The exporting countries Cameroon and Ivory Coast produced at costs higher than the border price equivalents, which meant they exported part of their produce with a loss, and Colombia and Honduras produced at costs higher than the costs of imported vegetable oil. The comparison of production costs, domestic prices and border price equivalents results in the conclusion that the price interventions by the governments of Cameroon, Ivory Coast, Colombia and Honduras are aimed at maintaining domestic prices at levels that enable domestic producers to operate. Production of palm oil and kernels in these countries is thus, at least partly and on the medium term, sheltered from international competition.

The marketing costs for crude palm oil and palm kernels are zero if these products are used domestically, because the costs of transport and of bagging, for ker-

Table 2.29. Production costs, domestic prices and border price equivalents in six of the selected countries (US$/t product).

	Production cost	Domestic price	Border price equivalent
Indonesia	252	345	325
Malaysia	224	319	338
Cameroon	443	444	350
Ivory Coast	513	469	352
Colombia	459	768	429
Honduras	573	554	427

Source: country studies (Chapter 3-6 and 9-10)

nels, are included in production costs. For export, there are additional costs for bulking, handling and other harbour costs. These costs, $4.00 to 19.30 per tonne for palm oil (Table 2.22) form the value added by marketing for exported products. The amounts for palm-kernel oil or palm kernels do not differ substantially from those for palm oil and the amounts listed are used for oil-palm products in general.

The supply of supporting services is an activity that adds substantially to the domestic product. The cost of supporting advisory services, expressed in $/t of product, is relatively small. Usual these could not be isolated from the general charges, so these inputs are not included. The total amount of physical non-factor inputs for primary production given in the country studies ranges from $80–147 per tonne of product. A proportion of physical inputs is produced domestically and the remainder is imported, in which case the domestic services rendered are just distribution. The proportion of domestic production for the recurrent inputs (fertilizers and other materials) and the capital goods (field establishment, vehicles, oil mill and buildings) has been estimated (Table 2.30). The domestic production of inputs has reached the highest level in Indonesia and Malaysia, although the structure of production in the two countries is different: Indonesia produces comparatively more of the recurrent inputs (fertilizers) and less of the capital goods (oil mills) than Malaysia. Domestic production is low in Honduras where domestic supporting services are restricted to distribution of imported inputs and building activities by contractors.

The contribution to the domestic product by production of crude palm oil and kernels, the marketing and the supply of domestically produced inputs is the value of the products minus the imported inputs, the domestic value added (Table 2.31). The value of the products depends on the destination and as exporting country the f.o.b. value is used for Malaysia, whereas the domestic price is used for the other countries as they produce mainly or entirely for the domestic market. The domestic value added per tonne of product shows great differences between the countries but these differences are mainly due to price interventions,

Table 2.30. Value of physical non-factor inputs for primary production according to origin in six of the selected countries (US$/t product).

	Total	Domestically produced				Imported		
		recurrent inputs	capital goods	sub-total	as share of total (%)	recurrent inputs	capital goods	sub-total
Indonesia	103	40	19	59	57	28	16	44
Malaysia	80	23	22	45	56	26	9	35
Cameroon	110	7	35	42	38	29	39	68
Ivory Coast	147	8	37	45	31	35	67	102
Colombia	127	23	17	40	31	48	39	87
Honduras	132	8	25	33	25	35	64	99

Source: country studies (Chapter 3-6 and 9-10) and own estimates

Table 2.31. Value added in production, marketing and supply of physical inputs in six of the selected countries (US$/t product).

	Domestic value added (1)	Value added at f.o.b./c.i.f. prices[1] (2)
Indonesia	301	298
Malaysia	284	313
Cameroon	376	288
Ivory Coast	367	252
Colombia	681	327
Honduras	455	326

1. F.o.b. prices for exporting countries: Indonesia, Malaysia, Cameroon and Malaysia; c.i.f. prices for importing countries: Colombia and Honduras.
Source: country studies (Chapter 3-6 and 9-10)

resulting in comparatively high domestic prices, especially in the importing countries Colombia and Honduras. Other figures (Table 2.31, Column 2) are more comparable as international prices are used: f.o.b. prices for the countries exporting part of their produce and c.i.f. prices for the importing countries. The differences between the exporting countries are due to the different import content per tonne product which depends on the availability of domestically produced inputs. The added value in Colombia and Honduras is high as domestic production replaces imports, whereas in the other countries every tonne extra produced is exported.

The efficiency of domestic production and marketing activities is expressed by the ratio between the domestic resources used for these activities and the value added. The ratio, the domestic resource cost coefficient (d.r.c.c.), is defined as

d.r.c.c. = (production and marketing costs – value imported inputs) / (value added at f.o.b. or c.i.f. prices). The value added computed with international prices is used to allow comparison between the countries (see previous paragraph). The coefficients (Table 2.32) show the efficiencies of the respective countries and Malaysia is clearly in the most advantageous position, as \$0.64 of domestic resources is required to produce \$1.00 exportable product. Indonesia follows closely; the gap between these two producing countries and the other countries is considerable. Prices on the world market in the year of comparison, 1982, were low and the coefficients would have been lower in 1981 as well as in 1983 but the ranking remains the same as costs, and imports did not change considerably over several years.

The domestic production requires foreign exchange for imported inputs. As the balance of payments is of importance in all producing countries, it is useful to examine the dependence of the domestic production on imports (Table 2.32). The foreign-exchange-saving rate (f.e.s.r.) defined as value added at f.o.b. or c.i.f. prices – f.o.b. or c.i.f. value of product is the indicator used to express this dependence. Rates close to one indicate that a country is only to a limited extent dependent on imports; a rate of 0.75 indicates a considerable dependence as \$0.75 is saved and for \$0.25 is imported per dollar produced. The rate is directly related to the use of non-factor inputs and the domestic production of these in the producing countries. Indonesia and Malaysia are to a limited extent dependent on imported inputs for their production; the dependence in the other countries is substantial. In Indonesia and Malaysia, where, 30 % and 90 % of production is exported, respectively, export earnings are larger than the value of imported inputs and the oil-palm sector is a net earner of foreign exchange. The export earnings in Ivory

Table 2.32. Use of domestic resources and imports (US\$/t product) in six of the selected countries.

	Production and marketing cost (1)	Imported inputs production and marketing (2)	F.o.b.-price/ c.i.f. price[1] (3)	Domestic resource cost coefficient[2]	Foreign exchange saving rate[3]
Indonesia	270	46	344	0.75	0.87
Malaysia	238	37	350	0.64	0.89
Cameroon	451	70	358	1.32	0.80
Ivory Coast	517	104	356	1.64	0.71
Colombia	459	87	414	1.14	0.79
Honduras	573	99	425	1.45	0.77

1. See note Table 2.31.
2. Domestic resource cost coefficient = (1-2)/(3-2).
3. Foreign exchange saving rate = (3-2)/3.

Source: country studies (Chapter 3-6 and 9-10)

Coast are about equal to the value of imported inputs which means that the effect on balance of payments is neutral. In the other countries, production is mainly or entirely destined for the domestic market and the oil-palm sector is a net user of foreign exchange.

2.6 Conclusions

Palm oil, rapeseed oil, soya oil and sunflower seed oil are the four major vegetable oils with shares of the world production of 9, 7, 22 and 9 %, respectively. The share of these four oils in the world production of all fats and oils is 47 %. Palm oil is the second largest vegetable oil on the world market after soya oil, with a market share of 19 % of the vegetable oils or 15 % of all fats and oils (data 1981/1983).

The ecological conditions for oil-palm cultivation show differences between production regions in South-East Asia, West Africa and Central and South America. Rainfall distribution is the dominant ecological factor determining production. The unequal distribution of rainfall in West African countries, with dry periods from 2 to 5 months, results in average yields of 8–13.5 t of f.f.b. per hectare on estates against average yields of 15–22 t of f.f.b. per hectare on estates in the countries in South-East Asia and Latin America where rainfall is distributed more evenly.

Oil palm has successfully competed for land in the same ecological region with rubber, coconut with or without cocoa as intercrop, bananas and root crops in all selected countries except Nigeria during the past 25 years. The high population density in southern Nigeria resulted in the replacement of semiwild oil palms with root crops, which give higher returns per hectare. Government support in that country for cultivation of modern D × P palms on smallholdings met with limited success for the same reasons. The comparison of the input-output relationship of oil palm with those of other oil crops grown in the selected countries: coconut, groundnut and soya bean, resulted generally in the decision of the governments involved to place emphasis on the development of oil-palm cultivation.

The advantageous position of oil palm over other crops resulted in a large expansion of the area planted in all countries under review except Nigeria. In total, 1.9 million hectares were under improved planted palms in the eight selected countries in 1982 and most of these were planted after 1960. In 1982, an estimated 85 % of the world production of palm oil was from improved planted palms. This means a radical change from the position before 1960, when palm oil was mainly produced from the fruits of the semiwild palms occurring in the forest zone of West Africa. The largest expansion took place in Malaysia and Indonesia, where 1.23 and 0.36 million hectares, respectively, were under oil palm in 1982. The expansion in these two countries was partly due to conversion of rubber estates into oil-palm estates and partly to development of virgin land. The expansion in Cameroon, Ivory Coast, Colombia and Honduras is less spectacular in absolute terms,

but these countries started from almost zero. In all countries where oil-palm cultivation expanded, the oil palm became the major oil crop in a period of 20 years.

Estates and smallholders integrated in an organization providing comprehensive services are the dominant producers using the production system based on improved, planted, palms and modern processing technology. There are technical reasons for this situation:

- Production and processing of fruit bunches must be carried out close to each other, as the fruits are perishable and the harvested product is bulky.
- Production, transport of fruit bunches, and processing into crude palm oil and kernels must be planned and implemented in an integrated way to optimize investments and to ensure a smooth production process.
- A high-technology mill, with the advantages of high quality and high milling efficiency, has a minimum capacity of 6 t of f.f.b. per hour and requires 1000 to 1500 ha plantation; usually mills and plantations are larger.

Production of crude palm oil and kernels is thus a large and complex activity with demands on finance, management and expertise, which can be met only by estates and smallholders integrated in an organization providing comprehensive services.

The size of the enterprises and the importance of the products for the domestic or export market result in a structural influence of the government in all selected countries. In all countries except Colombia, the governments participate in production and measures such as price regulation, control of imports and exports and taxation of exports are common.

Production costs in 1982 for the six countries reviewed show wide differences. (Insufficient data are available for Nigeria and Sierra Leone.) Production costs per tonne of product, operating costs plus depreciation of investments, were $210–240 in Indonesia and Malaysia and $440–570 in the other countries. High yields, a high milling efficiency, efficient use of labour and availability of wide experience in and outside the estates in Indonesia and Malaysia are major reasons for the low production costs in these countries compared with those in the other four countries.

The governments in all countries except Malaysia intervene in the price of crude palm oil and kernels. For 1982, this resulted in domestic prices above the border price equivalents. Malaysia only had a nominal protection coefficient below 1, hardly surprisingly as the country is the dominant exporter of oil-palm products on the world market. The nominal protection coefficient ranged from 1.06 in Indonesia to values around 1.30 for Cameroon, Ivory Coast and Honduras, and to 1.79 for Colombia, clear indication of the wide deviation of domestic prices from the corresponding prices on the world market. Prices on the world market were low in 1982 and the nominal protection coefficients would have been lower in 1981 and in 1983: for Cameroon, Ivory Coast and Honduras, probably close to 1.0 but for Colombia still well above 1.0.

Comparison of production costs, domestic prices and border price equivalents

derived from prices on the world market indicate that Indonesia and Malaysia only produce at costs lower than the border price equivalents and these countries were able to export palm oil profitably. The other exporting countries Cameroon and Ivory Coast exported at a loss. However as domestic prices were well above the border price equivalents, part of the loss was compensated in these two countries. Colombia and Honduras imported vegetable oil in 1982 and domestic prices were highest there. Producers in Colombia operated profitably and the cooperative producers in Honduras made a small loss at the domestic price, which was 30 % higher than the border price equivalent based on imported oil. In conclusion, production of crude palm oil and kernels was not internationally competitive as an enterprise in Cameroon, Ivory Coast, Colombia and Honduras in 1982.

Crude palm oil and kernels are processed in two stages. For crude palm oil, the first stage is refining and fractionating which results in intermediate products; kernels are crushed to produce in kernel oil and meal. The second stage is the processing of these intermediate products into end-products. The first-stage processing capacity for crude palm oil and kernels has been greatly increased since 1975. In 1982, most countries processed all or most of their production, extension of capacity being planned in countries with capacities less than production capacity. The extent of the second-stage processing capacity is related to the size of the domestic market, as exports are in the form of intermediate products. So on the world market, crude palm oil will soon be completely replaced by processed palm oil and exports of kernel products will take the place of kernels.

The marketing of crude palm oil and kernels differs according to the type of producer: large producers with high-technology mills; small producers using intermediate-technology mills or non-mechanical extraction methods. In the latter case, the palm oil is sold locally and kernels are sold through dealers to the crushing industry or marketing boards. Production from large producers is characterized by large amounts to be sold, known specifications and regular supply. The marketing channels are short and estates or estate companies often sell directly to refiners or exporters; in Malaysia, specialized licensed brokers and dealers operate. The marketing costs are small and restricted to various harbour costs, as estates normally deliver their produce at the refinery or port of export. In Nigeria and Sierra Leone with a large traditional sector, marketing boards collect the kernels, produced mainly from fruits of semiwild palms, through a network of agents. Guaranteed producer prices are fixed annually and the boards have a monopoly on exports.

Palm oil is an export commodity in Malaysia only, as 90 % of domestic production is exported. In the other countries, palm oil is mainly or completely produced for domestic markets; Indonesia and Ivory Coast export a sizeable proportion of their domestic production, about 30 %.

Export tax on oil-palm products is levied in all countries. In Malaysia, taxation starts when the f.o.b. price exceeds the cost price and the surplus is taxed at 30 %, rising to 45 % if the f.o.b. price is twice the cost price. All other countries

levy 5 to 10 % of the f.o.b. price. Differential tax rates for crude and processed palm oil operate in Indonesia and Malaysia to stimulate the export of processed products.

Production of crude palm oil and kernels requires considerable supporting services which can be divided into supply and domestic production of physical inputs and provision of advisory services. The width and depth of the supporting services sector in a country is positively related to the amount of palm oil produced. About 30 % of production costs are spent on physical inputs in all producing countries. In Indonesia and Malaysia, an estimated 60 % of these inputs is domestically produced; in the other countries, domestic production covers about 25 to 40 % of the physical inputs. Advisory services are based upon the availability of technical knowledge measurable by the existence of research institutes, periodicals and organizations of producers. Malaysia is well equipped with research institutes, has two periodicals and various organizations of producers; in Indonesia, Cameroon, Ivory Coast, Nigeria and Colombia, there are research stations but only in Colombia does a producers' organization exist. Research stations are lacking in the two smaller production countries, Sierra Leone and Honduras. Organizations of producers seem to flourish only in countries with a large and dominant number of private estates.

Production of crude palm oil and kernels increased considerably in six of the eight countries studied. Large areas of land were developed and employment opportunities were created for staff and labourers on estates and for farm families on smallholdings. The increased production provided further opportunities for marketing and processing activities, domestic production of physical inputs and development of technical knowledge. Primary production is an activity shielded from international competition through import/export regulations in most countries. It is supported by domestic prices set at levels well above corresponding prices on the world market. Such a price policy is possible as oil-palm products are primarily destined for the domestic market in all countries, except Malaysia. Indonesia and Malaysia were the only two countries able to produce at production costs below prices on the world market in 1982. The comparative advantage of these two countries is demonstrated by the domestic resource cost coefficients, which were 0.75 and 0.64, respectively. The coefficients in the other countries ranged from 1.14 to 1.64.

Primary production requires foreign exchange for imported inputs except in those countries with a well developed supporting services sector, Indonesia and Malaysia, which are less dependent on imports than the other countries. In Indonesia and Malaysia, imported inputs are required with a value of $40 to produce 1 t of oil-palm products; in the other countries, the import requirements per tonne of product are $70 to 100. Import requirements per tonne of product and the proportion of the domestic production exported determine the net effect of the oil-palm sector on balance of payments. In Indonesia and Malaysia, the oil-palm sector is a net earner of foreign exchange, with exports of 30 and 90 % of produc-

tion, respectively, and a limited dependence on imported inputs. In Ivory Coast, the export earnings are about equal to the import requirements and the effect on the balance of payments is neutral. In Cameroon, Colombia and Honduras, production is mainly or entirely destined for the domestic market and the oil-palm sector is a net user of foreign exchange.

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Part II. Country studies

3 Oil palm in Indonesia

3.1 Background

Indonesia is the most populous state in South-East Asia with 152.6 million people (1982). The total land area of 1.9 million square kilometres is spread over thousands of islands of which the Great Sundas, Sumatra, Sulawezi, Java and Kalimantan are the largest. Java is the most densely populated island with 680 people per square kilometre and a total population of 91 million. The population density on the other islands is much lower.

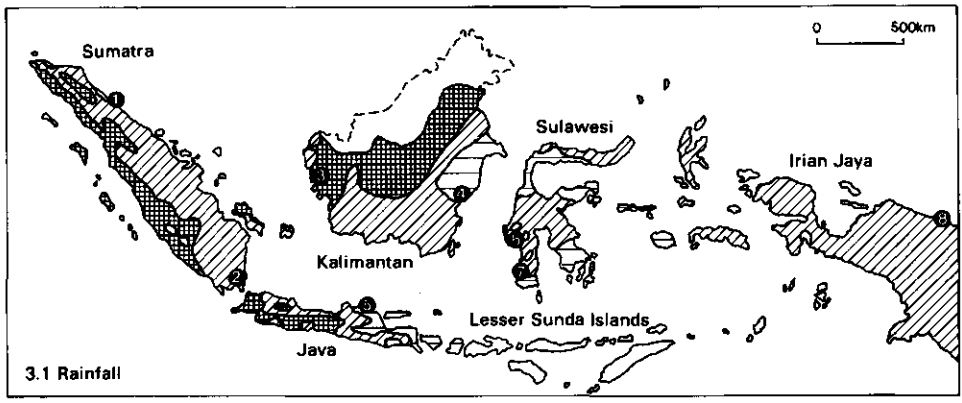
The GNP per person was $580 in 1982. Agriculture is the third sector of the economy with 26 % of GDP and 58 % of the total employment. Industry and services are the other main sectors with, respectively, 39 % and 35 % of GDP.

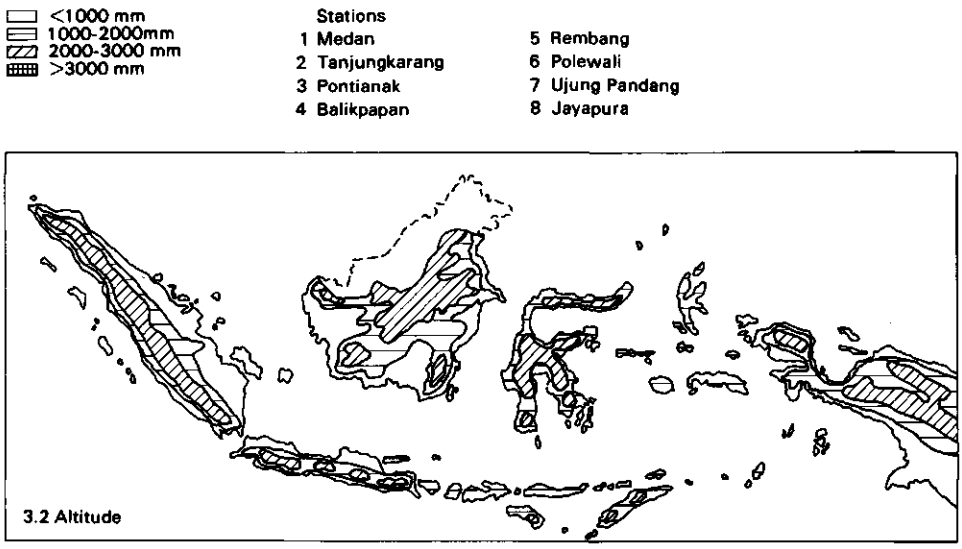
The agricultural area is 31.4 million hectares with 14.2 million hectares of arable land, 5.2 million hectares under permanent crops and 12 million hectares of permanent pasture. Major crops are given in Table 3.1. The government's policy

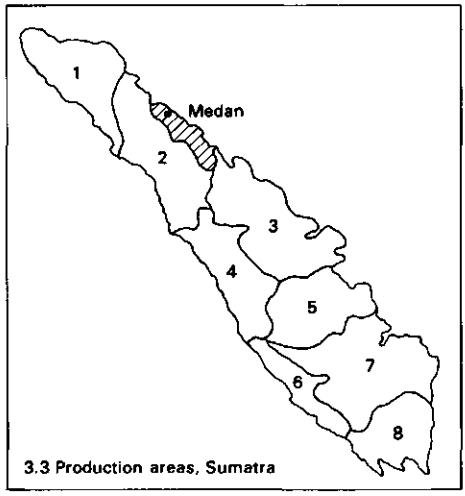
Table 3.1. Average area harvested, yield and national production of major crops over 3-year periods.

Crops	Area (1000 ha)		Yield (kg/ha)		Production (1000 t)	
	1969-1971	1979-1981	1969-1971	1979-1981	1969-1971	1979-1981
Food crops						
rice (paddy)	8160	8940	2350	3320	19100	29700
maize	2670	2700	965	1430	2570	3870
cassava	1430	1420	7510	9630	10700	13700
Oil crops						
oil palm (palm oil)	104	203	2100	3500	218	703
(kernels)			500	600	49	128
coconut (nuts)	1700	2200	4300	4900	7330	10800
soya bean	643	747	728	881	468	658
Beverages						
cocoa	9	18	184	490	2	9
coffee	380	409	455	617	173	253
tea	85	87	772	1070	65	93
Other crops						
rubber	2200	2300	381	406	838	934
sugar-cane (sugar)	69	171	14000	9620	967	1650
tobacco	174	170	422	497	73	84

Sources: FAO (1971-1983), BPPM (1981)







Province	Oil palm area (ha)
1. Aceh	35 900
2. North Sumatra	287 500
3. Riau	22 800
4. West Sumatra	–
5. Jambi	–
6. Bengkulu	–
7. South Sumatra	5 200
8. Lampung	13 500
Total	364 900

Table 3.2. Distribution of monthly rainfall for selected stations (mm).

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Medan	185	60	116	139	163	143	136	181	202	268	175	170	1939
Tandjung Karan	271	274	238	173	126	103	86	84	81	120	110	217	1883
Pontianak	277	208	242	278	282	222	164	204	228	365	388	322	3180
Balikpapan	198	173	228	205	228	190	178	160	138	130	165	203	2196
Rembang	257	195	188	123	100	74	32	21	30	61	122	205	1480
Polewali	155	158	208	246	230	158	114	79	89	190	215	198	2040
Ujung Pandang	719	531	425	166	92	68	34	10	13	40	174	590	2862
Jayapura	318	297	284	230	202	155	169	166	136	161	188	217	2523

Sources: Oldeman & Frère (1982), Surre & Ziller (1963)

for the agriculture sector emphasizes food production, the creation of rural employment opportunities and the expansion of agricultural exports. Tree crops with their effect on food production (coconut and oil palm) and exports (coffee, cloves, oil palm, rubber, tea) are receiving increased attention.

Oil palm is the major oil-crop, followed by coconut, and its contribution is rising. Indonesia is the second producer of palm oil in the world after Malaysia with a production of 824 000 t in 1982, which was 15 % of world production. The main part of the palm oil produced was for domestic consumption but Indonesia was the second exporter with an export of 260 000 t and a share of 8 % in total exports by primary producers. Indonesia is one of the OPEC countries, and exports are dominated by petroleum and gas. The export value of oil-palm products was 0.4 % of exports in 1982.

3.2 Ecology

The climate in Indonesia is determined by its geographical position along the Equator between the Eurasian and Australian continents. The south-east monsoon winds, blowing from April to October, bring relatively dry air from Australia and the north-west monsoon, November to February, brings humid air. The effects of the monsoon winds are different in the various parts of the country and mountains and mountainous ridges add their influence to the climate. The resulting climates range from warm humid and tropical in extensive areas in Sumatra, West Java, Kalimantan, Sulawezi and Irian Jaya to distinctly drier on the Lesser Sundas, and to cool or cold tropical in the mountainous areas.

The average annual rainfall is shown on Figure 3.1. The rainfall pattern in selected stations at or slightly above sea-level in areas with an annual rainfall of at least 1500 mm is given in Table 3.2. The monthly figures show the wide differences in rainfall pattern. General statements about the suitability of the rainfall

Fig. 3.1–3.3. Average annual rainfall (3.1) and altitude (3.2) in Indonesia, production areas on Sumatra (3.3). After Lingen (1981), Hamidon (1980).

must therefore be considered with care. However with this proviso, the greater part of Sumatra, Kalimantan except the southeastern area, the central part of Sulawezi, the southwestern part of Java and most of Irian Jaya are suitable for oil palm.

Temperatures in coastal areas vary roughly between 22 °C and 32 °C, so temperatures there are no constraint. Inland, the maximum and minimum temperatures are directly related to altitude and distance from the coast. Annual mean maximum and minimum temperatures drop by about 0.6 °C for every 100 m increase in altitude and the temperature range increases with distance from the coast. In general, temperatures in areas at altitudes from sea-level to 500 m are suitable for oil-palm cultivation. Figure 3.2 gives a picture of the relief.

Sunshine data for Medan give an annual average duration of sunshine of 2508 h (Surre & Ziller, 1963), while Oldeman & Frére (1982) give an average 5–6 h bright sunshine per day for two other places at sea-level. Detailed information from other areas considered for oil-palm cultivation is not available but the available data and the fact that coastal areas receive in general more hours of sunshine than inland areas make it unlikely that sunshine is a limiting factor.

The soils in the main oil-palm area around Medan are sandy loams suitable for oil-palm cultivation, if hard layers or gravel and stones are absent. Data from other areas are not available.

In summary, climatic conditions and soils are suitable in the existing area of oil-palm cultivation around Medan on Sumatra. Climatic conditions are also suitable in extensive areas in South Sumatra, Kalimantan, Sulawesi and Irian Jaya, and in parts of West Java. Soil surveys are required in those areas to determine the suitability of specific sites for oil-palm cultivation.

3.3 The oil-palm sector

3.3.1 History

The first oil-palm seeds were introduced to Java in 1848. Palms were generally planted for ornamental purposes but van Gorkum, quoted by Hunger (1924), reported oil-palm plots in Central Java producing soap stock around 1867. The Botanical Garden in Bogor, then "s-Lands Plantentuin te Buitenzorg', played a major role in the distribution of seeds to many sites in the archipelago and in collection of information on agronomy.

Oil-palm plantations producing edible oil were established in Sumatra around 1911. In 1938, about 90 000 ha were under oil palm. The Japanese invasion disrupted the plantation industry as tree crops were cut down to make way for annual food crops. The first 20 years after World War II were generally unfavourable for the development of the estate sector. The struggle for independence, the taking over of Dutch-owned and later all foreign-owned estates, and the imposition of unrealistic production targets, all contributed to this.

3.3.2 Recent developments

The situation in the estate sector changed under the new government in 1968. All nationalized Dutch estates in Indonesia were regrouped into 28 independent management units, PTP or PNP I to XXVIII (Perseroan Terbatas Perkebunan and Perusahaan Negara Perkebunan, state estate company with limited liability, state estate company). Of these PNPs/PTPs, ten are in Sumatra, with six of those are specialized in oil palm or oil palm and rubber. Rehabilitation and development plans were made and, with some financial and technical assistance from donor agencies such as the World Bank and the Asian Development Bank, implemented.

The nationalized estates previously owned by other than Dutch owners were returned in 1968 and these, again private, estates too started with rehabilitation and development. Oil palm was considered more profitable than rubber in the late 1960s and early 1970s and large areas with aged rubber stands were replanted with oil palm.

The development of the Indonesian oil-palm sector since 1969 is shown in Tables 3.3 and 3.4. The area increased by 310 %, with an average annual growth rate of 8.4 %. The government-owned estates grew at a slightly higher rate than the private estates. Smallholder production is fairly new and the total area is small.

The increase in oil production in the given period is more than 500 % with an average annual growth rate of 12.5 %. Taking into account the immature areas in 1969 and in 1983, oil yield increased more than half from 2.2 to 3.9 t/ha. The areas, production and yields for the various producers in 1983 are listed in Table 3.5. The yields from government-owned estates do not differ much from those on private estates. The areas that are not yet productive are 35 % of the total area

Table 3.3. Area under oil palm per group of producers (1000 ha).

	State-owned estates	Private estates	Smallholders	Total
1969	84.1	34.9	–	119.0
1970	86.6	46.7	–	133.3
1975	120.9	67.9	1.3	190.1
1976	141.3	69.7	1.4	212.4
1977	148.8	76.6	2.8	223.2
1978	163.5	76.7	2.9	243.1
1979	176.4	81.4	3.1	260.9
1980	199.5	88.8	6.2	294.5
1981	213.3	100.0	5.7	319.0
1982	259.3	100.7	5.9	365.9
1983	261.0	101.9	5.9	368.8

Sources: BPPM (1981), Directorate General of Estates

Table 3.4. Production of crude palm oil and kernels (1000 t).

	Palm oil	Palm kernels
1969	188	42
1970	217	49
1975	411	83
1976	433	82
1977	497	92
1978	525	99
1979	641	121
1980	721	128
1981	796	141
1982	874	147
1983	972	165

Sources: see Table 3.3

Table 3.5. Area, production and yield per group of producers in 1983.

Producer	Area (1000 ha)			Production palm oil (1000 t)	Yield palm oil (t/ha)
	productive	not yet productive	total		
State estates	170.2	90.8	261.0	679	3.99
Private estates	75.1	24.0	101.9[1]	292	3.90
Smallholders	1.9	4.1	5.9[1]	1	0.60[2]
Total/average	247.1[2]	118.9	368.8	972	3.90

1. Including old, non productive areas.
2. The fields of smallholders are in the first years of production and yields are still low.
Sources: see Table 3.3

for the government-owned estates and 24 % of the area for the private estates, indicating that the former have a higher rate of planting or replanting.

The greater part of the development outlined has taken place in the province of North Sumatra with Medan as centre of activities. Production, however, has started recently in Aceh and Lampung, both on Sumatra, in West Java and Sulawesi. The government gives priority to further development of the oil-palm sector in the current five-year development plan (1984/1985–1988/1989) and long-term plans. The target for 1989 is 480 000 ha and for 1993 912 000 ha. The extension of the planted area will be implemented by

- Government plantations.
- Government plantations and private plantations developing land to be handed to small farmers.
- Nucleus estates surrounded by smallholders settlements.
- Private companies who want to expand existing plantations or start new ones.

Expansion of the oil-palm areas is planned in Sulawesi, Irian Jaya, the Riau archipelago and in Sumatra.

3.3.3 Organization

Production of crude palm oil and kernels is predominantly an estate activity with the government-owned estates as the major producers (Table 3.5). The main production area is a belt 350 km long along the east coast of Sumatra with Medan as main city (Figure 3.3). This area is situated in the Province of North Sumatra, which includes 78 % of the total oil-palm area. Aceh, Riau, South Sumatra and Lampung are other provinces on Sumatra with oil-palm estates. The areas outside Sumatra are limited: about 4000 ha in West Java and an estate just started in East Kalimantan (all data refer to 1983).

The marketing of crude palm oil and kernels is regulated by the government through the Joint Marketing office. Prices are fixed and the export of crude palm oil is only allowed after domestic requirements are fulfilled.

The processing of crude palm oil into cooking oil for the domestic market is in the hands of private industries mainly in Jakarta.

The supply of inputs and services to the primary producers is undertaken partly by the government and partly by private industries.

In summary, the government plays a dominant role in the oil-palm sector. Firstly as main producer, secondly through the regulation of marketing, and thirdly through planning and implementation of development plans. The oil-palm sector is outlined in Figure 3.4.

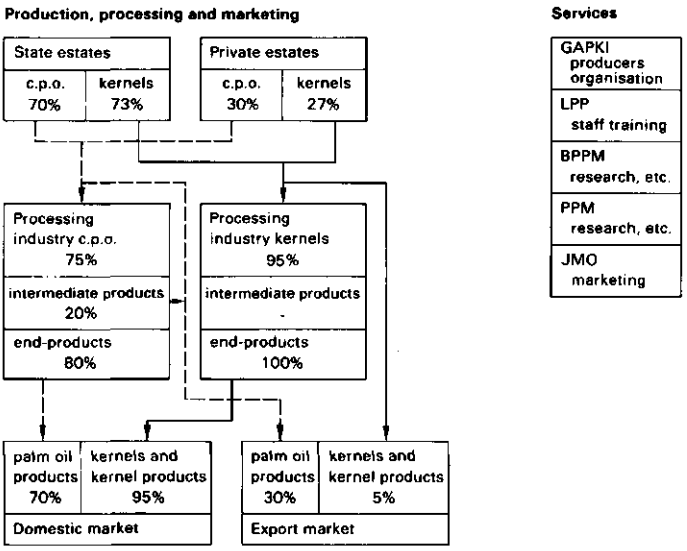


Fig. 3.4. The oil-palm sector in Indonesia, 1982. Broken line, palm oil and palm-oil products; solid line, kernels and kernel products.

3.4 Production of crude palm oil and kernels

3.4.1 Production factors

Land is available on Sumatra and the other islands. The government has authority to allocate land to public or private estates. Private estates are required to renew their titles, usually after 30 years, and they pay varying amounts in tax.

Rubber and coconut underplanted with cocoa are the main crops competing with oil palm for land. The government places most emphasis on oil-palm expansion on their estates and rubber and coconut is more or less left to smallholders and estates in the private sector.

A disciplined and trained work force is available in oil-palm areas. There are no signs of labour shortage. The labour costs including wages, housing and fringe benefits, 1982, are Rp 1600 for estate labourers and Rp 2500 for foremen.

Capital for the planned expansion of the oil palm on government estates and nucleus estates is from the government budget. Expansion of oil-palm areas on private estates is mainly financed from self generated funds.

3.4.2 Producers and production systems

Crude palm oil and kernels are predominantly produced on estates; smallholders are of minor importance. These estates are for the most part owned by estate companies, which usually own 4 to 10 estates. The estate companies have their offices in the main towns near the estates, often in Medan. From these offices they take care of marketing and supply of inputs for the estates and play a major role in the financial management of the estates. The estate companies in Indonesia are government-owned, owned by international estate groups or privately owned by Indonesians.

The government-owned estates are directed by PNP/PTPs, estate enterprises without or with limited liability. In total, 55 estates produce palm oil and these are part of six PNP/PTPs. The total area of these estates is 261 000 ha (1983) and most are on Sumatra, mainly in the Province of North Sumatra. An advisory unit to the Minister of Agriculture, SBPN (Staff Bina Perusahaan Negara, assistant staff for state enterprises), is responsible for policy formulation, coordination of estate-sector investment planning, and assisting PTP/PNPs through monitoring and inspecting estate operation. This advisory unit is outside the regular structure of the Ministry of Agriculture, but is planned to bring SBPN within the structure of the Tree Crop Council, a new government bureau to be established in 1983.

There are about 22 private estates, totally or partly owned by foreign companies. They have an average area of 3000 ha each, owned by 4 companies. The biggest company owns 33 000 ha of oil palms; the others about 10 000 ha each. These estates grow other crops too, such as rubber, cocoa and coconut. The offices of these companies are in Medan and their headquarters are in European capitals.

About 27 Indonesian private estate companies are listed with an area ranging from 50 to 4000 ha, average 400 ha. Usually these companies do not own a mill, but sell their fruit to mills on other estates.

The number of smallholders is limited. Smallholder development is directed by the Directorate General of Estates in the Ministry of Agriculture. A special team for externally assisted nucleus estate and smallholder projects, Team Khusus, is being created within the directorate.

The oil mills are integrated in the estate structure. The total estimated bunch production of 4.8 million tonnes (1983) is processed in about 45 oil mills spread over the government-owned and bigger privately owned estates. The fruits of several estates belonging to the same company may be processed in one mill. Bunches are transported from field to mill by lorry as the additional costs of some extra kilometres are small. Fruit is transported over distances to 10 to 15 km to make optimum use of existing processing capacity. The average turnover per mill is 108 000 t of bunches per year. With an average pressing time of 3500 h/year (two shifts of 7 hours per day for 250 days), the average capacity used is 31 t f.f.b. per hour per factory. This is in line with the capacity of the mills, which run from 20 to 30 to 60 t of f.f.b. per hour, allowing for periodic overhaul and for maximum capacity being used only during peak periods lasting one to two months.

3.4.3 Costs

Information about costs was obtained from several sources: private and state estates and manufacturers of mills. The data refer to the situation in 1982.

3.4.3.1 Investment costs

Field establishment. The first three years after clearing is the establishment period and no fruit is harvested. Land is cleared and terraced with manual labour as heavy equipment results in serious erosion. The costs of replanting in the first year depends partly on the previous land-use. Old stands of rubber trees may be felled and cleared for the price of the wood. Felling, clearing and burning of old oil-palms or primary forest involves expenditure that depends on the density of trees. The costs of (re)construction of roads and bridges varies from place to place. The greater part of the expansion of the oil-palm area in Sumatra has taken place on land planted with rubber trees and expenditure for new roads and bridges is generally nor required. The data listed in Table 3.6 refer to oil palm planted after rubber.

Vehicles. Various means of transport are in use on estates. Four-wheel-drive vehicles, pick-ups, minibuses and motorcycles for staff and workers; tractors and trailers for transport of fertilizer and for agricultural purposes, and tipping trucks for transport of bunches to the factory. A list of vehicles for an average estate of 4000 ha is given in Table 3.7. The tipping trucks for the transport of fruit bunches

Table 3.6. Total field establishment costs for the years 1, 2 and 3.

	(Rp 1000/ha)	(US$/ha)
Materials		
fertilizers	180	272
plants	100	151
seeds legumes	30	45
other	15	23
Labour (375 man-days)	600	908
Other	75	113
General charges	500	756
Total	1500	2268

Table 3.7. Vehicles required for a 4000 ha estate.

	Number of units	Unit cost (Rp million)	Total costs	
			(Rp million)	(US$ 1000)
Tractor (65 hp)	4	17.0	68.0	102.9
Plough, harrow, etc.	2 sets	5.0	10.0	15.1
Trailer (3 tonne)	4	2.5	10.0	15.1
Tractor with grader blade	1	25.0	25.0	37.8
4 wheel drive	2	6.3	12.6	19.1
Motorcycle	12	0.8	9.6	14.5
Pick up	2	6. 3	12.6	19.1
Minibus	1	8.0	8.0	12.1
Truck, tipping with crane	6	31.0	136.0	205.7
Total			291.8	441.4

to the factory are the major cost. The actual number required varies with the distance between field and factory, so great variation in vehicle costs between estates can be expected.

Oil mill. The mills now operating have partly been built during the past 10 years and partly rehabilitated and extended. Capital costs for a new mill or for an extension depend on several factors:

- The installation of imported or locally produced equipment. Imported equipment is more expensive but operation costs are lower. Import tax increases the price difference between imported and local equipment, but the rate varies from 15 to 100 % for various pieces of equipment and for raw materials. Definitions are not always clear and regulations often change, making calculation of an average rate of import tax for palm-oil equipment impossible.
- Capacity. Costs are directly related to capacity as economies of scale do not clearly exist within the normal range of mills from 20 to 60 t of f.f.b. per hour. A mill of 20 t of f.f.b. per hour has two screw-presses of 10 t each installed. A mill of

30 t of f.f.b. per hour has three of these presses, while a 60 t of f.f.b. per hour mill has two separate production lines of 30 t each.

– Position, availability of water, topography of the site and stability of the soil are major factors in actual construction costs.

The capital costs of two mills are given below in Table 3.8. The two mills are extreme cases: the 30-t mill was built mainly with imported machinery and equipment, whereas the 60-t mill was built in Medan with minimum imports. Normally mills are built with some imported and some locally made equipment according to the wishes of the estate company. Costs per tonne of f.f.b. per hour will be somewhere between Rp 168 million and Rp 76 million. The required capacity per hectare is: 19 t/ha × 12 %/500 h = 0.00456 t/h of f.f.b. with the following assumptions: yield 19 t of f.f.b. per hectare, production in peak month 12 % of annual production, 500 pressing hours in peak month. This brings the investment costs per hectare to Rp 347 000–Rp 766 000.

Buildings. Staff and labourers of estates and mills are generally all housed in

Table 3.8. Investment costs for two oil-mills, one 30 t f.f.b./h mill build mainly with imported equipment, one 60 t f.f.b./h mill build mainly with local equipment.

	Mainly imported equipment		Mainly local equipment	
	(Rp million)	(US$ 1000)	(Rp million)	(US$ 1000)
Processing machinery and equipment	2740	4150	.	.
Storage	90	140	.	.
Other equipment	190	290	.	.
Subtotal	3020	4570	3040	4600
Costs of import, buildings and construction	2030	3070	1520	2300
Total	5050	7640	4560	6900
Costs per t f.f.b./h	168	225	76	110

Table 3.9. Investment costs for buildings for a 4000 ha estate.

	Number of units	Unit costs (Rp million)	Total costs	
			(Rp (million)	(US$ 1000)
Houses				
manager	1	20	20	30
assistant manager	4	12	48	73
foremen & clerks	30	6	180	272
labourers	800	1.5	1200	1815
subtotal			1448	2190
Other buildings			75	113
Utilities			75	113
Total			1598	2416

Table 3.10. Investment costs per hectare.

	(Rp 1000)	(US$)	Share of total (%)
Field establishment (year 1-3)	1500	2268	59
Vehicles	73	110	3
Oil mill	557	842	22
Buildings	400	604	16
Total	2530	3824	100

estate houses. Besides houses, there are offices, stores and facilities such as a mosque, a school, a clinic and a community hall. In the main compound, there are normal utilities such as piped water and electricity. The capital costs per hectare are Rp 400 000 or $604 (Table 3.9). The costs are given as indication only, as standards for houses and requirements for other buildings are different from estate to estate. Most buildings on the estates are older than 10 years but in good state of repair. Actual costs of buildings are shown in two ways:
- As capital expenditure in new buildings or major renewals.
- Under general charges in maintenance and minor improvements.

The division between the two is very flexible.

The investment costs per hectare are summarised in Table 3.10.

3.4.3.2 Operating costs

Production costs of fruit bunches in the productive stage are divided into costs for upkeep and cultivation, harvesting costs and transport to the mill. The first includes: weeding, fertilization, foliar analysis, pest and disease control, maintenance of roads, bridges and paths, and hand-pollination. The relative importance of these factors change with the age of the palms, i.e. old palms receive less fertilizer, hand-pollination is stopped when the palms are too high. Hand-pollination is abandoned altogether now as pollinating insects were released in 1983. Harvesting is with a chisel first and later with a knife attached to a pole. Bunches are transported by bicycle to the roadside and from there to the mill by lorry. Loose fruit is gathered by women. Harvesting costs change with the age, and thus with the height of the palms. The average costs of six estates with a total area of 10 000 ha and with an average yield of 19 t of f.f.b. per hectare per year are given in Table 3.11.

Processing. The costs are split into three main categories:
- Current expenditure, which covers all costs for upkeep, maintenance and processing.
- Forwarding and distribution, the costs to transport the palm oil to the bulking installations at Belawan Port near Medan and the transport costs for kernels.
- And general charges, being overhead costs related to the mill.

The costs are expressed per tonne of f.f.b. and per tonne of product, palm oil and

Table 3.11. Production costs fruit bunches.

	Per hectare		Per tonne f.f.b.	
	(Rp 1000)	(US$)	(Rp 1000)	(US$)
Upkeep and cultivation				
labour (15 d/ha)	24	36	1.3	1.9
fertilizer (975 kg/ha)	70	106	3.7	5.6
other materials	8	12	0.4	0.6
subtotal	102	154	5.4	8.1
Harvesting				
labour (1.7 d/t f.f.b.)	53	80	2.8	4.2
materials	4	6	0.2	0.3
subtotal	57	86	3.0	4.5
Transport incl. collection	36	55	1.9	2.9
Total	195	294	10.3	15.5

Table 3.12. Processing costs.

	Per tonne f.f.b.		Per tonne product	
	(Rp 1000)	(US$)	(Rp 1000)	(US$)
Processing				
labour (2 d/t product)	1.1	1.7	4.3	6.5
utensils	0.9	1.4	3.3	5.0
spares	3.9	5.9	14.9	22.5
subtotal	5.9	9.0	22.5	34.0
Forwarding and distribution				
transport (by contractor)	–	–	5.4	8.2
godown	–	–	2.8	4.2
other	–	–	0.1	0.2
subtotal	2.1	3.2	8.3	12.6
General charges mill				
staff and foremen	1.1	1.7	4.2	6.4
medical/welfare	0.3	0.5	1.2	1.8
insurance	0.8	1.2	2.9	4.4
other	0.6	0.9	2.4	3.6
subtotal	2.8	4.3	10.7	16.20
Total	10.8	16.5	41.5	62.8

palm kernels. The annual costs of one mill with the general data given below are listed in Table 3.12.

Mill installed in 1974–1976 with some imported equipment:
- Screw-presses, steamturbines.
- Capacity 20 t of f.f.b. per hour.
- Turnover in 1982, 69 000 t of f.f.b. (relative use of 86 %)
- Oil production, 14 900 t (oil/bunch = 21.6 %)
- Kernel production, 2950 t (kernel/bunch = 4.3 %)
- Staff management 4; foremen 6; labourers 134.

Processing costs vary from mill to mill due to the state of equipment, type and quality of fruit and management. Costs for product Rp 30–45 per kg or $45–68 per tonne are considered normal.

General charges is a heading under which costs are grouped that cannot directly be related to one of the production or processing activities. Part of the general charges is related to the estate such as costs for estate management, land rent, insurance, office expenses, upkeep of buildings and compound, medical welfare, and water and power system. Another part is related to costs of the head office or agent. General charges in a narrower sense are generally calculated for the oil mill, especially when fruit from other estates is processed. General charges in total are a major cost item varying from Rp 20 000 to Rp 30 000 per tonne of product on several estates. General charges are also calculated for the immature areas. These are part of the investment costs.

A considerable amount of capital is invested in estate and mill and working capital is required for the operation of both. The costs on this invested capital are estimated at 10 % interest of half of the capital goods (linear depreciation) and 10 % interest on the working capital estimated at a quarter of the current operating costs over one year. The interest costs per year per hectare:
10 % of Rp 2 530 000 × 50 % = Rp 126 500 or $191.40
10 % of Rp 505 000 × 25 % = Rp 126 000 or $19.10
total Rp 139 100 or $210.50

3.4.3.3 Production costs

The costs outlined in the previous sections are summarized in Table 3.13. Average costs have been taken where a range has been given before. Capital costs are taken into account through the inclusion of depreciation: 4 % for investment for field establishment, as 25 years is the normal productive lifespan of oil palm; 20 % for vehicles; 8 % for the oil mill, assuming a complete overhaul of the mill after 12 years; 2.5 % for buildings. With 83 %, current expenditure forms the major part of total production costs. The five major components of the total costs (bunch production, processing and forwarding, general charges, interest costs and depreciation of capital) are of the same magnitude with 25, 22, 18, 18 and 17 %, respectively.

Table 3.13. Production costs oil-palm products.

	Per hectare		Per tonne f.f.b.		Per tonne product	
	(Rp 1000)	(US$)	(Rp 1000)	(US$)	(Rp 1000)	(US$)
Operating costs						
upkeep and cultivation	102	154	5.4	8.1	20.7	31.3
harvesting	57	86	3.0	4.5	11.6	17.5
transport	36	55	1.9	2.9	7.3	11.1
total bunch production	195	295	10.3	15.5	39.6	59.9
processing incl. forwarding[1]	172	261	9.1	13.7	35.0	53.0
general charges[2]	138	209	7.3	11.0	28.0	42.4
interest	139	210	7.3	11.1	28.3	42.7
subtotal	644	975	34.0	51.3	120.9	198.0
Depreciation capital						
field establishment	60	91	3.1	4.8	12.2	18.5
vehicles	15	23	0.8	1.2	3.1	4.6
oil-mill	45	68	2.4	3.6	9.1	13.8
buildings	10	15	0.5	0.8	2.0	3.1
subtotal	130	197	6.8	10.4	26.4	40.0
Total	774	1172	40.8	61.7	157.3	238.0

1. Average costs of a number of mills, Rp 35000 per tonne product.
2. Average general charges of a number of estates, Rp 138000 per hectare.

3.4.4 Returns

Yields. Aggregate data on bunch production are not available. Assumed an oil-extraction ratio of 20.5 %, bunch production was about 17 t/ha in 1982. Corresponding average yields of crude palm oil and kernels were 3500 and 580 kg/ha, respectively, for all areas in production. These yields are below the average yields of palm oil reached in 1981 and 1983: 3600 and 3900 kg/ha, respectively. The yields of palm oil obtained in recent years fit in with the yield expectation of modern D × P material produced by Pusat Penelitian Marihat (Marihat Research Station) and planted in North Sumatra, if two factors are taken into account:

- The gradual improvement of D × P material during the past 15 years.
- The fact that a more than normal proportion of the productive palm-oil area is in the first years of production due to the expansion of the area.

Yield expectations of the now available D × P material from Marihat are listed in Table 3.14. The average yield of f.f.b. during the total estimated productive lifetime is 20.9 t/ha.

Besides the gradual improvement in yield, there are two developments with a more drastic effect on yields. First, the recent release of the weevil resulted in better pollination and a higher kernel-extraction ratio. The total effect on yield of

Table 3.14. Yield expectations for D × P palms by Marihat research station (t of f.f.b./ha).

Year after planting	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Yield	6	14	22	25	25	24	23	23	23	23	23	23	23	23	23	22	22	21	21	20	20	19	19	18	18

Table 3.15. Prices of crude palm oil and palm kernels.

	Crud]e palm oil			Palm kernels		
	export[1] (US$/t)	local		export[1] (US$/t)	local	
		(US$/t)	(Rp 1000/t)		(US$/t)	(Rp 1000/t)
1970	220	181	66	124	.	.
1975	422	357	148	149	.	.
1976	343	352	146	146	.	.
1977	471	347	144	230	.	.
1978	533	328	145	235	.	.
1979	595	334	208	346	.	.
1980	490	354	222	261	.	.
1981	504	396	250	193	158	100
1982	370	378	250	194	151	100
1983	322	.	.	238	.	.

1. F.o.b. price Belawan port, Medan.
Sources: BPPM (1981), Central Bureau of Statistics (1984)

oil and kernels can only be assessed after several years when the initial shock effect of improved pollination has dampened and a new equilibrium has been established. The second development is the use of planting material propagated by tissue culture from high-yielding palms. The first commercial plantings were in 1983. It is expected that the new types may have yields 30–40 % higher than present palms. The effect of this development will be felt gradually, as clonal palms come into the productive stage.

Prices. Two prices are in operation for oil-palm products: the local price for produce sold to local refiners and millers and the export price derived from the world market price (Table 3.15). The government decides about the destination of crude palm oil. Most of the crude palm oil has been channelled to the domestic market since 1981 (Section 3.6) and palm kernels are almost completely sold to domestic millers. The local prices refer to palm oil and kernels delivered in Medan and estates arrange for transport, either with their vehicles or with contracters. The local price for crude palm oil in 1982 was Rp 250 000/t or $378/t and for kernels Rp 100 000/t or $151/t which results in a price of Rp 228 000 or $345 per tonne of product. These prices are close to the corresponding prices on the world market (Section 3.6.3).

3.4.5 Review costs and returns

The price per tonne of product in 1982 was well above production costs and palm-oil production was in general a profitable activity for the estates. The situation in previous years must have been favourable as well, as prices on the world market reached the $400/t in 1973/1974 and remained well above that level until the end of 1982. Local prices in Indonesia reached $300/t in 1973 and increased gradually to $370/t in 1982. Price developments within Indonesia were much more pronounced, as the consumer price index rose from 1970 to 1981 from 41.0 to 233.4, an increase of 570 %; the wholesale price index rose from 40.5 in 1971 to 285.8 in 1980, an increase of 700 %. Production costs are related to consumer price index and wholesale price index. The margin between production costs and prices of oil and kernels has thus certainly been considerable in the past twelve years especially after the price increase of palm oil in 1974. This margin explains

Table 3.16. Input-output data.

Output per hectare	Quantity		Domestic price		Value	
	(t)	ratio (%)	(Rp 1000/t)	(US$/t)	(Rp 1000/t)	(US$/t)
F.f.b.	17.5					
C.p.o.	3.57	20.5	250	378	893	1349
Kernels	0.60	3.5	100	151	60	91
Total product	4.17	24.0	228	345	953	1440

Inputs per tonne product	Quantity	Costs	
		(Rp)	(US$)
Land	0.24 ha	p.m.	p.m.
Labour			
upkeep (15 d/ha/yr)	3.6	5900	8.90
harvesting (1.7 t f.f.b.)	7.1	11300	17.10
mill	2.0	3200	4.80
subtotal	12.7	20400	30.80
Non-factor inputs:			
from operating costs			
fertilizer	234 kg	16800	25.40
other materials		20700	31.30
depreciation investments			
field establishment		5900	8.90
vehicles		3600	5.50
oil mill		10800	16.30
buildings		2400	3.60
subtotal		60200	91.00

why a major part of the expansion of the palm-oil industry has been financed by the estate companies themselves.

The input-output data (Table 3.16) are based on the national averages for yield and yield factors in Section 3.4.4 and the investment and operating costs per hectare in Section 3.4.3. A proportion of the investments for field establishment is supplied from outside the estate, Rp 612 000/ha or $925/ha, and the standard depreciation rate of 4 % and the average yield of 4.17 t/ha are used to compute the input per tonne of product. Vehicles, oil mill and buildings are either bought or build by contractors and the total investments are used to compute the input amounts stated.

The labour input of 12.7 days per tonne of product results in 53 days per hectare per year or 4.5–5 hectare of productive area per labourer. The total estimated amount of the non-factor inputs is about 40 % of production costs given in Section 3.4.3. Production of palm oil and kernels has considerable effects on other sectors in the economy.

3.5 Processing

Crude palm oil was processed by 33 companies with a total installed capacity of 1.2 million tonnes in 1983. Three of the companies were owned by estate companies in North Sumatra. The others in Medan and Jakarta were specialized in processing. The main product is cooking oil; of lesser importance are margarine, soap and other products. The total amount processed was about 600 000 t/year in 1981 to 1983, so that half the capacity installed was utilized.

The main part of the palm kernels produced are processed into kernel oil and cake in crushing mills in Indonesia but no details about number of mills and capacity are available.

3.6 Marketing

3.6.1 Marketing channels

The government controls the allocation of crude palm oil to guarantee a sufficient supply to the processing industry that produces cooking oil for the domestic market. All estates, private and government-owned, are required to sell a specific proportion of their production to local refiners through the Joint Marketing office (JMO) at prices fixed by the Ministry of Trade. The JMO operates under supervision of the advisory unit on government estates (SBPN), which is placed directly under the Minister of Agriculture. If quotas are fulfilled or if no local buyers can be found by the JMO, the estates can apply for an export licence and the palm oil can be sold for export through agents or, in foreign-owned companies, through head offices in Europe.

Table 3.17. Marketing costs crude palm oil export in 1982.

	(Rp 1000/t)	(US$/t)
Price ex estate	214.8	324.9
Forwarding to Belawan or Medan	5.4	8.2
Godown costs	2.8	4.2
Other harbour costs	10.0	15.1
F.o.b. price (excl. tax)	233.0	352.4
Export tax (5 %)	11.6	17.6
F.o.b. price	244.6	370.0
Insurance, freight to European port	41.8	63.2
C.i.f. price West European port	286.4	433.2

3.6.2 Marketing functions

Crude palm oil and kernels are transported by road tankers or by rail, if the estate is linked with the railway system. The products are usually transported to Belawan, the harbour of Medan, for export or transport to Jakarta or to refiners around Medan. Transport is by the estate or arranged by the estate, and the costs are usually included as 'forwarding and distribution' in production costs. The costs listed in Table 3.12 are Rp 5400/t or $8.20/t for an estate 160 km from Medan.

Bulking installations are available in the harbour to store the crude palm oil awaiting transport by ship. Palm oil is sold in bulk. The storage costs are Rp 2800/t, $4.20/t, and further charges are Rp 10 000/t, $15.10/t (Table 3.17).

Crude palm oil may be exported only after the quality has been checked by BPPM (Section 3.7). Internationally accepted standards are followed.

3.6.3 Pricing, taxation and costs

Vegetable oil is one of the nine basic commodities for which the government regulates prices and supplies. The prices of crude palm oil, kernels and refined palm oil are fixed by a committee consisting of representatives from the Ministries of Agriculture, Finance and Trade. Production costs, costs of refining and consumer prices are taken into account. The prices refer to palm oil and kernels delivered at Belawan or Medan. The fixed local prices have been below or above the corresponding prices on the world market (Table 3.15). In 1982, the border price equivalent at Medan (f.o.b. price minus harbour and 'godown' costs) was Rp 231 800/t or $350.70/t for crude palm oil (Table 3.17) and an estimated Rp 115 000/t or $174.00/t for palm kernels. These prices were slightly below and above the respective local prices. The border price equivalent at Medan for oil-palm products was Rp 215 000/t or $325/t which is Rp 13 000/t or $20/t lower than the local price (Section 3.4.4). In other terms, the nominal protection coefficient is 1.06. An increasing share of palm-oil production has been directed to the local

market at the fixed prices, so that the price links with world markets are increasingly cut off and replaced by domestically controlled prices.

One special tax is levied on oil palm: the export tax, which is 5 % of the f.o.b. value of palm oil. In 1984, an 'additional export tax' was imposed ranging from 37.18 % for crude palm oil to 26.1 % for refined palm-oil products. Other taxes that affect palm-oil production on estates are corporation tax, various taxes to local governments and import duties on imported equipment ranging from 15 % to 100 %. Government estates may be exempt from paying import duties and corporation tax.

The marketing costs described in the previous sectors are summarized in Table 3.17. The price received off the estate for exported palm oil, Rp 214 800/t, was below the local price, Rp 250 000/t in 1982, but prices on the world market were extremely low in that year.

3.6.4 Export and domestic consumption

Consumption of vegetable oils in Indonesia was estimated at 1278 000 t in 1982 which is 8.4 kg per person. The annual increase in oil consumption was about 7 % in the 1970s due to population increase and higher incomes per person. The use of oils and fats in total of 10.9 kg/year is low compared with Malaysia, 16.8 kg, and the Philippines, 12.3 kg, and a further increase in consumption can be expected.

Coconut was the major source of vegetable oil in Indonesia until 1978. Production of coconuts has increased at an annual average rate of 1.4 % between 1955 and 1974, and an estimated rate of 1.5 % till 1980. The increase in area, 4.2 %/year in the period 1966–1975, has been offset by a decline in yields due to

Table 3.18. Exports of oil-palm products.

	Crude palm-oil[1]		Kernels	
	(1000 t)	share of production (%)	(1000 t)	share of production (%)
1970	159	73	42	87
1975	286	70	21	25
1976	406	94	26	31
1977	405	81	25	27
1978	412	78	7	7
1979	351	55	21	17
1980	503	70	43	34
1981	196	25	23	16
1982	260	30	7	5
1983	346	36	13	8

1. From 1980 onwards a proportion of the palm oil exported was in the form of R.D.B. palm oil and palm stearin. In 1982 50 % of exports was c.p.o.

Sources: Central Bureau of Statistics, various publications

the advanced age of most of the coconut palms. Of the coconuts, 98 % are a smallholder crop and the effects of a government programme to stimulate replanting with new varieties will be felt in the long run only, the more so as coconut palm starts production around the 6th year and reaches its full production potential around the 12th year.

The oil palm became the major oil-crop in 1979 when the combined production of palm oil and palm-kernel oil, about 700 000 t, surpassed production of coconut oil, 624 000 t. Production of palm oil and kernel oil rose faster than production of coconut oil and production of palm oil, palm kernel oil and coconut oil was 53 %, 4 % and 42 %, respectively, of the total domestic production of 1.6 million tonnes in 1982. Palm oil has been increasingly used to fill the gap between supply and demand for vegetable oils, so that exports declined, especially after the introduction of the governments allocation policy in 1981 (Table 3.18). In 1982, 614 000 t of palm oil was directed to the domestic market and this accounts for 48 % of the total consumption of vegetable oil. Palm kernels are almost completely processed and consumed domestically and only small amounts are exported.

3.7 Supporting services

3.7.1 Research and advisory services

Several institutes deal with research and related services. The Balai Penelitian Perkebunan Medan (BPPM) is the Research Institute for Estate Crops, controlled by the Agency for Agricultural Research and Development (AARD), under the Ministry of Agriculture. BPPM deals with cocoa, coconut, oil palm and rubber. The research section is split into four subsections: agronomy; crop protection; soil and fertilizers; and technology. The extension section provides information in the form of reports, booklets and leaflets. The third section, services, controls the quality of palm oil and rubber and provides the required export certificates. The institute has a staff of about 100 people, several laboratories and an extensive library.

Pusat Penelitian Marihat (PPM) in Siantar, about 100 km from Medan, is the research station for the government estates. The research section deals with agronomy, crop protection, breeding and selection and statistics. The extension section prepares regular information notes, to which estates may subscribe. The section seed production provides germinated seeds to government and private estates in Indonesia. In 1982, 12.5 million germinated seeds for about 70 000 ha were sold to government and private estates, with a total value of Rp 1825 million, $2.7 million. The laboratory section deals mainly with foliar analysis to assess the fertilizer requirements of a particular field.

The bigger private estate companies, such as PTPP London Sumatra Indonesia and Socfindo have their own research institutes on one of their estates. They are organized in much the same way as BPPM but are smaller.

3.7.2 Supply of inputs

The annual use of fertilizer by the oil-palm estates can be estimated at 300 000 t divided into urea 81 000 t (27 %), rock phosphate 43 000 t (14 %), MOP 107 000 t (36 %) and kieserite 69 000 t (23 %). This is 4, 3 and 47 % of the total annual consumption in Indonesia, respectively (data on the total consumption of kieserite are not available). Nitrogen fertilizers are produced in the country; of phosphate fertilizer, 80 % is produced in Indonesia; potassium fertilizer and kieserite are completely imported. This means that about 60 % of the fertilizers (expressed as weight of product) used in oil-palm estates are imported. The above estimate is based on average fertilizer recommendations by P.P. Marihat (Table 3.19), which provided recommendations for 116 000 ha, more than a third of the total oil-palm area, in 1981.

Fertilizer is heavily subsidized in Indonesia and it is estimated that prices paid by the estates, Rp 63 to Rp 81 per kg depending on type, distance and quantity bought, are only 65 % of the real costs. This means an average subsidy of Rp 35 000/t ($53/t), or with above stated recommendation, Rp 35 000 per hectare per year.

The costs of the processing installation with its two components: spares and depreciation is 15 % of the total cost price. Processing equipment is partly imported and partly locally produced. One European producer has a representative in Medan. If major investments are considered, contacts are generally made with several foreign suppliers as well as local producers. In and around Medan there are several firms of various size producing processing equipment for oil mills as well as for other installations: 3 firms with 200–500 employers, 4 firms with 100–150 employers, 25 firms with about 20 employers. In addition to these firms, there are numerous small workshops for small repairs or for producing spare parts. Several the bigger government-owned estate companies have there own workshop in Medan for repair and maintenance of equipment and vehicles.

The estimated annual turnover of spares only is Rp 12.6 thousand million or $19 million based on the cost component spares given in Table 3.12 and the estimated production for 1982 of a million tonnes of product. If new mills are built

Table 3.19. Fertilizer recommendations by PPM in 1981 (kg/ha per year). Based on 143 trees/hectare (original recommendations are given per tree).

Age trees (years)	Urea	Rock phosphate	MOP[1]	Kieserite	Borate	Total
2.5- 5	215-290	105-145	290-360	145-215	7	880
6 -15	290-360	145-215	290-435	215-290	–	1120
more than 15	125-290	70-145	290-435	145-290	–	920

1. Muriate of Potash.
Source: PPM (1982)

according to the rate of depreciation of 8 %, an amount of Rp 9.4 thousand million or $14 million would be added annually to the turnover of the industry producing processing equipment.

Vehicles are the third major external input in palm-oil production. Four-wheel-drive vehicles, tractors, motorcycles and trucks are imported as components and assembled in Indonesia, mainly Jakarta. Oil tanks and trailers for tractors are locally made. The annual turnover of vehicles based on average depreciation of 20 % is Rp 4.6 thousand million or $7 million. Transport vehicles for the transport of oil and kernels from the mill to the bulking installation are not included in these totals.

3.7.3 Other institutions

Recently a producers' organization was founded: GAPKI, the Indonesian Palm Oil Producers Organization. Activities and responsibilities are not yet completely crystallized.

The Lembaga Pendidikan Perkebunan (LPP), the Training Institute in Plantation Management and Agro-Technology, was established in 1970 by the Minister of Agriculture to increase training facilities for the plantation sector. There are two campuses, one in Yogyakarta and one in Medan, and several training centres in various places in plantation areas. In 1982 there were 111 courses conducted for 2500 participants from government estates. In addition, some courses were conducted for staff of private estates and staff of several projects.

3.8 Summary and economic parameters

Indonesia is the second largest producer of palm oil in the world and also the second largest exporter with a share of 8 % of exports by primary producers (1982), despite a domestic consumption of 70 % of production. Within the country oil palm is the main oil-crop, followed by coconut, and its contribution is still rising. The present position of Indonesia as main producer is the result of considerable effort from the government and private estate companies, who revived the estate sector after 1968.

Oil palm is an estate crop and most estates are in the province of North Sumatra with Medan as the centre of activities. The government-owned estates are the major producers with 71 % of the total area under oil palm. Private estates, partly foreign-owned and partly Indonesian, cover 27 % of the area and the remaining 2 % are owned by smallholders.

Favourable ecological conditions, good cultivation practices and a high milling efficiency results in average yields of oil of about 4 t/ha, which is among the highest in the world. Production costs are below corresponding prices on the world market and exports are profitable.

There is an extensive processing industry in the country, which processes the

primary products, crude palm oil and kernels, into consumer goods and, increasingly, into partly processed products for exports.

The government plays a dominant role in the oil-palm sector, in the first place as producer but also in marketing, as it determines the local sales price and the proportion of the domestic production that must be sold at the fixed price to domestic refiners. In addition, the government plays a major role in research, seed

Economic parameters of the oil-palm sector in Indonesia (1982).

Resources used	
Land under oil palm	366 000 ha
as share of area under permanent crops	7 %
area in production	245 000 ha
Labour for total area	117 500 man-year
for area in production	54 000 man-year
Non-factor inputs for production and marketing	
domestically produced	US$ 60 million
imported	US$ 47 million
Output	
Crude palm oil (874 000 t)	
70 % at domestic price	US$ 232 million
30 % at f.o.b. price	US$ 85 million
Palm kernels at domestic price (147 000 t)	US$ 22 million
Total product (1 021 000 t)	US$ 339 million
Value added by primary producers	US$ 232 million
Value added by sector	US$ 292 million
Productivity primary producers	
Gross return per hectare	US$ 1380
Value added per hectare	US$ 950
Gross return per man-year	US$ 6280
Value added per man-year	US$ 4300
Destination products	
Crude and processed palm oil	
domestic market	70 %
export	30 %
Palm-kernel products	
domestic market	95 %
export	5 %
Other parameters	
Export value palm oil and kernels	US$ 98 million
as share of total value of exports	0.4 %
Contribution to domestic market vegetable oils	
palm oil	48 %
palm kernels	4 %

Sources: see previous tables; own estimates

production and the overall planning of the oil-palm sector.

The basic conditions for further expansion of the oil-palm sector are present in Indonesia with land available in ecologically suitable areas as well as labour. Exploiting the possibilities will largely depend on the government, which plays a decisive role in allocation of land to government and private estates, nucleus estates and smallholder settlements schemes and which largely controls the profitability of oil-palm enterprises by price setting and marketing arrangements.

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Currency equivalents and price indices in Indonesia (1970-1983).

	Exchange rate (Rp per US$)	Consumer price index (1980 = 100)
1970	365	20
1971	393	21
1972	415	22
1973	415	29
1974	415	40
1975	415	48
1976	415	58
1977	415	64
1978	442	69
1979	623	84
1980	627	100
1981	632	112
1982	661	123
1983	909	137

Source: IMF (1984)

4 Oil palm in Malaysia

4.1 Background

The Federation of Malaysia consists of three parts: Peninsular Malaysia, divided into 11 states, and Sabah and Sarawak both situated in the northern part of the Island of Borneo (Kalimantan), of which the other part belongs to Indonesia (Figure 4.1). The total population is 14.5 million (1982). With Laos and Kampuchea, Malaysia is a country in South-East Asia with a relatively small population.

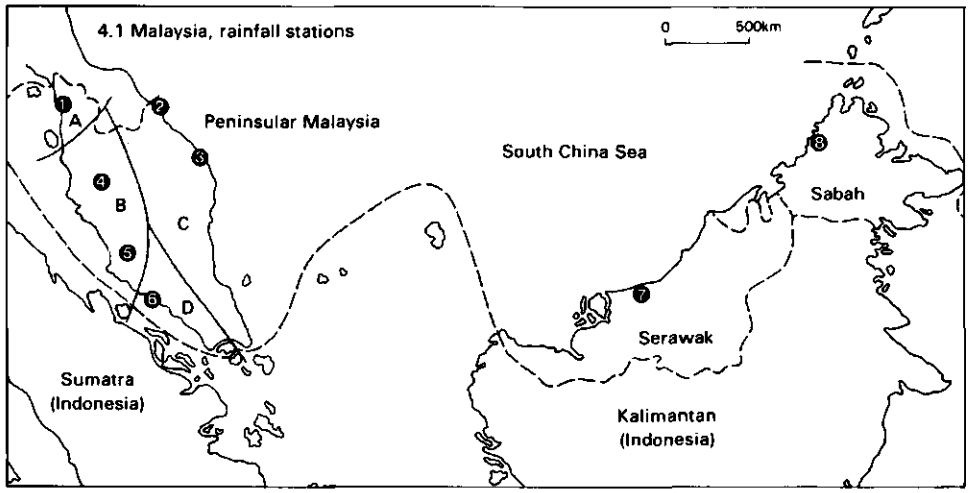
The GNP per person was $1860 in 1982. With 23 % of the GDP, agriculture is the smallest sector in the economy after industry with 30 % and services with 47 %. About half the work force is employed in the agricultural sector against 16 % in the industry and 34 % in services. The mining sector, included in 'industry' above, is important with tin and petroleum as main products.

The total land area is 330 000 km^2, of which 68 % is forest and woodland. Of the remaining area a million hectares is arable land, 3.3 million hectares are under

Table 4.1. Average area harvested, yield and national production of major crops over 3-year periods.

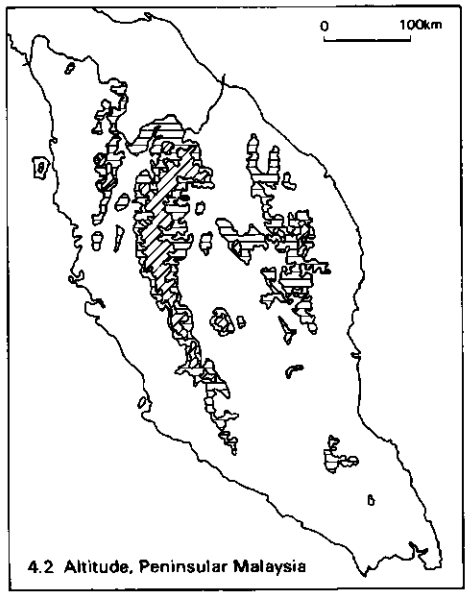
Crops	Area (1000 ha)		Yield (kg/ha)		Production (1000 t)	
	1969-1971	1979-1981	1969-1971	1979-1981	1969-1971	1979-1981
Food crops						
rice (paddy)	708	755	2400	2830	1700	2140
roots & tubers	52	59	7610	8700	397	515
Oil crops						
coconut (copra)	.	.	.	.	220	210
oil palm (palm oil)	302[1]	1030[1]	1500	2400	450	2530
(kernels)			300	500	93	550
Beverages						
cocoa	9	72	422	447	4	32
coffee	9	10	698	955	6	9
Other crops						
pepper	.	12	.	2240	.	28
rubber	1990	2000	640	800	1280	1600
suger-cane (sugar)	4	19	2300	3160	9	60
tobacco	3	14	840	703	3	10

1. Total area planted.
Source: FAO (1971-1983)



A North West
B West
C East
D South West

Stations
1 Alor Setar
2 Kota Bharu
3 Kuala Trengganu
4 Ipon
5 Kuala Lumpur
6 Muar
7 Mukah
8 Kota Kinabalu



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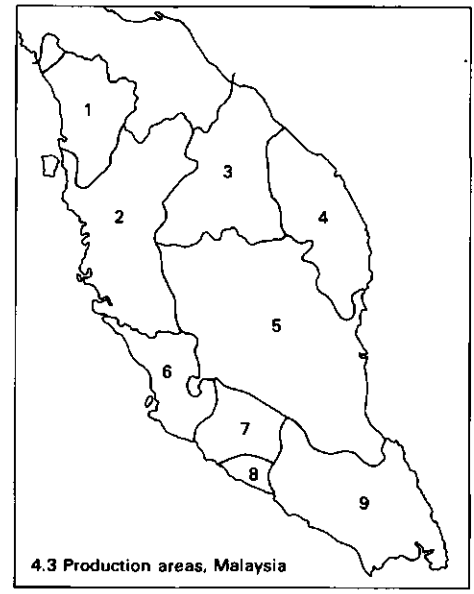

State	Oil palm area (ha) (1983)
1. Kedah	11 000
2. Perak	95 000
3. Kelantan	27 000
4. Trengganu	97 000
5. Pahang	303 000
6. Selangor	107 000
7. Negri Sembilan	50 000
8. Melaka	9 000
9. Johor	347 000
10. Pinang	5 000
11. Sabah	124 000 (Figure 4.1)
12. Sarawak	24 000 (Figure 4.1)
Total	1 199 000

permanent crops and 0.4 million hectares are irrigated land. Rice, rubber and oil palm are the major crops (Table 4.1) and oil-palm products and rubber each contributed about 5 % to the GDP in 1982. With a production of 3.5 million tonnes of palm oil and an export of 2.7 million tonnes of palm-oil products in 1982, Malaysia is the largest producer and exporter in the world with 56 % of world production and 85 % of exports.

The main exports are petroleum, manufactures, rubber, oil-palm products, timber and tin. The share of rubber and oil-palm products in the total exports is 10 % each.

4.2 Ecology

The climate of Peninsular Malaysia is determined by the seasonal changes in direction and speed of the air streams crossing the Peninsula, the influence of the mountain ranges in the northern part and the distance from Sumatra with its range of volcanoes. East Malaysia, the provinces of Sarawak and Sabah, is 1500 km east of Peninsular Malaysia (Figure 4.1) and its climate will be dealt with separately.

Peninsular Malaysia can be roughly divided into four sections (Figure 4.1) with different rainfall patterns. Western Malaysia has two rainy seasons and two relatively dry spells. Total rainfall varies from 1800 to 3600 mm/year and minimum rainfall in any month of the year is 75 mm. Much of the western part is suitable in rainfall for oil palms, except the highland areas. The dry periods in the north western section are more pronounced and suitability for oil palms depends more on moisture-holding properties of the soil. The eastern part is characterized by a single-peak rainy period with annual rainfall from 2500 to 3500 mm. The uneven distribution of rainfall makes this area less suitable for oil palm than the western part. The south-west with a rainfall of less than 1750 mm, is not suitable for oil palms except for a coastal belt 20–25 km wide where rainfall is evenly distributed. The rainfall distribution in selected stations on Peninsular Malaysia and East Malaysia is listed in Table 4.2.

Average monthly maximum temperatures range from 29 to 34 °C and average monthly minimum temperatures range from 21 to 24 °C in Peninsular Malaysia at low altitudes. Differences in temperature during the year and from place to place are small, and the temperatures are suitable for oil-palm cultivation at altitudes below 500 m throughout Peninsular Malaysia. Figure 4.2 gives the relief of Peninsular Malaysia.

Sunshine at lower altitudes is not less than 2100 h annually and this is suitable for oil palms. The topography of the area where the climatic factors are suitable for oil palms is generally flat or undulating and so suitable in this way. Coastal

Fig. 4.1–4.3. Federation of Malaysia with rainfall zones (4.1), altitude (4.2) and production per state (4.3) in Peninsular Malaysia. After Hamidon (1980), Williams & Hsu (1970).

Table 4.2. Distribution of monthly rainfall for selected stations (mm).

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Alor Setar	46	62	111	197	239	183	206	215	298	303	221	85	2166
Kota Bharu	185	71	91	91	115	134	151	168	189	307	700	550	2752
Kuala Trengganu	185	107	112	99	106	111	105	145	183	272	672	536	2633
Ipoh	166	139	188	250	221	144	152	153	193	298	285	233	2422
Kuala Lumpur	173	145	225	295	198	133	125	146	185	269	265	234	2393
Muar	125	120	171	227	203	234	233	230	220	232	230	161	2386
Mukah	670	425	305	162	153	174	157	192	254	273	308	482	3555
Kota Kinabalu	128	65	72	112	209	321	273	256	318	341	289	212	2596

Source: Oldeman & Frère (1982)

areas may have poor natural drainage and a drainage system is then required.

Soils. The coastal clays along the west coast of Peninsular Malaysia are rich in nutrients, have good physical characteristics and have an adequate moisture-holding capacity. They are excellent for oil palms and the highest yields are obtained on these soils. It is estimated that there are 800 000 ha of these coastal clays, partly planted with rice, other food crops and coconut. There are several other suitable soil types, which are sufficiently deep, have a good structure for root development and have a good moisture-holding capacity. These soils are from various parent materials but are grouped for practical purposes under 'inland soils'. Generally they require more fertilizer than the coastal soils and are slightly less productive. The total area of soils suitable for oil palms in Peninsular Malaysia is estimated by Ng Siew Kee (1968) at 3.2 million hectares, mainly situated in the southern half. In addition to this area, there are 1.5 million hectares marginally suitable.

In summary, climatic and soil conditions in extensive areas of Peninsular Malaysia are suitable for cultivation of oil palms.

In East Malaysia, annual rainfall ranges from 2000–4000 mm. There is a drier season in February, March or somewhat later, depending on the region, but months with an average precipitation of less than 100 mm are an exception. Temperature fluctuations at lower altitudes are small; monthly maximum temperatures range from 29 to 33 °C and monthly minimum temperatures range from 23 to 24 °C. The average annual duration of sunshine ranges from 1800 to 2600 h, values suitable for oil palm. Although information about East Malaysia is not as detailed as for Peninsular Malaysia, climatic conditions are very suitable for oil-palm cultivation in large parts of both provinces.

Table 4.3. Development of oil palm area (1000 ha).

1925	3.2
1930	20.0
1940	31.0
1950	38.8
1960	54.6
1970	295.0
1980	1021.0

Sources: PORIM (1981), Dept. of Statistics, various publications

4.3 The oil-palm sector

4.3.1 History

Development of the oil-palm industry in Malaysia can be divided into three periods. The first runs from 1875 to 1916 during which seeds were imported from various sources. Oil palms were generally grown for ornamental purposes but the Department of Agriculture started the first trials. The second period started in 1917 with the first commercial planting and ended in 1960. The area increased gradually to 54 000 ha but oil palm remained of minor importance relative to rubber, the main plantation crop with 1600 000 ha in 1960. The third stage is the stage of rapid development. Since 1960, the oil-palm area increased at an average rate of 16 % per year until 1982 (Table 4.3).

4.3.2 Developments since 1960

The Malaysian economy in the 1950s was strongly oriented towards production of rubber, tin and iron ore for export. Manufactured consumer goods and supplementary food was imported. The need for diversification of exports and industrial development was recognized as early as 1955 but favourable rubber prices were no incentive for major changes. The situation changed in the early 1960s. Rubber prices showed a downward trend and competition from synthetic rubber resulted in pessimism about long-term prospects. The demand for edible oil increased and cost calculations based on expected market prices showed that oil palm was a more profitable investment than rubber. Both estate companies and government shifted their attention to oil palm. The expansion of the oil-palm area on estates took place through replanting of rubber land with oil palm, as virtually no new land was allocated to estates. The government decided to open up large areas of virgin forest to provide employment opportunities for individual farmers grouped together in settlement schemes. The programme was arranged by the Federal Land Development Authority (FELDA), other agencies and State Governments through the implementation of settlement projects for smallholders. In addition to these projects, smallholders growing rubber were encouraged to replant with oil

palm by replanting grants. The efforts of government and estate companies resulted in an enormous expansion of oil-palm cultivation (Table 4.4). The figures show an average rate of expansion of 18 % per year between 1960 and 1970, and 13 % per year increase between 1970 and 1980. FELDA became the largest single producer and in 1982 the government schemes plus some individual smallholders accounted for about 47 % of the total area planted.

In the same period, the rubber area remained around 2 million hectares, but the share of the estates in the total area declined and that of the smallholders increased. Coconut is of lesser importance than rubber as a competing crop for oil palm and only in coastal areas can both crops be cultivated. Coconut has gained as a smallholder crop and declined somewhat as estate crop since 1965. Data on rubber and coconut areas are given in Table 4.5.

Table 4.4. Area under oil palm per group of producers (1000 ha).

	Estates	Land Schemes			Others[3]	Total
		FELDA[1]	RISDA[2]	Sabah & Sarawak		
1960	54.6	–	–	–	–	54.6
1965	84.1	11.0	–	–	–	95.2
1970	214.2	64.7	–	11.9	4.8	295.6
1975	389.8	181.4	5.1	33.4	31.0	640.7
1976	415.7	207.4	8.3	41.9	40.2	713.5
1977	444.9	239.1	19.1	45.3	38.6	787.0
1978	480.8	255.3	26.4	49.1	45.0	856.6
1979	509.3	282.7	23.8	53.5	72.2	941.5
1980	545.5	307.6	22.0	55.8	90.6	1021.5
1981	590.7	335.7	23.2	182.5		1132.1
1982	645.7	356.5	24.0	200.3		1226.5

1. Federal Land Development Authority.
2. Rubber Industry Smallholders Development Authority, figures refer to blockplantings only.
3. State schemes and individual smallholders.

Sources: Department of Statistics, various publications; PORLA (1981a)

Table 4.5. Rubber and coconut areas (1000 ha).

	Rubber			Coconut		
	estates	smallholders	total	estates	smallholders	total
1965	780	1200	1980	26	170	196
1970	670	1330	2000	22	188	210
1975	580	1390	1970	17	213	230
1980	580	1420	2000	20	230	250

Source: Department of Statistics (1982)

Four factors were of major importance for the rapid expansion of the oil palm stated above:

- Climate and soils in extensive areas of Malaysia are suitable for oil palm.
- Virgin land was available and the government had the authority to allocate this.
- The plantation system present in Malaysia for rubber production could be readily adapted to oil palm.
- New technology, initially based on research elsewhere, became available in the fields of agricultural production techniques, plant breeding and processing.

Production of palm oil and kernels increased more than expansion of the area as yields of palm oil rose from 2.3 t/ha and of kernels from 0.6 t/ha in 1960 to 3.8 and 0.8 t/ha, respectively, in 1980 (Table 4.6). The production of crude palm oil and kernels increased by 17 % per year from 1960 until 1970 and by 20 % per year from 1970 until 1980. Production of kernels, and to a lesser extent palm oil, was boosted in 1982 by the release of the weevil, resulting in improved pollination. The kernel-extraction ratio rose to 6 %, a 33 % increase. Production declined in 1983, most likely because the sudden increase in production exhausted the palms. The long-term effect of the weevil is not yet certain, but it is likely that yield components, such as fruit-to-bunch ratio and kernel-to-fruit ratio, will change resulting in other yields of oil and kernels.

Oil-palm products are mainly produced for export and the amount exported increased with production. The type of products exported changed after 1975. From that year, the local refinery industry received a tax incentive. By 1980 more than 90 % of the palm oil exported was in the form of processed palm oil. The export of palm kernels stopped in 1972 and since then kernel oil and kernel meal have been exported. Export figures for selected years are given in Table 4.7.

Developments since 1960 were not merely a quantitative increase; the total plantation sector and the oil-palm industry changed drastically. Production and

Table 4.6. Production of crude palm oil and kernels (1000 t).

	Palm oil	Palm kernels
1960	91.8	23.7
1965	150.4	34.4
1970	431.1	93.1
1975	1259.6	257.6
1976	1392.0	256.0
1977	1612.7	310.6
1978	1785.5	339.8
1979	2188.7	441.0
1980	2573.2	552.4
1981	2821.7	613.3
1982	3510.9	904.6
1983	3016.5	834.6

Sources: Dept. of Statistics (1982), PORLA (1981a), MEOMA (1983)

Table 4.7. Exports of oil palm products (1000 t).

	Palm oil		Palm kernels		
	crude palm oil	processed palm oil	palm kernels	kernel oil	kernel cake
1960	97.6	–	.	–	–
1965	141.5	–	.	–	–
1970	401.9	–	28.9	–	–
1975	957.4	203.2	–	109.1	.
1976	877.4	458.0	–	123.6	.
1977	701.0	726.0	–	105.0	.
1978	574.0	935.5	–	135.1	.
1979	358.2	1543.2	–	203.4	.
1980	197.7	2086.0	–	214.9	255.9
1981	138.8	2346.7	–	242.2	266.3
1982	126.0	2737.0	–	289.4	320.2
1983	3164.5		–	368.7	.

Sources: see Table 4.6

Table 4.8. Oil palm areas in Sabah and Sarawak (1000 ha).

	Sabah	Sarawak	Malaysia
1970	34.1	0.6	295.6
1975	58.0	14.1	640.7
1980	92.1	22.7	1021.5
1982	127.0[1]	27.0[1]	1226.5

1. Preliminary figures.
Sources: Dept. of Statistics, various publications, MOPGC (1982b)

trade of crude palm oil in the 1960s were dominated by three large foreign based, international estate companies. Now, most of the production area is in Malaysian hands and there is a thriving processing industry producing a range of palm-oil products. The organization of the oil-palm industry will be dealt with in Section 4.3.3.

The developments took place mainly in Peninsular Malaysia, as palm-oil production on Sabah and Sarawak started later. The developments in Sabah and Sarawak and the total area in Malaysia are listed in Table 4.8. The share of Sabah and Sarawak in the total oil-palm area is 10 % and 2 %, respectively. In Sabah, half the area is in the hands of private estates and the other half is under government schemes and smallholders. In Sarawak, 80 % of the area is under the control of government schemes and the remaining 20 % is for private estates and smallholders.

4.3.3 Organization

Crude palm oil and kernels are produced by smallholders and public estates and by private estates. Government agencies such as the Federal Land Development Authority (FELDA) and the Rubber Industry Smallholders Development Authority (RISDA) dominate the public sector. Most private estate companies are controlled by Malaysian interests, since the largest companies were taken over by purchase of shares on the stockmarket. The producers of palm oil are organized in the Malaysian Oil Palm Growers' Council. The Incorporated Society of Planters, of which individual people are members, is one of the oldests organizations in the estate sector in Malaysia.

Crude palm oil is processed in 68 refineries with a total capacity of 3.53 million tonners of crude palm oil per year (1982). These refineries are either independent enterprises or are owned by estate companies. The refiners are organized in the Palm Oil Refiners Association of Malaysia, PORAM.

Kernels are processed in palm-kernel crushing mills of which 129 were licensed at the end of 1982. The Malaysian Edible Oil Manufacturers' Association (MEOMA) represents this section of the industry.

The larger estate companies comprise estates as well as refineries, kernels crushing mills and bulking installations at the main harbours. FELDA, the largest

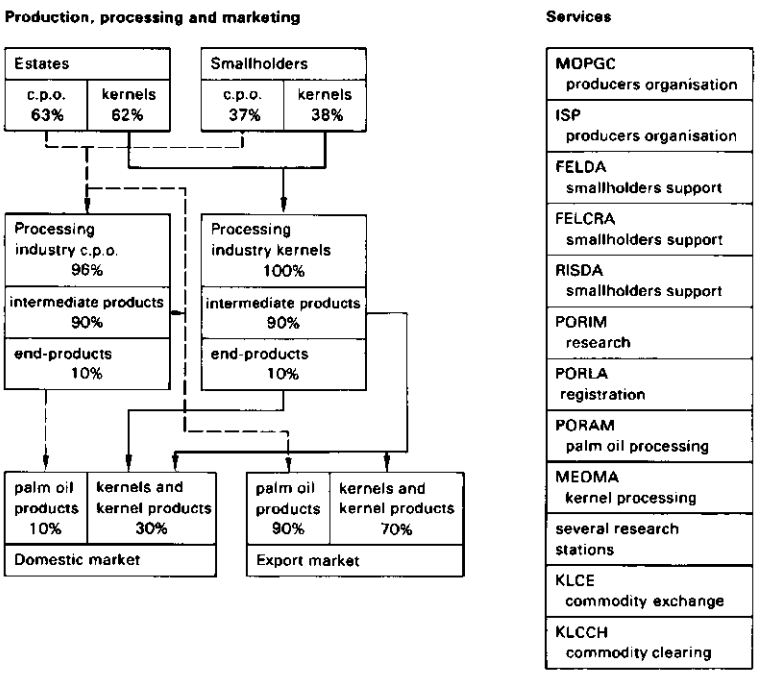

Fig. 4.4. The oil-palm sector in Malaysia, 1982. Broken line, palm oil and palm-oil products; solid line, kernels and kernel products.

single producer, controls several subsidiaries and joint ventures in fertilizer production, manufacturing of processing equipment and marketing as well.

The estate sector is served by several consultancy firms providing management services and advice, for instance on feasibility of proposed investments. The oil-palm sector is served by brokers, dealers, surveyors, chemists and bulking installation operators providing specialized services. They all have to be licensed.

The Kuala Lumpur Commodity Exchange started in 1980 with trading in palm-oil futures.

The Palm Oil Registration and Licensing Authority (PORLA) was inaugurated in 1977. This authority comprises members of both the government and industry. It regulates, coordinates and promotes all activities in the oil-palm sector. The registration and licensing of the various categories of people operating in the oil-palm sector is one of the tasks of the authority.

The Palm Oil Research Institute of Malaysia (PORIM) was established in 1979 with the objectives of conducting research and development in biology, chemistry and technology, end-use, techno-economic studies and technical advisory services for the palm-oil sector.

The government plays a major role in the oil-palm sector by direct participation in production, processing and marketing through several agencies, by regulation and licensing and by stimulation of research. The latter functions are carried out by specialized organizations governed by representatives of the government and representatives of the various private interests in the oil-palm sector.

An outline of the oil-palm sector is given in Figure 4.4.

4.4 Production of crude palm oil and kernels

4.4.1 Production factors

Land, in the form of virgin forest, is still available in Peninsular Malaysia, Sabah and Sarawak, but the most suitable areas are occupied to a large extent. The Federal Government and State Governments are authorized to allocate land to estate companies or development agencies like FELDA. Private entrepreneurs pay a land premium of $175/ha once in the first year of development. After that, a 'Quit Rent' is paid of about $30/ha per year.

Two crops compete with oil palm for the same type of land: rubber; and coconut with cocoa. Several studies showed that oil palm gives better returns on investment than rubber. Anuwar Mahmud (1982) gives internal rates of return of 17 % for rubber, 24 % for oil palm and 28 % for coconut with cocoa in 1975; Nor (1978) compares oil palm and rubber on four soil classes and shows that oil palm gives the highest returns on the two best soil classes, if slopes are less than 12 % and if areas with distinctly dry weather are avoided. The relatively strong position of oil-palm cultivation resulted in expansion of the area on new land as well as in conversion of rubber lands to oil palm. The area under coconut with cocoa in-

creased as well (Table 4.5).

Availability of labour is one of the main problems on estates. Studies by the United Planting Association of Malaysia in 1980 showed that only 83 % of the number of working days offered for oil-palm harvesting were filled. In more recent publications (Anuwar Mahmud, 1982), the increasing shortage of labour for harvesting and handling of fruit bunches on estates is stressed. Research in labour-saving techniques is undertaken by PORIM and other organizations. The cost of labour in 1982 was \$11/d for estate workers; \$14/d for harvesters and about \$800–1000/month for office staff.

In the early 1960s, capital for oil-palm development was obtained from domestic and foreign sources. Now, the oil palm expansion by estates and agencies is financed from domestic resources.

4.4.2 Producers and production systems

About half the area under oil palm consists of estates. Most of the estates are owned by private people or groups of private people and the remainder are owned by State Governments. These State Governments may develop estates with wage-earning workers as a source of state income. Joint ventures with private enterprises are possible too and no division is made in the statistics between state estates and private estates. The estates in Malaysia classified according to size and ownership are listed in Table 4.9. Of the 874 estates in Peninsular Malaysia, 288 are purely oil-palm estates, 291 cultivate oil palm as principal crop and

Table 4.9. Estates in Malaysia, ownership and total areas (1000 ha).

Size category (ha)	Ownership						Total	
	Malaysian residents		Non-Malaysian residents		Joint ownership		number	area
	number	area	number	area	number	area		
Peninsular Malaysia								
0- 80	238	10.5	35	1.2	1	0.06	274	11.8
81- 201	159	20.5	22	2.8	–	–	182	23.3
202- 404	95	28.4	30	9.4	–	–	124	37.8
405- 809	74	40.0	27	15.4	–	–	101	55.4
810-1213	36	36.0	11	11.3	–	–	47	47.3
1214-2023	48	76.2	29	45.3	1	1.80	78	123.2
2024-above	46	122.1	22	74.5	–	–	68	196.6
subtotal	696	333.6	176	159.9	2	1.86	874	495.4
Sabah	53	.	5	.	–	–	58	46.1
Sarawak	–	–	1	.	–	–	1	3.9
Total	749	.	182	.	2	.	933	545.5

Source: Department of Statistics (1982)

the remaining 295 have rubber or sometimes coconut or tea as main crop. About two-thirds of the oil-palm area is owned by Malaysian residents, the remaining third by non-Malaysian residents. The classification by size shows that 65 % of the area is on estates larger than 1214 ha. A few large estate companies, Harrisons Malaysian Plantations Bhd, Kumpulan Guthrie Sendirian Bhd and Sime Darby Plantations Bhd, with 75 000–85 000 ha of oil palm and rubber each play a major role as they have their own research stations and seed production units. Most estates in Sabah are owned by Malaysian residents; information about size classification is not available.

Several federal and state organizations are involved in smallholder production through land development schemes. FELDA, the Federal Land Development Authority, develops settlement schemes on jungle land, provides a comprehensive package of services to the settlers on the schemes, deals with processing and trade in crude palm oil and kernels and is involved in production and supply of inputs. FELDA schemes are generally more than 2000 ha. The initial development activities of a scheme such as jungle clearing, establishment of the oil palms, building of houses and basic social amenities is done by contract labour. Afterwards, settlers are allotted 4 ha. The costs of land development and house are repaid by the settlers in a period of 15 years. Fruit bunches are sold to a central oil-mill run by a FELDA subsidiary. FELDA provides intensive supervision at all stages. Most of the FELDA schemes are planted with oil palms, 256 500 ha until 1982, but there are also schemes with rubber, sugar or cocoa planted.

FELCRA, the Federal Land Consolidation and Rehabilitation Authority, deals with rehabilitation of earlier developed low cost State Schemes and with increasing the basic land resources of existing villages by opening up jungle or unused land. In some ares, FELCRA has also taken over previously started Youth Land Schemes. The FELCRA schemes too provide a comprehensive package of advise, inputs, finance and services to participating smallholders. FELCRA rehabilitated or developed 21 000 ha of oil palm and 43 000 ha of rubber up to 1980 and plans are being made for further expansion.

The Rubber Industry Smallholders Development Authority (RISDA), Block Plantings are financed by rubber replanting grants, which are used to replant rubber as well as oil palm. A total of 24 000 ha of oil palm was developed by RISDA at the end of 1982.

State Land Schemes are usually smaller than the FELDA schemes and the infrastructure provided is limited. These scheme play a major role in Sabah and Sarawak.

The oil-mills are integrated in the estates or are centrally sited in the land development schemes among the smallholdings. At the end of 1982, there were 234 mills approved by PORLA producing crude palm oil with a total capacity of 6526 t of f.f.b per hour. The average installed capacity per mill is 28 t/h.

4.4.3 Costs

The cost data given in Sections 4.4.3.1 to 4.4.3.3 are based on average costs for estates and settlements computed by PORIM, data from estate companies, feasibility studies and actual estate data. The costs of each activity vary between sources but the range is narrow, usually about 20 % or less, and this makes it possible to give average figures. A distinction is made between two soil types, inland soils and coastal soils, as land preparation costs, costs of fertilizer and yield are widely different. All data refer to 1982.

4.4.3.1 Investment costs

Field establishment. Generally the period lasts three and a half years. Land preparation is mechanical, generally by contractors. The establishment of roads, drains and terraces requires more investment on coastal soils as the drainage system is often elaborate. On these soils, about 60 % of the amounts of fertilizer required on inland soils are used, so compensating the higher costs for drains (Table 4.10).

Vehicles. Various types of transport are used on estates. Bunches from the tree can be carried to collecting points by hand, with buffaloes and carts, with tractor and trailer or with a dump-truck, a small vehicle with capacity of 0.5–1.0 t of f.f.b.

Table 4.10. Field establishment costs on inland and coastal soils.

	In year		(M$/ha)		Total	
	1	2	3	4	(M$/ha)	(US$/ha)
Land preparation[1]						
inland soils	850	–	–	–	850	360
coastal soils	1050	–	–	–	1050	450
Roads, drains, etc.[2]						
inland soils	350	–	–	–	350	150
coastal soils	450	–	–	–	450	190
Ground cover	150	–	–	–	150	60
Planting[3]	500	40	–	–	540	230
Fertilizer						
inland soils	200	240	350	160	950	410
coastal soils	120	145	250	85	600	260
Upkeep	320	680	600	200	1800	770
General charges	300	300	300	150	1050	450
Total inland soils	2670	1260	1250	510	5690	2430
Total coastal soils	2890	1165	1150	435	5640	2410

1. Including clearing, felling and burning of forest or old oil palms, mainly with heavy equipment.
2. Establishment of new road and drainage system.
3. 138 palms/h.

From collecting points, produce is carried to the mill by rail or by tipping truck with a hydraulic crane. The capital costs for an estate of 4000 hectares with tractors and trailer for collection and with tipping trucks with hydraulic crane for further transport are listed in Table 4.11. The investment costs are $226/ha or $97/ha.

Oil mill. Most equipment for oil-mills is produced in Malaysia. The FELDA organization has its own construction services subsidiary. Foreign producers of mill equipment have offices in Kuala Lumpur and provide screw-presses, turbines and other high technology equipment. One supplier gave the cost estimates listed in Table 4.12. The costs per tonne of f.f.b. per hour decline with increased mill capacity but the difference between mills processing 30 and 60 t of f.f.b per hour is small. The equipment used in all these factories is fairly standard and the basic unit is a 10 to 12 t screw-press with supply line. Economies of scale are due to less costs for civil works and construction for larger oil-mills. All mills are required to install an effluent treatment unit. The cost for a unit for a mill of 30 t of f.f.b per hour ranges from $250 000 to 1000 000, $107 000 to 427 000, depending on the system used. Trials are under way to use the effluent for fertilizer and to produce methane gas. The introduction of the weevil resulted in modification of oil-mills. Better pollination results in a better setting of the bunches and the more compact bunches require a longer sterilization time, thus the sterilization units require ex-

Table 4.11. Vehicles required for a 4000 ha estate.

	Number of units	Unit costs (M$ 1000)	Total costs	
			(M$ 1000)	(US$ 1000)
4 wheel drive	3	30.0	90.0	38.5
Tractor	8	36.0	288.0	123.1
Trailer	12	7.5	90.0	38.5
Grader	2	55.0	110.0	47.0
Tipping truck with crane	6	54.0	324.0	138.5
Total			902.0	385.6

Table 4.12. Investment costs for oil mills with different capacity.

Capacity (t f.f.b./h)	Total		Costs per t f.f.b./h	
	(M$ million)	(US$ million)	(M$ million)	(US$ million)
10-12	5.0	2.1	0.45	0.19
20-24	8.5	3.6	0.39	0.17
30-36	10.0	4.3	0.30	0.13
60-72	18.0	7.7	0.27	0.12

Source: Palm service SDN BHD, personal communication

tension. The higher proportion of kernels results in extension of the unit separating fibre from nut and kernel-recovery unit.

Total investment costs for a mill depend on size, position, amount of civil works required and availability of water supply. An average of $10 million ($4.3 million) is taken for a mill of 30–36 t of f.f.b. per hour. The capacity required per hectare is calculated with the following assumptions: yield 20 t of f.f.b. per hectare per year; production in peak month 15 % of annual production; pressing time in peak month 500 h. The required capacity is: 20 × 15 % / 500 = 0.006 t of f.f.b. per hectare per hour. The factory of 30–36 t of f.f.b. per hour has sufficient capacity for 6000 ha. Investment costs are $1670/ha or $714/ha.

Buildings. Staff of estate and mill are housed in estate houses. The proportion of labourers housed on the estate varies with the situation of the estate. The proportion is smaller if estates are near urban centres. Table 4.13 assumes that 50 % of the work force is housed in estate houses. The other buildings include office, stores, garage, créches, dispensary and a school.

Yields on coastal soils are higher than on inland soils and this results in higher investment costs per hectare for vehicles, oil mill and buildings. However several assumptions are made about transport requirements for bunch transport, production in the peak month, pressing time in peak month and proportion of labourers housed on the estate. Average figures are listed but actual figures vary, being in-

Table 4.13. Investment costs for buildings for a 4000 ha estate.

	Number of units	Unit costs (M$ 1000)	Total costs	
			(M$ 1000)	(US$ 1000)
Houses				
manager	1	150	150	64
assistent manager	6	95	570	244
other staff	30	38	1140	487
labourers	500	9.5	4750	2030
subtotal			6610	2825
Other buildings			250	107
Total			6860	2932

Table 4.14. Investment costs per hectare.

	(M$)	(US$)	Share of total (%)
Field establishment (year 1-4)[1]	5665	2420	61
Vehicles	226	96	2
Oil mill	1670	714	18
Buildings	1715	733	19
Total	9276	3963	100

1. Average costs on inland and coastal soils.

dependent of whether estates are on inland or coastal soils. The effects of different assumptions is such that a distinction between investments on coastal soils and inland soils is merely arithmatic. The investment costs per hectare are listed in Table 4.14.

4.4.3.2 Operating costs

Production of fruit bunches. The costs for the three main activities and the division into components are listed as far as possible in Table 4.15. The calculation of cost per tonne of f.f.b. was based on a yield of 18 t of f.f.b. on inland soils and 22 t of f.f.b. on coastal soils. An average cost of transport of fresh fruit bunches of $6 per tonne was used, which is somewhat high for the modern 'kulim system' with nets and a hydraulic crane mounted on a tipping truck and is low for a railway system. The difference between the two soil types is considerable, as higher costs on inland soils are combined with a lower output than on coastal soils.

Processing costs. The processing costs quoted by various sources range from $14.00 to $20.00 per tonne of f.f.b. and averaged $17.00 per tonne in 1982. Crude palm oil is sold ex estate or delivered to bulking installation or refiner. Prices are quoted on delivered basis and therefore transport costs are included under forwarding and distribution. The costs of gunny bags for kernels are included as well. An average oil-extraction ratio of 20 % and a kernel-extraction ratio of 6 % is used in Table 4.16 for the conversion of cost per tonne of f.f.b. into cost per tonne of product.

Table 4.15. Production costs fruit bunches.

	Inland soils				Coastal soils			
	per hectare		per tonne f.f.b.		per hectare		per tonne f.f.b.	
	(M$)	(US$)	(M$)	(US$)	(M$)	(US$)	(M$)	(US$)
Upkeep and cultivation								
labour (20 d/ha)	220	94	12.2	5.2	220	94	10.0	4.3
fertilizer[1]	325	139	18.1	7.7	190	81	8.6	3.7
other materials	80	34	4.4	1.9	80	34	3.6	1.5
subtotal	625	267	34.7	14.8	490	209	22.2	9.5
Harvesting								
labour (1.3 d/t f.f.b.)	315	135	17.5	7.5	385	165	17.5	7.5
materials	9	4	0.5	0.2	11	5	0.5	0.2
subtotal	324	139	18.0	7.7	396	170	18.0	7.7
Transport incl. collection	108	46	6.0	2.6	132	56	6.0	2.6
Total	1057	452	58.7	25.1	1018	435	46.2	19.8

1. 965 kg/ha on inland soils; 550 kg/ha on coastal soils.

Table 4.16. Processing costs.

	Per tonne f.f.b.		Per tonne product	
	(M$)	(US$)	(M$)	(US$)
Processing				
labour (1.5 d/t product)	5.1	2.2	19.6	8.4
spares and materials	8.2	3.5	31.6	13.5
other	3.7	1.6	14.2	6.1
subtotal	17.0	7.3	65.4	28.0
Forwarding and distribution[1]	3.4	1.4	13.1	5.5
Total	20.4	8.7	78.5	33.5

1. Transport of crude palm oil and gunny bags for kernels.

General charges include costs for management, agency fees, office expenses, upkeep of buildings and compounds, medical welfare, water and electricity, and land rent. The annual for land rent, called quit rent, is $30/ha ($13/ha). Average general charges are $300/ha ($128/ha) for a year.

The interest costs of capital invested in estate and mill and the interest costs of the required cash for working capital are calculated below:
10 % of 50 % of invested capital = $464/ha ($198/ha)
10 % of 25 % of annual operating costs = $43/ha ($19/ha)
total annual interest costs = $507/ha ($217/ha)

4.4.3.3 Production costs

The costs outlined in the previous sections are summarized in Table 4.17. The average investment costs per hectare (Table 4.4) were used to calculate the depreciation. For the conversion of data per hectare to data per tonne of f.f.b. an average yield of 20 t of f.f.b. per hectare was used. The following depreciation rates are used: 4 % for field establishment; 20 % for vehicles; 8 % for the oil-mill; 2.5 % for buildings.

The operating costs are 83 % of the total costs. Operating costs per hectare are the same for both soil types but differ clearly per tonne of f.f.b. or per tonne of product because of the difference in yield. The combined costs for interest and depreciation amount to 36 % of the total production costs and this points to the important role of financial institutions for production of perennial crops requiring processing facilities.

4.4.4 Returns

Yields. The yield of palm oil increased from 2.3 t/ha in 1960 to 3.4 t/ha in 1980, at an average annual rate 2.4 % per year. The yield of kernels increased less in the same period, from 0.6 t/ha to 0.75 t/ha, or 1.1 % per year. The difference in

Table 4.17. Production costs oil-palm products on inland soils and coastal soils.

	Per hectare		Per tonne f.f.b.		Per tonne product	
	(M$)	(US$)	(M$)	(US$)	(M$)	(US$)
Operating costs inland soils						
upkeep and cultivation	625	267	34.7	14.8	133.5	57.1
harvesting	324	139	18.0	7.7	69.2	29.6
transport	108	46	6.0	2.6	23.1	9.9
total bunch production	1057	452	58.7	25.1	25.8	96.6
processing	306	131	17.0	7.3	65.4	27.9
forwarding and distribution	61	26	3.4	1.5	13.1	5.6
general charges	300	128	16.7	7.1	64.1	27.4
interest	507	217	28.2	12.0	108.3	46.3
subtotal	2231	954	124.0	53.0	476.7	203.8
Operating costs coastal soils						
upkeep and cultivation	490	209	22.2	9.5	85.7	36.6
harvesting	396	170	18.0	7.7	69.2	29.6
transport	132	56	6.0	2.6	23.1	9.9
total bunch production	1018	435	46.2	19.8	178.0	76.1
processing	374	160	17.0	7.3	65.4	27.9
forwarding and distribution	75	32	3.4	1.5	13.1	5.6
general charges	300	128	13.7	5.8	52.4	22.4
interest	507	217	23.0	9.8	88.6	37.9
subtotal	2274	972	103.3	44.2	397.5	169.9
Depreciation capital						
field establishment	227	97	11.4	4.9	43.7	18.7
vehicles	45	19	2.3	1.0	8.7	3.7
oil-mill	134	57	6.7	2.9	25.8	11.1
buildings	43	18	2.2	0.9	8.3	3.6
subtotal	449	192	22.6	9.7	86.5	37.1
Total						
inland soils	2680	1146	146.6	62.7	563.2	240.9
coastal soils	2723	1164	125.9	53.9	484.0	207.0

annual increase indicates that research has been directed primarily to to oil production. The yields showed a sharp increase in 1982 with the introduction of the weevil. The average bunch production reached nearly 18 t/ha, which resulted in 3.6 t of crude palm oil per hectare (oil-extraction ratio 20.5 %) and 0.9 t of kernels per hectare (kernel-extraction ratio 5.3 %). In 1983, production declined and an equilibrium should be established after several years with about the same yield trend but with a higher kernel-extraction ratio.

Prices. Recent prices of crude palm oil delivered at bulking installations or refinery, and of palm kernels are listed in Table 4.18. The prices reflect the prices

Table 4.18. Prices of crude palm oil delivered basis and kernels ex mill.

	Crude palm oil		Palm kernels	
	(M$/t)	(US$/t)	(M$/t)	(US$/t)
1977	893	382	639	273
1978	1069	457	655	280
1979	1038	444	869	371
1980	919	393	487	208
1981	964	412	490	209
1982	829	354	425	182
1983	991	427	678	292

Sources: PORLA (1981a, 1983, 1984)

on the world market but price variations on the world market are reduced for the producer through the export duty on palm oil-exports (Section 4.6.3). The prices for crude palm oil and kernels in 1982, $829/t and $425/t, respectively, resulted in a product price of $746/t or $319/t with the stated oil-extraction and kernel-extraction ratios.

4.4.5 Review costs and returns

The prices per tonne of product received by the estates in the period 1977 to 1982 were well above production costs and oil palm must be regarded as a profitable enterprise. Local prices before 1977 are not available but a review of f.o.b. prices and taxation policy (Section 4.6.3) shows that oil palm must have been profitable since at least 1970. The continuous expansion of the area under oil palm is further proof that oil palm has been profitable and is expected to remain profitable in future.

The input-output data (Table 4.19) are based on the national averages for yield and yield factors mentioned in Section 4.4.4. and on average operating costs per hectare converted to inputs per tonne of product with the ratios listed in Table 4.19. A proportion of the field establishment cost, $2850/ha, refers to materials and services supplied to the estate and the non-factor costs are derived from this amount. Vehicles, oil-mill and buildings are bought or build by contractors and the total investment costs are used to compute the inputs per tonne product.

The labour input of 11.4 days per tonne of product is equivalent to 52 d/ha or about 4.5–5 ha in production per labourer. Non-factor inputs account for 36 % of production costs and the external effects of production of palm oil and kernels on other sectors in the economy are considerable.

Table 4.19. Input-output data.

Output per hectare	Quantity		Domestic price		Value	
	(t)	ratio (%)	(M$/t)	(US$/t)	(M$)	(US$)
F.f.b.	17.7					
C.p.o.	3.62	20.5	829	354	3001	1281
Kernels	0.93	5.3	425	182	395	169
Total product	4.55	25.8	746	319	3396	1450

Inputs per tonne product	Quality	Costs	
		(M$)	(US$)
Land	0.22 ha	p.m.	p.m.
Labour			
upkeep (20 d/ha/yr)	4.4 d	46.90	20.00
harvesting (1.3 d/t f.f.b.)	5.0 d	67.30	28.80
transport (0.1 d/t f.f.b.)	0.5 d	7.70	3.30
mill	1.5 d	16.50	7.10
subtotal	11.4 d	138.40	59.20
Non-factor inputs			
from operating costs			
fertilizer (750 kg/ha)	165 kg	56.10	24.00
other materials		57.70	24.60
depreciation investments			
field establishment		25.10	10.70
vehicles		9.90	4.20
oil mill		29.40	12.50
buildings		9.40	4.00
subtotal		187.60	80.00

4.5 Processing

Two types of processing industry are based on oil-palm products: the refining industry processes crude palm oil into products such as neutralized palm oil, olein and stearin; the palm-kernel-crushing industry produces palm-kernel oil and kernel cake. The major part of the processed products is exported and the rest is used locally, for instance in the food industry. The refining industry has built up rapidly since 1975, greatly assisted by the export-duty rebate on refined products.

By 1982, 51 refineries were in operation and 17 were in various stages of implementation. Most refineries are situated around Kuala Lumpur and in Pasir Gudang. One refinery is in operation in Sabah. The total capacity of all 68 refineries is 3.53 million tonnes, about the total production of crude palm oil in Malaysia in 1982. The increasing competition among refineries resulted in high prices for

crude palm oil relative to the f.o.b. prices of refined products, despite the export duty exemption on these products. PORLA (1982) states that '1982 was a dismal year for the palm-oil refinery sector. Profit margins were reduced and many refineries found it uneconomical to continue operation. No new license to refine crude palm oil was issued by the Ministry of Trade and Industry in 1982'. No data on costs and margins in the refining industry were available. The main processed palm-oil products are refined, bleached and deodorized (RBD) palm oil, RBD olein and RBD stearin with 35, 34 and 13 % of the total refined products respectively.

The palm-kernel-crushing industry faced similar problems regarding excess capacity and no new licences were issued in 1982 over the existing 129 licences for palm-kernel-crushing mills. The situation greatly improved in 1982 with the considerable increase in palm-kernel production, as a result of the introduction of the weevil. Details of costs and margins in the crushing industry are not available.

4.6 Marketing

4.6.1 Marketing channels

Oil-palm products are traded before and after processing. Main producers like FELDA and several private estate companies have close links with refineries, crushing factories and bulking installations through direct ownership or through participation in joint ventures. Other producers sell their crude palm oil and kernels to refiners and crushers, who in turn sell the processed products on the domestic market or to overseas buyers. In the trade in oil-palm products brokers and dealers operate, both types having to apply to PORLA for a licence.

4.6.2 Marketing functions

Transport of crude palm oil and refined products is by road tankers with a capacity of 10–20 t. Large producers operate their own transport fleet, whereas others make use of specialized transport companies. No data are available about the total number of road tankers in Malaysia but data from one large producer suggest that one tanker can handle 2500 t per year. This would mean a total of 1400 tankers. The change from export of crude palm oil to export of processed palm oil increased the required number of tankers as two trips must now be made with more time loss during loading and unloading.

Bulking installations. Palm-oil products are stored in bulking installations at ports before export. The main concentration of bulking installations is at Port Klang but they lie all along the coast of Peninsular Malaysia as well as in Sabah and Sarawak. In total, 24 bulking installations are listed. It is estimated that an installation can handle 8 times the tank capacity per year, which would mean that the total tank capacity of the bulking installations in Malaysia is about 400 000 t.

Bulking installations are basically suitable for crude palm oil and processed palm oil; for some of the refined products that are solid at ambient temperatures, an extra heating system must be installed.

4.6.3 Pricing, taxation and costs

The f.o.b. prices of crude palm oil, as given by the Department of Statistics, closely follow the prices on the world market, as can be expected from the leading position of Malaysia as exporter. The same applies to palm-kernel prices (Table 4.20). The border price for crude palm oil at delivered basis (f.o.b. price minus marketing costs from export harbour to place of delivery, Table 4.24) was \$884.50/t (\$378/t) in 1982 which is \$55.50/t (\$24/t) above the price received by the estate. The estimated border price for kernels was \$427/t (\$183/t), practically the same price received by the estate. The combination of both border prices into the product price results in \$791/t or \$338/t. Comparison of the price for oil-palm products locally delivered and the border price results in a nominal protection coefficient of (\$746/t)/(\$791/t) = 0.94.

The main factor between the f.o.b. price of palm-oil products and the local price on delivered basis (Table 4.18) is the ad valorem export duty. The export duty is based upon the monthly average f.o.b. prices of crude palm oil and processed palm oil calculated by the Royal Custom and Excise Department and published as 'gazetted f.o.b. prices'. The gazetted price may deviate slightly from the average f.o.b. price calculated by the Department of Statistics. The structure of

Table 4.20. Prices of crude palm oil and palm kernels.

	Crude palm oil			Palm kernels		
	world market[1] (US$/t)	f.o.b. Malaysia[2]		world market[3] (US$/t)	f.o.b. Malaysia	
		(US$/t)	(M$/t)		(US$/t)	(M$/t)
1970	260	209	641	168	142	434
1975	434	440	1055	207	191	458
1976	406	347	882	230	223	567
1977	530	498	1225	326	312	767
1978	600	508	1178	364	339	786
1979	654	598	1309	500	476	1043
1980	584	526	1146	345	268	585
1981	569	478	1100	317	.	.
1982	445	391	916	270	.	.

Sources:

1. Malaysian 5 %, c.i.f. N.W. Europe. (World Bank, 1984a)
2. Dept. of Statistics (1982).
3. Nigerian, c.i.f. U.K. (World Bank, 1984a).

the export duty is shown in Table 4.21. The starting point for the payment of export duty, $500/t, relates to production costs of crude palm oil. The MOPGC advises the government about this on the basis of their annual survey of production costs. The result of the equation used is that the proportion of the price above $500/t is taxed at a rate that increases with price, starting at 30 % for prices up to $549/t and rising, for example, to 45 % if the price reaches $1000/t.

Processed palm oil is partly or completely exempted from export duty; the rate of duty exemption depends on the category of refining: the more refined, the higher the exemption. Crude palm oil from Sabah or Sarawak receives a rebate of 30 % on export duty. The duty exemption on processed palm oil contributed to the rapid expansion of the refinery capacity since 1975. The great demand for crude palm oil by the refiners and exemption from duty on the export of processed palm oil resulted in local prices, delivered basis, for crude palm oil well above the average f.o.b. prices for crude palm oil minus export duty in recent years (Table 4.22). Thus the average f.o.b. prices for crude palm oil are no longer indicators for local prices. On the world market, the increased supply of processed palm oil resulted in a scarcity of crude palm oil and this, together with the tax exemption,

Table 4.21. Export duty structure for crude and processed palm oil, 1982.

Gazetted price (M$/t)	Duty formula[1]
less than 500	–
500 -549.21	0.30 p-150
549.21-598.42	0.35 p-177.46
598.42-647.63	0.40 p-207.38
647.63-696.84	0.45 p-239.76
more than 696.84	0.50 p-274.62

1. p is the gazetted price.
Source: PORLA (1981a and 1983)

Table 4.22. Prices of crude palm oil and processed palm oil.

	Crude palm oil			Processed palm oil	Share of crude palm oil in
	average f.o.b. price (M$/t)	export duty (M$/t)	local price delivered basis (M$/t)	Gazetted f.o.b. price (M$/t)	total export of palm oil products (%)
1979	1309	374	1038	1413	19
1980	1146	302	919	1310	9
1981	1100	275	964	1199	6
1982	916	183	829	1036	3

Sources: see Tables 4.18 and 4.20

led to the 'Singapore cocktail': processed palm-oil products, exported with tax exemption to Singapore, mixed again, and sold as 'crude palm oil'.

The f.o.b. prices of processed palm oil were $60 to 96 per tonne above the f.o.b. prices for crude palm oil but the system of duty exemption and the lack of information about processing costs makes linkage of the two prices impossible.

All palm kernels have been processed in Malaysia since 1975. Most of the kernel oil and the cake is exported. The price of palm-kernel oil on the world market fluctuates with the price of coconut oil (Table 4.23). No official data are available about the price of kernels ex estate during the past few years but an estimate for 1981 and 1982 results in prices of $490 and $425 per tonne. An export duty of 5 % of the f.o.b. price is levied on palm-kernel oil and meal.

Costs and margins. The various costs and margins for exported crude palm oil are listed in Table 4.24. The average local price, delivered basis (PORLA, 1982), and the average f.o.b. price for 1982, as given by the Department of Statistics, are taken as basis for calculations. Hardly any crude palm oil was exported in 1982 and this partly explains why the local price delivered, differs from the computed

Table 4.23. F.o.b. prices of kernel oil, kernel meal and coconut oil.

	Palm-kernel oil (M$/t)	Palm-kernel meal (M$/t)	Coconut oil (M$/t)
1979	1895	.	2111
1980	1352	.	1556
1981	1266	257	1128
1982	1071	259	1166

Sources: see Tables 4.18 and 4.20

Table 4.24. Crude palm-oil, price, costs and margins in 1982.

	M$/t	US$/t
Price of c.p.o. ex estate	815.0	348.3
Distribution to bulking installation/refinery	14.0	6.0
Local price, delivered (PORLA, 1982)	829.0	354.3
Local price, delivered (computed)	701.1	299.6
Bulking charges	14.0	6.0
Port charges	3.0	1.3
Secretarial and documentation fee	0.8	0.3
Brokerage and selling commission 1.5 % f.o.b. price	13.7	5.9
Export duty	183.4	78.4
F.o.b. price (Dept. of Stat.)	916.0	391.5
Marine insurance	2.8	1.2
Freight to West European port	152.2	65.0
C.i.f. Rotterdam	1071.0	457.7

local price starting from the f.o.b. price. Other reasons for the difference are competition among refiners for crude palm oil and the lower export duty on processed palm oil. Bulking charges and other costs for processed palm oil are similar to those stated for crude palm oil. Data on average export duty paid for processed palm oil are not available.

4.6.4 Export and domestic consumption

The export of palm-oil products has changed considerably over the past 8 years. There was the change from crude palm oil to processed palm oil. The destination shifted from countries in Western Europe and the United States to countries in Asia. Table 4.25 gives the export data in three years. The amount of palm-kernel oil exported changed but the destination remained unchanged (Table 4.26). Palm-kernel cake has been exported mainly to West Germany and the Netherlands in recent years. The value of the various exported oil-palm products is given in Table 4.27. Palm-oil products, processed and crude palm oil, are the main export products with a share of about 90 % of the total value of oil-palm products.

Data are not available on the size of the internal market in oil-palm products in Malaysia. Calculation of internal consumption by subtracting exports from total production is erratic, as the stock of crude palm oil and processed palm oil might fluctuate considerably and as refining results in losses of 1 to 5 %, depending on

Table 4.25. Export destination of palm-oil products (1000 t).

	1975		1980		1982[1]	
	c.p.o.	p.p.o.	c.p.o.	p.p.o.	c.p.o.	p.p.o.
FR. Germany	23	1	21	25	2	39
The Netherlands	164	1	80	106	40	112
United Kingdom	163	1	73	59	11	82
United States	263	75	–	120	–	68
Soviet Union	–	–	–	56	–	229
India	23	–	2	396	–	260
Iraq	75	–	–	26	–	27
Japan	51	9	1	142	–	95
Pakistan	10	–	4	113	–	193
Singapore[2]	49	107	4	650	1	425
Other in Asia	–	–	–	157	–	209
Other	136	9	13	236	5	241
Total	957	203	198	2086	59	1980

1. Figures cover the months January to September only, the total export quantities for 1982 were 12 600 t crude palm-oil and 2 735 000 t processed palm-oil.

2. The exports to Singapore are for the greater part re-exported. These exports follow the same pattern of destination as Malaysia exports.

Sources: Department of Statistics (1982), PORLA (1981a, 1983), Bank Negara Malaysia (1983)

Table 4.26. Export of palm kernel oil (1000 t).

	1976	1978	1980	1982
Japan	1.0	6.1	7.4	.
The Netherlands	25.1	28.1	59.1	130.2
Singapore	9.3	7.4	15.7	.
United Kingdom	20.8	13.2	12.9	31.7
United States	38.7	51.2	76.3	78.8
Other	28.6	23.4	43.4	.
Total	123.5	129.4	214.8	333.7

Sources: see Table 4.25

Table 4.27. Value of exported oil-palm products (million M$).

	1976	1978	1980	1982
Palm-oil products	1 220	1 872	2 604	2 776
Palm-kernel oil	121	185	299	334
Total	1 341	2 054	2 903	3 110

Source: Bank Negara Malaysia (1982, 1983)

the process. An estimate of the size of the domestic market in 1982 results in the following figures: 316 000 t of processed palm oil, 45 000 t of kernel oil and 209 000 t of kernel meal.

4.7 Supporting services

4.7.1 Research and advisory services

Research on agronomic and technological aspects of palm-oil production and processing has been carried out by the major private estate companies. The Chemara Research Station of Guthrie and the Oil Palm Research Station near Banking of Harrisons & Crosfield are two of the better known research institutes. More recently, the Agricultural Services Corporation of FELDA started operation. Main research topics are:

- Breeding and selection of superior planting material.
- Improved propagation through tissue culture.
- Various agronomic practices such as weed, pest and disease control and optimum planting density.
- Treatment and use of mill effluent.

The identification, testing and finally the release of the weevil, *Elaeidobius kamerunicus*, is the result of research in recent years. In addition to research, the stations provide germinated seed from selected palms and they advise on fertilizer

use. These services are provided to the company estates as well as to others.

In 1979, the Palm Oil Research Institute of Malaysia (PORIM) was established, which took over research by the oil-palm branch of MARDI, Malaysia Agricultural Research and Development Institute. The main areas of activity of PORIM are research in chemistry and technology of the extraction, processing and end-use of oil, on techno-economic studies in the Malaysian palm-oil industry, and the marketing of palm oil and other oils and fats on the world market. Research results are published in the half annually bulletin 'PORIM Bulletin' or as occasional papers. The Institute is governed by a board in which government, producers and the refining industry are represented. The Institute is financed through a cess of $4/t of crude palm oil to be paid by the producer with a maximum of $600 000 per producer. The total net expenditure of PORIM in 1981 was $5 million.

There are many consultancy firms, either Malaysian or subsidiaries of international firms, in Malaysia. The firms are specialized in specific technical fields such as the brokers, dealers, surveyors and chemists, and partly they provide comprehensive advisory services to participants in the oil-palm sector such as producers, processors or potential investors.

4.7.2 Supply of inputs

The main non-factor inputs such as fertilizers, processing equipment and vehicles are partly produced in the country and partly imported. About 90 % of fertilizer is imported, partly as raw materials. The FELDA organization participates in a joint venture producing granulated fertilizers for its own use and for sale on the domestic market. Processing equipment is largely produced in Malaysia by Malaysian companies or by joint ventures with foreign producers of equipment. Vehicles and means of transport in general are mainly assembled in Malaysia with an increasing share of domestically produced parts.

4.7.3 Other institutions

The Incorporated Society of Planters is an organization of individuals working in the estate sector. It organizes conferences, seminars on topics like 'the oil palm in agriculture in the eighties'. It publishes a monthly bulletin 'The Planter', which is an international forum for scientists dealing with estate crops such as oil palm, coconut, rubber and cocoa.

The Kuala Lumpur Commodity Exchange was incorporated in 1980 and became operational in the same year, with trading in crude palm oil futures. The trading unit is 25 t, prices are quoted in Malaysian Ringgit ($) and up to 12 months forward trading is allowed. The total tonnage traded in 1982 equalled about 40 % of Malaysian production. The separate independent clearing organization, the Kuala Lumpur Commodities Clearing House Sdn. Bhd. has the main

functions of guaranteeing the fulfilment of contracts and maintaining the financial stability and integrity of the futures market. The KLCCH does this mainly by registering all contracts traded on the KLCE, and establishing and collecting deposits from members. The KLCE offers the opportunity to producers and others involved in the oil-palm sector to transfer risk to speculators who in turn hope to benefit from price changes.

The Malaysian Edible Oil Manufacturers' Association has several subcommittees dealing, for instance, with palm kernels and products, copra and products, and cooking oil. The objective of the Association is to represent members' views at meetings of official and unofficial committees, councils or conferences as necessary and expedient. In total, 97 manufacturers are member and 58 of these deal with palm-kernel crushing.

Malaysian Oil Palm Grower's Council is an organization of estate owners and estate companies. The Council represents the growers in discussions with other participants in the palm-oil industry, the PORIM and PORLA boards, the government and government agencies. Several committees and subcommittees deal with specific tasks such as statistics, surveys of production costs and labour relations.

The Palm Oil Refiners Association of Malaysia (PORAM) had a membership of 33 refineries in 1981. The Association represents its members in the various organizations in the oil-palm industry and in discussions with the government.

Palm Oil Registration and Licensing Authority started in 1977 with the main function stipulated in the PORLA Act: 'to regulate, coordinate and promote all activities relating to the supply, sale, purchase, distribution, movement, storage, export and import of oil-palm fresh fruit, palm oil and palm kernel and the milling of oil-palm fresh fruit'. The board consists of representatives of several ministries, PORIM, FELDA, representatives of the palm-oil industry and representatives from Sabah and Sarawak.

The Department of Statistics issues special publications about area, production and trade oil palm and other estate crops.

4.8 Summary and economic parameters

Malaysian is the largest producer and exporter of palm oil with 56 % of world production and 85 % of world exports. With rice and rubber, oil palm is a main crop in Malaysia and contributed about 5 % to the GDP in 1982.

The development of oil palm from a crop of minor importance towards its present position began in 1960. Four basic factors were of major importance:

- Suitable climate and soils in extensive areas of Malaysia.
- Availability of virgin land.
- Adaptability of the plantation system from rubber to oil palm.
- New technology in agricultural production and processing.

A fifth factor of importance was the higher profitability of oil palm over rubber,

Economic parameters of the oil-palm sector in Malaysia (1982).

Resources used	
Land under oil palm	1 226 500 ha
as share of area under permanent crops	37 %
area in production	970 500 ha
Labour for area in production	209 000 man-year
Non-factor inputs for production and marketing	
domestically produced	US$ 119 million
imported	US$ 154 million
Output	
Crude palm oil (3 510 000 t)	
10 % at domestic price	US$ 124 million
90 % at f.o.b. price	US$ 1235 million
Palm kernels (904 000 t)	US$ 165 million
Total product (4 414 000 t)	US$ 1524 million
Value added by primary producers	US$ 1171 million
Value added by sector	US$ 1370 million
Productivity primary producers	
Gross return per hectare	US$ 1570
Value added per hectare	US$ 1210
Gross return per man-year	US$ 7290
Value added per man-year	US$ 5600
Destination products	
Crude and processed palm oil	
domestic market	10 %
export	90 %
Palm-kernel oil	
domestic market	13 %
export	87 %
Palm-kernel meal	
domestic market	40 %
export	60 %
Other parameters	
Export value palm oil and palm-kernel products	US$ 1350 million
as share of total value of exports	11 %

Sources: see previous tables; own estimates

which resulted in large-scale replanting of rubber land with oil palm.

Private estates, largely owned by Malaysian interests, and smallholders, organized in land development schemes by parastatals, are the main producers. FELDA, one of the parastatals, is the largest producer with about 356 000 ha in 1982. The major part of the oil-palm area is in Peninsular Malaysia (88 %); Sabah and Sarawak account for 10 % and 2 % of the area, respectively.

Favourable ecological conditions, high management standards and research ac-

tivities result in average yields of about 4 t of palm oil per hectare which is the highest in the world. These yields are obtained with production costs below corresponding prices on the world market, and palm oil and kernel production is a profitable enterprise.

The industrial linkages with primary production are well developed. The capacity of the refining industry is sufficient for the total crude palm-oil production and the same applies to the palm-kernel-crushing industry. Refined palm oil, kernel oil and meal are further processed into end-products or exported. Inputs for primary production and processing are largely manufactured in the country, partly with imported raw materials.

Marketing is by the larger producers themselves or through registered brokers and dealers. Government and private institutions are active in the development of overseas markets. Agronomic, technical and economic research is by several research institutions. Dissemination of research results is greatly facilitated by the existence of specialized periodicals and conferences organized from time to time by several institutions. Primary producers, refiners and seed crushers are all organized and have close links with the government.

The government has played a major role in the oil-palm sector. Firstly as organizer of production through several parastatals, secondly through several specialized institutions dealing with various aspects of production, processing, marketing and research and thirdly through a national policy aimed at balancing private and national interests.

The availability of suitable unused land, especially in Sabah and Sarawak, and the existence of a well developed infrastructure in its widest sense favour a further increase in the oil-palm area and a further increase in yields. The increasing real wages on the estates and the problems of the estates to attract sufficient labour may hamper actual development. Technological innovation, especially in harvesting, is therefore a major factor in further development of the oil-palm sector.

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Currency equivalents and price indices in Malaysia (1960-1983).

	Exchange rate (M$ per US$)	Consumer price index (1980 = 100)
1960	3.06	51
1965	3.06	53
1970	3.06	56
1971	3.05	57
1972	2.82	59
1973	2.44	65
1974	2.41	77
1975	2.40	80
1976	2.54	82
1977	2.46	86
1978	2.32	90
1979	2.19	94
1980	2.18	100
1981	2.30	110
1982	2.34	116
1983	2.32	120

Source: IMF (1984)

5 Oil palm in Cameroon

5.1 Background

Cameroon is one of the larger countries in Central Africa with a total land area of 475 442 km^2. The total population is 9.3 million (1982), of which 66 % live in rural areas. The average population density is 18 people per square kilometre. But there are population concentrations around Yaounde, the capital, Douala, the trade centre, Bafoussam in the west and Maroua in the north.

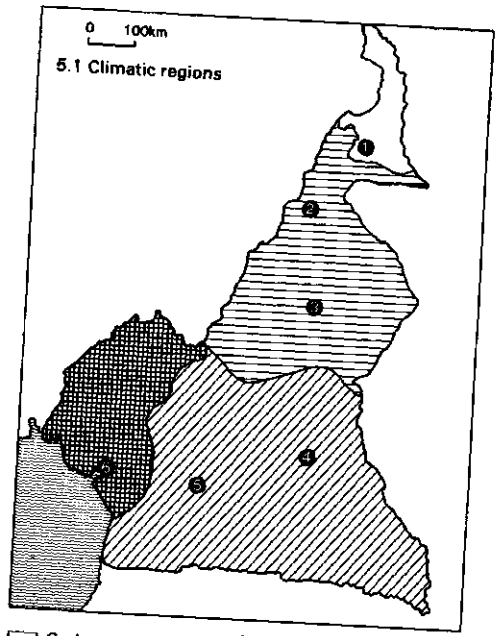
The GNP per person was $890 in 1982. Agriculture, industry and services accounted for 27 %, 31 % and 42 % of the GDP in the same year, respectively. An estimated 83 % of the active population is engaged in agriculture.

The agricultural area is 7 million hectares of which 6 million is arable land and a million under permanent crops. The major crops are listed in Table 5.1. The oil

Table 5.1. Average area harvested, yield and national production of major crops over 3-year periods.

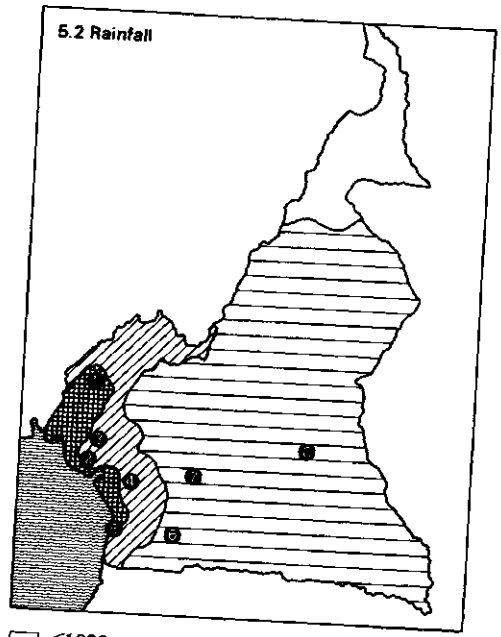
Crops	Area (1000 ha)		Yield (kg/ha)		Production (1000 t)	
	1969-1971	1979-1981	1969-1971	1979-1981	1969-1971	1979-1981
Food crops						
cassava	161	233	3950	4300	637	1000
maize	309	540	1150	860	355	464
plantain					694	988
sorghum & millet	477	466	719	871	343	405
yam & taro	259	363	3330	3370	862	1220
Oil crops						
cotton (seed)	103	57	320	860	33	49
groundnut (nuts)	244	353	845	320	206	113
oil palm (palm oil)	.	55[1]	.	1440	63	79
(kernels)			.	.	41	46
Beverages						
cocoa	387	426	328	276	127	118
coffee	241	352	373	292	90	102
Other crops						
cotton (lint)	103	57	204	509	21	29
sugar-cane (sugar)	11	20	909	2300	10	46
rubber	21	29	620	590	13	17

1. Planted area with improved palms.
Source: FAO (1971-1981a)



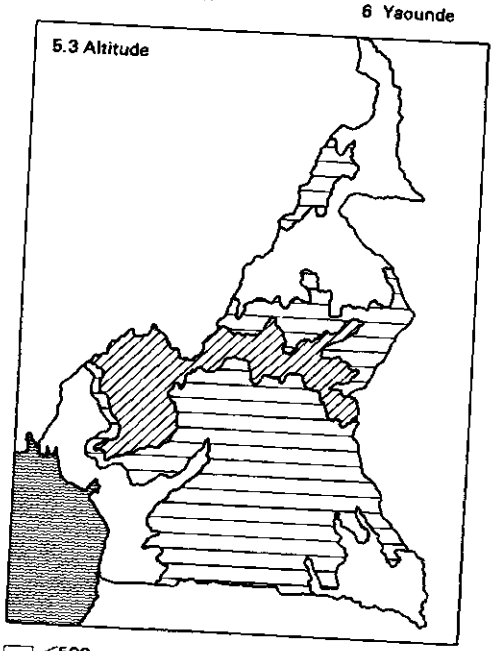
Sudano-Sahelian climate
Sudanian climate
Equatorial climate, Guinean type
Equatorial climate, Cameroonian type

1 Maroua
2 Garoua
3 Ngaoundéré
4 Bertoua
5 Douala
6 Yaounde



<1000 mm
1000-2000 mm
2000-3000 mm
>3000 mm

Stations
1 Mamfe
2 Dibombari
3 Kumba
4 Edea
5 Kribi
6 Ebolowa
7 Yaounde
8 Bertoua



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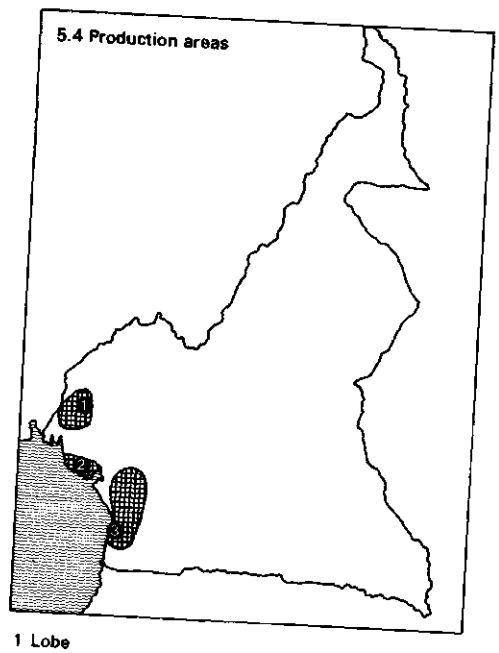

1 Lobe
2 Limbe
3 Kribi

Table 5.2. Distribution of monthly rainfall for selected stations (mm).

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Mamfe	32	69	175	220	321	428	497	454	559	466	149	40	3410
Dibombari	12	43	84	150	238	229	431	479	321	193	107	1	2288
Kumba	26	83	174	220	261	239	288	304	297	314	157	22	2340
Edea	43	63	150	238	280	256	231	337	470	370	161	42	2641
Kribi	103	122	198	254	367	267	117	520	505	525	198	95	2970
Ebolowa	45	72	171	216	215	159	43	69	198	281	187	60	1716
Yaounde	27	62	144	184	211	144	57	77	222	302	134	23	1587
Bertoua	24	53	111	142	158	175	98	135	233	297	108	32	1564

Sources: Ministère de l'Agriculture (1981), Information Socapalm

palm is indigenous in West Africa, and wild or semiwild palms are numerous in the southern part of the country. Oil palm as a planted crop on estates and smallholdings recently became a major oil crop and Cameroon is the fourth producer in Africa after Nigeria, Ivory Coast and Zaire. The share in the world production was 1.7 % in 1982.

Agricultural products account for 65 % of the total value of export. Coffee, cocoa, timber and cotton are the main exports; oil-palm products are one of the minor export commodities together with bananas, tobacco and rubber.

5.2 Ecology

The climate is affected by two air masses, the stable and dry air mass from the Sahara and the unstable humid air mass from the Atlantic. The air masses meet along the intertropical front, which moves north-south during the year. The mountainous western and central part of the country and the South Cameroon Plateau modify the influence of the air masses. The result is three main climatic regions:

- The equatorial region, south of about 7°N, is divided into two climatic types; The Guinean type with four seasons and total rainfall between 1500–2000 mm and the Cameroonian type in the west with permanent rainfall from 2000 to 11 000 mm.
- The Sudanian region from 7 to 10°N with rainfall of 1000–1500 mm and one marked dry season of 5–6 months.
- The Sudano-Sahelian region in the northern part of the country with less than 1000 mm rainfall and a dry season of 7 months or more (Figure 5.1).

The rainfall isohyets are given in Figure 5.2. The monthly rainfall of selected stations in the area receiving more than 1500 mm rainfall annually are listed in Table 5.2. All stations show a drier period from December to February. The stat-

Fig. 5.1–5.4. Main climatic regions (5.1), average annual rainfall (5.2), altitude (5.3) and production areas (5.4) in Cameroon. After Les Atlas Jeune Afrique (1980).

ions in the 'Guinean' region with less rainfall than 2000 mm, clearly show the second drier period in July and August, which makes this region less suitable in rainfall for oil palm. Information about the water deficit is only available for Dibombari, where the average annual deficit was 313 mm, measured over a period of 8 years.

The temperatures in the southern and western parts of the country, the parts that should be considered for oil-palm cultivation on the basis of rainfall, are related to altitude. Average monthly minimum temperatures are below 20 °C during the longer part of the year in the South Cameroon Plateau with an altitude of 600–900 m, so oil palm cannot be cultivated. The same applies to the area around Bafoussam, the Bamileke Plateau, and the grass fields around Bamenda. At altitudes below 500 m, the temperature is suitable for oil-palm cultivation (Figure 5.3).

Sunshine data are only available for Douala and the annual average duration of sunshine is 1023 h. If this is a typical value for low altitude areas with high rainfall, sunshine could limit production.

The soils in the area outlined above are generally ferralitic. These soils are red, clayey and highly permeable and generally poor in nutrients but suitable for oil-palm cultivation. Many areas have a hardened horizon of ferruginous materials and this may make the area unsuitable.

In summary, the area suitable for oil-palm cultivation is a belt 50–100 km wide along the coast from Equatorial Guinea to Nigeria plus the area around Mamfe, excluding the slopes of Mount Cameroon and the Rumpi fields. The dry or drier period from December to February/March, however, limits production. Sunshine could be another factor limiting production in this area. Soil conditions in specific sites may be unsuitable for oil palms.

5.3 The oil-palm sector

5.3.1 History

The oil palm is indigenous in Cameroon, and the fruits of the wild and semiwild palms are processed into palm oil by village people. Towards the end of the 19th Century, oil palm became a cash crop as a regular trade in palm oil and kernels developed.

The plantation industry started in West Cameroon in the period of German colonization from 1884–1915. The area became a British protectorate, governed together with Nigeria after World War I. Two plantation regions developed in West Cameroon, one around Mount Cameroon with Victoria, recently renamed Limbe, as port and trade centre and one around Lobe, which was oriented to Calabar, the centre of the Nigerian plantations. The main crops in the early period of development were cocoa and rubber.

The first oil-palm plantation was established between 1928 and 1933 at Ndian

near Lobe, close to the present Nigerian border. After World War II, the plantation industry expanded. Pamol, in the Unilever group, expanded the estate at Ndian and opened a second oil-palm estate at Lobe. The Cameroon Development Cooperation (CDC) was created in 1947 and all formerly German-owned plantations were brought under its control. Oil palm became a major plantation crop and in 1960, the year of independence, there were about 15 000 ha oil palm owned by Pamol and CDC. At independence, the English-speaking West Cameroon and the former French Colony of Cameroun formed the United Republic of Cameroon. The new border with Nigeria resulted in a reorientation of the estate sector in West Cameroon towards Douala.

5.3.2 Recent developments

The declining production of palm oil from the semiwild oil palm groves, due to difficulties in finding man prepared to do the dangerous work of climbing and harvesting, resulted in government efforts to increase production on estates. External finance was obtained from several sources such as IBRD/IDA, Commonwealth Development Corporation, European Development Fund and the Caisse Centrale de Cooperation économique for several development plans. A new state corporation, Société; Camerounaise de Palmeraies (Socapalm), was established in 1968 to develop oil-palm plantations in the coastal area south-east of Douala. Private estates too expanded their area. The development plans for state corporations are being implemented and further expansion is not being planned. More attention will be given to the development of the smallholder sector and a further increase can be expected in area planted. The increase in the area under improved oil palms is listed in Table 5.3. Figure 5.4 gives the main oil-palm areas.

Table 5.3. Area under improved oil palms per group of producers (1000 ha).

	State corporations	Private estates	Smallholders	Total
1960	12.0	3.0	–	15.0
1965	13.0	4.9	–	17.9
1970	17.0	6.7	–	23.7
1975	27.5	8.0	–	35.5
1976	29.1	9.0	–	38.1
1977	31.5	9.3	–	40.8
1978	32.9	9.9	0.1	42.9
1979	34.9	10.9	0.4	46.2
1980	35.5	11.9	0.9	48.3
1981	37.2	12.9	1.7	51.8
1982	37.0	13.7	2.5	53.2
1983	37.5	14.5	3.0	55.0

Sources: Ministère de l'Agriculture (1981), Ediafric (1983)

Production of palm oil from the estates increased considerably (Table 5.4). The figures for production of semiwild oil palms are estimates, since direct data are not available. Under 'kernels', total estimated production is given. The proportion of kernels from semiwild palms has presumably declined over the years.

Detailed production data for the three main producers covering 88 % of the area and 89 % of production of improved oil palms in Cameroon are listed in Table 5.5. The available production data show that 1982, in practice the period July 1981–June 1982, was a normal year. The average yield of 1.7 t of oil or 8.5 t of f.f.b. per hectare is fairly low for estates. The overall yield of Socapalm estates will presumably rise, since most of the productive area is in the early years of production. No data are available about the average age of CDC and Pamol oil-palm stands.

Table 5.4. Production of crude palm oil and kernels (1000 t).

	Palm oil			Palm kernels
	improved palms	semi-wild palms	total	
1970	.	.	54	58
1975	38	22	80	40
1976	39	41	80	40
1977	37	43	80	40
1978	43	35	78	45
1979	36	42	78	45
1980	52	27	79	46
1981	70	23	93	46
1982	73	32	105	46

Sources: FAO (1971-1981a); see Table 5.3

Table 5.5. Area, production and yield of main producers in 1982.

Producers	Area (1000 ha)		Production (1000 t)			Yield (t/ha)		
	productive	not yet productive	f.f.b.	c.p.o.	kernels	f.f.b.	oil	kernels
CDC	14.2	1.3	110	22.0	2.5	7.7	1.5	0.18
Socapalm	15.2	6.2	134	24.9	4.8	8.8	1.6	0.32
Pamol	8.7	.	94	18.8	5.2	10.8	2.2	0.60
Total	38.1	.	338	65.7	12.5	8.9	1.7	0.33

Sources: GICAM (1983), CDC (1983), personal communication Socapalm

5.3.3 Organization

The government plays a major role in the oil-palm sector. Two of the three main producers are state corporations and prices of crude palm oil are fixed by the government, on the basis of production costs, prices on the world market and consumer interests. Until recently, the National Produce Marketing Board (NPMB, in French ONCPB) was in charge of marketing of palm kernels.

Private enterprises, completely or partly owned by foreign companies, produce and process crude palm oil.

Very little information is available on small-scale production and processing. The amount of fruit bunches bought by plantation mills from growers points to the existence of farms with improved oil palms. A village processing industry using traditional and more modern techniques exists but no information is available about production or about organizations dealing with these activities.

The oil-palm sector is outlined in Figure 5.5.

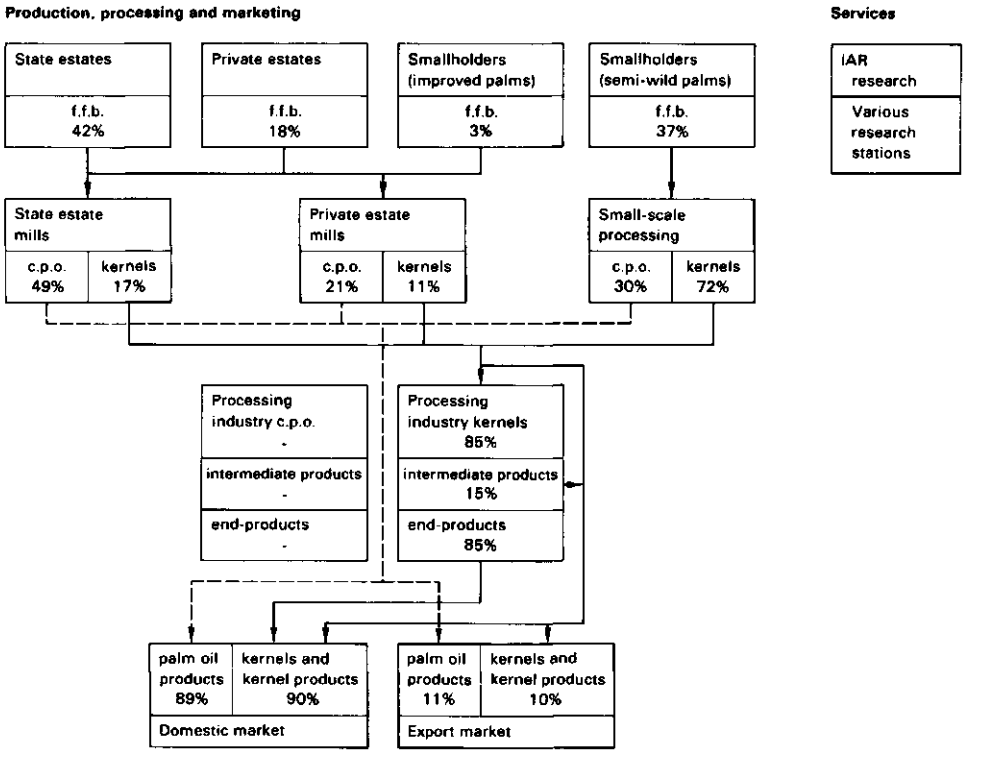

Fig. 5.5. The oil-palm sector in Cameroon, 1982. Broken line, palm oil and palm-oil products; solid line, kernels and kernel products.

5.4 Production of crude palm oil and kernels

5.4.1 Production factors

Land is still available in the region suitable for oil-palm cultivation. The population densities in the districts along the coast range from 6–20 in most of the districts to 70 people per square kilometre in the districts bordering Douala (1976). The area north-west of Douala is more densely populated than the area south of Douala, where the estates of Socapalm were established in the 1970s on what is called 'new land'.

All estates experience difficulties in maintaining a sufficient work force. The turnover of labour is high, as labourers often leave the estate after 1–2 years. Dongmo (1982) found that on one estate in Sanaga Maritime District, close to Douala, 52 % of the work force was recruited in the previous 18 months. Annual reports of CDC and Socapalm and an earlier publication by Courade (1977) confirm the problem of instability of the work force. The costs of labour range from CFAF 1040 for unskilled labour to CFAF 1500 per day for skilled labour (1982).

Capital for the public estate companies is partly from domestic sources (self-generated funds, government, ONCPB and SNI) and partly from loans from IBRD, CCCE and EIB.

5.4.2 Producers and production systems

Three production systems can be distinguished: production on estates, smallholders with stands of planted, improved palms, and the traditional system in which oil palms as semiwild trees are part of the farming system.

Two government estate corporations, CDC, Cameroon Development Corporation and Socapalm, Société Camerounaise de Palmeraies, dominate the modern sector, as they control 70 % of the oil-palm area. CDC controls oil palm, rubber, tea, pepper and banana estates, all in the western part of Cameroon. Socapalm is in the first place concerned with oil-palm plantations but its activities include coconut production and some animal husbandry. The estates of Socapalm are situated south-east of Douala in the coastal belt. The estates of CDC and Socapalm have their own processing mills. Fruit bunches from private estates and smallholders are bought and processed too. During the season 1981/1982, they bought a total of 17 000 t of f.f.b., 7 % of total input.

Three private estates are in operation, with about 26 % of the area of improved palms. Plantations Pamol du Cameroun Limited (Pamol) of the Unilever group, Société; Africaine Forestiere et Agricole au Cameroun (Safacam), owned by Terre Rouge and Socfin, and Société Palmeraies de la Fèrme Suisse (SPFS). Processing mills are available on the estates of Pamol and Safacam.

A few smallholders with improved palms, with a total area of 3500 ha, supply fruit to mills of CDC and Socapalm estates. In addition, some smallholders have

their fruits processed in small processing units, but information about area and production is not available.

Smallholders harvesting semiwild palms produce an estimated 30 % of the total palm-oil production. Such a production can be expected from 100 000 ha with an average yield of 2 t of f.f.b. per hectare and an oil-extraction ratio of 15 %.

5.4.3 Costs

The costs refer to data from the two largest producers, CDC and Socapalm for 1981/82. Investment costs refer to the most recent investments made, with prices updated, if necessary, to the level of 1982.

5.4.3.1 Investment costs

Field establishment (Table 5.6). Land preparation is done by heavy equipment. During the fifth year after planting, harvesting starts and the costs and returns from then on are listed under area in production.

General charges per hectare are high relative to other cost components, but costs for surveys and studies for the total estate are included under that heading.

Other investment costs. The total costs for vehicles for an estate of 6000 ha are CFAF 160 million. Oil-mills are generally build under turnkey contracts and all equipment is imported. An estate of 6000 hectares with a top production of 10 t of f.f.b. per hectare requires a mill of capacity 20 t of f.f.b. per hour with 15 % of the annual production in the peak month and a processing time of 450–500 h/month. The costs of a mill with a capacity of 20 t of f.f.b. per hectare are estimated at CFAF 1300 million. Houses, offices and schools are built on the estates. The total costs of buildings for an estate of 6000 ha are estimated at CFAF 700 million. The total costs of investments are listed in Table 5.7.

Table 5.6. Field establishment costs.

	In year (CFAF 1000/ha)					Total	
	1	2	3	4	5	(CFAF 1000/ha)	(US$/ha)
Land preparation	120.0	–	–	–	–	120.0	365
Road, drains, etc.	7.6	1.8	0.5	0.3	5.7	15.9	48
Planting material	62.0	3.1	0.5	–	–	65.7	200
Planting labour	19.2	2.5	0.5	–	–	22.2	67
Upkeep & fertilizers	24.6	44.5	29.0	30.7	42.8	181.6	552
General charges	136.0	136.0	136.0	136.0	136.0	680.4	2067
Total	369.5	187.9	176.5	167.0	184.0	1085.4	3299

Table 5.7. Investment costs.

	Total costs		Per hectare		Share of total (%)
	(CFAF million)	(US$ 1000)	(CFAF 1000)	(US$)	
Field establishment (year 1-5)	.	.	1085.0	3299	75
Vehicles for 6000 ha estate	160	486	27.0	81	2
Oil mill (20 t f.f.b./hr)	1300	3951	217.0	659	15
Buildings for 6000 ha estate	700	2128	117.0	355	8
Total	.	.	1446.0	4394	100

5.4.3.2 Operating costs

Production of fruit bunches. The average costs of 11 estates with an area of 29 000 ha are given in Table 5.8. The average yield of 8.3 t of f.f.b. per hectare has been used to convert costs per hectare into costs per tonne of of f.f.b.

Processing costs vary between mills from CFAF 2800–6000 per tonne of f.f.b. The weighted average costs of five mills are listed in Table 5.9. Extraction performance too varies widely: oil-extraction ratios from 18.4–21.2 % and kernel-extraction ratios from 2.1–5.2 %. An oil-extraction ratio of 19 % and a kernel-extraction ratio of 3.0 % has been used for the conversion of costs per tonne of f.f.b.

Table 5.8. Production costs fruit bunches.

	Per hectare		Per tonne f.f.b.	
	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)
Upkeep and cultivation				
fertilizer[1]	7.5	22.8	0.9	2.8
all other costs	23.0	69.9	2.7	8.4
subtotal	30.5	92.7	3.7	11.2
Harvesting	24.2	73.6	2.9	8.9
Transport	7.9	24.0	0.9	2.9
Total	62.6	190.3	7.5	23.0

1. Fertilizer applications vary from 0-200 kg/ha among the estates, an average doses of 125 kg/ha is used in the table.

Table 5.9. Processing costs.

	Per tonne f.f.b.		Per tonne product	
	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)
Processing	2.8	8.4	12.5	38.1
Forwarding and distribution	0.8	2.5	3.7	11.2
Total	3.6	10.9	16.2	49.3

Table 5.10. General charges for estates and mills and for headquarters.

	Per hectare		Per tonne f.f.b.		Per tonne product	
	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)
Estates and mills	46.5	141.3	5.6	17.0	25.5	77.4
Headquarters	58.2	176.9	7.0	21.3	31.9	97.0
Total	104.7	318.2	12.6	38.3	57.4	174.4

5.4.3.3 Production costs

The costs outlined in Sections 5.4.3.1 and 5.4.3.2 are summarized in Table 5.11. The depreciation rates for the investments are 4 % for field establishment, into costs per tonne of product. The average forwarding and distribution costs for production of the five mills are included in Table 5.9.

The general charges are grouped under two headings: 'General charges estates and mills' include all costs made for staff, general upkeep, medical and social services. 'General charges for headquarters' include costs for staff, legal expenses, bank charges, board expenses and interest on loans. The average general charges for the two main estate companies are listed in Table 5.10.

Table 5.11. Production costs oil-palm products.

	Per hectare		Per tonne f.f.b.		Per tonne product	
	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)
Operating costs						
upkeep and cultivation	30.5	92.7	3.7	11.2	16.7	50.7
harvesting	24.2	73.6	2.9	8.9	13.3	40.3
transport	7.9	24.0	0.9	2.9	4.3	13.1
total bunch production	62.6	190.3	7.5	23.0	34.3	104.1
processing	22.9	69.6	2.8	8.4	12.5	38.1
forwarding and distribution	6.7	20.4	0.8	2.5	3.7	11.2
general charges	104.7	318.2	12.6	38.3	57.4	174.4
subtotal	196.9	598.8	23.7	72.2	107.9	327.8
Depreciation capital						
field establishment	43.4	131.9	5.2	15.9	23.8	72.2
vehicles	5.4	16.4	0.6	2.0	3.0	9.0
oil-mill	17.4	52.9	2.1	6.4	9.5	29.0
buildings	2.9	8.8	0.3	1.1	1.6	4.8
subtotal	69.1	210.0	8.3	25.4	37.9	115.0
Total	266.0	808.8	32.0	97.6	145.8	442.8

20 % for vehicles, 8 % for the mill and 2.5 % for the buildings. Interest is included in general charges.

5.4.4 Returns

Yields. Estate data show the yields of 3–4 t of f.f.b. in the 4th or 5th year rising to 10–12 t for blocks 10–13 years old. The plantations of Socapalm are young and the average yield of 8.3 t of f.f.b. per hectare (Section 5.4.3.2) should rise to around 10 t of f.f.b. per hectare in a few years, as the age composition of the oil-palm stands becomes more balanced. The average yield of all producers was 8.9 t of f.f.b. per hectare in production in 1982. This resulted in yields of oil and kernels of 1.7 and 0.33 t/ha, respectively.

Prices. The domestic sales price ex estate for palm oil is fixed by the government. Producers may export after the domestic demand has been met. If the world price is well below the domestic price, the government may decide to decrease the domestic price. This happened in July 1981, when prices were reduced from CFAF 162 to CFAF 143 per kg. The fixed prices of crude palm oil were generally above prices on the world market in recent years (Table 5.13). The local price for palm kernels ex estate was CFAF 50 000/t in 1982 and price data for previous years are not available. Although fixed prices are quoted ex estate palm oil and kernels are normally delivered at Douala or at bulking installations at Limbe-Bota. This results for 1982 in prices delivered of CFAF 162 200/t for crude palm oil and CFAF 63 000/t for palm kernels. The price for oil-palm products, using the oil-extraction and kernel-extraction ratios as factors, was CFAF 146 100/t or $444/t. The price received by estates for exports was well below the domestic price (Section 5.6.3) but the amount exported was low in 1982 (and in previous years) and the effect on the average price received is small.

5.4.5 Review costs and returns

The average price received for oil-palm products is slightly above production costs. Production of palm oil and kernels therefore cannot be considered a profitable enterprise in general: some estates make a small profit and others make a small loss. The rate of increase in price of palm oil was 8 % per year in the period 1970 to 1982, which is below the inflation rate of 11 % per year. So production of palm oil and kernels was most likely more profitable in the past.

Inputs and outputs (Sections 5.4.3 and 5.4.4, respectively) are brought together in Table 5.12. The labour input is calculated from general data of CDC and Socapalm estates and mills. So the amount of labour included under 'all other estate' includes a proportion of labour used for general purposes, of which the costs are listed under general charges and a proportion of labour for areas not yet productive whose costs are included in depreciation. The proportion of labour used for upkeep of the productive area is estimated at half of the amount stated, corre-

Table 5.12. Input-output data.

Output, per hectare	Quantity		Domestic price		Value	
	(t)	ratio (%)	(CFAF/t)	(US$/t)	(CFAF)	(US$)
F.f.b.	8.9					
C.p.o.	1.7	19.1	162200	493	275700	838
Kernels	0.33	3.7	63000	191	20800	63
Total product	2.03	22.8	146100	444	296500	901

Inputs per tonne product	Quantity	Costs	
		(CFAF)	(US$)
Land	0.49 ha		
Labour			
harvesting (3.2 d/t f.f.b.)	14.0 d		
mill	3.0 d		
all other estate[1] (32.5 d/ha) upkeep	8.0 d*		
subtotal	25.0 d	31250	95.00
Non-factor inputs:			
operating costs			
fertilizer (125 kg/ha)	62 kg	3680	11.20
other materials, estimated		8230	25.00
depreciation investments			
field establishment		11500	35.00
vehicles		2660	8.10
oil mill		8550	26.00
buildings		1440	4.40
subtotal		36060	109.70

1. Including area not yet in production, see text.
* Estimation.

sponding to a requirement of 8 d/t of product. The non-factor inputs involved in investments are included through application of the depreciation rates on the investments per hectare. The non-factor inputs for field establishment are estimated at CFAF 583 650/ha or $1774/ha.

The estimated total labour input of 25 d/t of product is equivalent to 51 d/ha or one labourer for 4.5–5 ha. The overall employment rate for the total estates including mills is one labourer for 4.3 ha. Non-factor inputs represent 30 % of the total production costs.

5.5 Processing

One processing enterprise is in operation in Douala, the Complex Chemique du Cameroun (CCC) with a capacity of 35 000 t of kernels per year. The products

are soap, detergents and refined palm-kernel oil. A second enterprise, Huilerie-Raffinerie du Cameroun (Huraco), for refining palm oil and kernel oil is under construction. The demand for refined palm oil, and thus the need for refining, is limited, because crude palm oil is used directly by consumers in Cameroon.

5.6 Marketing

5.6.1 Marketing channels

A small proportion of the total bunch production is sold to mills of the larger estate companies. The sellers are mainly smallholders, private estates or newly planted estates. No information is available on the trade in locally produced oil-palm products from semiwild palms. The data below refer to the flow of products from estates and smallholders selling fresh fruit bunches to estate mills only.

5.6.2 Marketing functions

Bulking installations are available in Limbe-Bota and in the Harbour of Douala to store the palm oil before export.

The two government-controlled estate enterprises, CDC and Socapalm, do their own marketing and exporting. The same applies to the largest private estate, Pamol, which is owned by Unilever.

Palm oil is transported by tank lorries from CDC and Socapalm mills to Limbe-Bota and Douala for export or to local processors. Palm kernels are transported in bags with lorries. The estates of CDC are close to the port of export, Limbe-Bota, and about 75 km from Douala. The estates of Socapalm are situated 75–250 km from Douala. The mills of Pamol are near the Nigerian border. As roads are generally in a poor state, crude oil is partly transported by barges. Average transport costs in 1982 for CDC were CFAF 570/t for palm oil and CFAF 7600/t for kernels. For Socapalm, these costs were CFAF 3270/t and CFAF 14 900/t, respectively. The costs of bagging and bags are included in the figures for kernels.

5.6.3 Pricing, taxation and costs

The domestic sales price ex estate for crude palm oil set by the government was generally higher than prices on the world market (Table 5.13). The calculation of the border price for crude palm oil in 1982 with the various marketing costs in Table 5.14 results in a price of CFAF 124 250/t ($378/t). The estimated border price for palm kernels was CFAF 68 000/t or $206/t in the same year. The border price for oil-palm products, with oil-extraction and kernel-extraction ratios as factors, was CFAF 115 200/t ($350/t), which is well below the price of CFAF 146 100/t ($444/t) for oil-palm products delivered for the domestic market. The nominal protection coefficient equals (CFAF 146 100/t)/(CFAF 115 200/t) = 1.27.

Table 5.13. Prices of crude palm oil and palm kernels.

	Crude palm oil			Palm kernels	
	world market[1] (US$/t)	local[2]		world market[3]	
		(US$/t)	(CFAF/1000 t)	(US$/t)	(CFAF/1000 t)
1970	260	223	62	168	44.6
1975	434	467	100	207	44.3
1976	406	418	100	230	55.0
1977	530	463	114	326	80.2
1978	600	562	127	364	82.3
1979	654	685	146	500	106.5
1980	584	692	146	345	72.8
1981	569	566	154	317	86.2
1982	445	486	160	270	88.8

1. Malaysian 5 % c.i.f. N.W. Europe (World Bank, 1984b).
2. Local price ex estate excluding sales tax.
3. Nigerian, c.i.f. U.K. (World Bank, 1984b).

Table 5.14. Marketing costs crude palm oil in 1982.

	Domestic market	Export	
	(CFAF/1000 t)	(CFAF/1000 t)	(US$/t)
Price ex estate	160.0	101.3	307.9
Transport to Douala or port of export	2.2	2.2	6.7
Price delivered	162.2		
Sales tax (10 % fixed price)	16.0	16.0	48.8
Price domestic market	178.2		
Habour costs		2.7	8.2
Export duty		4.7	14.4
F.o.b. price		126.9	386.0
Freight and insurance to West European port		19.4	59.0
C.i.f. price West European port		146.3	445.0

A 10 % sales tax on the fixed price for crude palm oil is paid by the estate company. An export duty of 9.5 % of the 'mercurial value' for crude palm oil, which is fixed at CFAF 50 000/t, is levied. For export of kernels, an export duty of 10.8 % on the 'mercurial value', also fixed at CFAF 50 000/t as well, must be paid.

The various costs in marketing crude palm oil (Table 5.14) provide the information required for the calculation of the border price and the prices received by the estate for locally delivered or exported palm oil.

Table 5.15. Export of oil-palm products (1000 t).

	C.p.o.	Kernels	Kernel oil	Meal
1970	8.4	22.7	0.8	2.0
1975	9.1	12.2	0.5	5.5
1976	5.5	11.7	0.0	5.4
1977	8.8	10.2	.	4.4
1978	9.4	6.5	0.6	6.4
1979	5.6	7.8	0.4	1.6
1980	13.8	6.8	.	4.0
1981	4.4	2.7	.	3.0
1982	12.2	2.3	0.1	2.4

Sources: see Table 5.13, FAO (1971-1981b)

5.6.4 Export and domestic consumption

The average amount of crude palm oil exported has fluctuated around 8000 t annually since 1970 (Table 5.15). The export of palm kernels is declining. The export of kernel meal remains at 2000–6000 t. The kernel oil is consumed in Cameroon, since exports are very small. No direct information is available on domestic consumption. Production of crude palm oil of improved oil palms rose from 5000 t in 1970 to 100 000 t in 1982 and exports remained more or less at the same level. So the internal market probably absorbed the increase in production. The decline in export of kernels is most probably a result of declining productivity of the stands of semiwild oil palms and increase in local processing capacity.

5.7 Supporting services

5.7.1 Research and advisory services

There are three research stations dealing with oil palm: The station at Likomba, near Limbe, of CDC; the station of Pamol in Lake and the new central station in La Dibamba which is part of the Institute for Agronomic Research. Research will be concentrated in La Dibamba and a new seed-production section will be built to replace the present palm-breeding unit of CDC in Likomba. The capacity of the seed-production unit will be 2 million germinated seeds per year, which is sufficient to plant 7000 ha. Research topics are selection of high-yielding palms for multiplication by tissue culture, hybridization between *E. guineensis* and *E. oleifera* (American oil palm), and selection of palms with a regular production pattern throughout the year. The last subject is of special relevance for Cameroon, and West Africa in general, as dry periods tend to result in peak harvest periods and thus in less efficient use of processing mills.

5.7.2 Supply of inputs

Most of the inputs of fertilizer, vehicles and processing equipment are imported. Fertilizers and agricultural chemicals are directly imported by the estate companies. A small amount is further distributed to smallholders receiving services from CDC and Socapalm. Processing mills have been built by European companies on a turnkey basis.

5.8 Summary and economic parameters

The oil palm is indigenous in Cameroon and palm oil is produced from semiwild oil palms and from improved planted palms on estates and smallholdings. The oil palm became a major estate crop after 1960 and Cameroon is the fourth largest producer in Africa with 7 % of production. On a world scale, Cameroon is one of the medium-sized producers after Malaysia, Indonesia and Nigeria.

Two state corporations, CDC and Socapalm, are the main producers with about 70 % of the total area of 53 000 ha under improved oil palm. Several private estates account for 26 % of the area and the remaining 4 % is planted by individual smallholders. An estimated 30 % of the total production of palm oil is from semiwild oil palms harvested by farmers; fruits are processed with hand-extraction methods or with medium-technology installations.

Ecological conditions are moderately suitable in the oil-palm area along the coast. The rainfall distribution data show a distinct dry period from December to February/March and this limits production to 1.5–2.5 t of palm oil per hectare. Production costs of crude palm oil and kernels were about equal to the prices determined by the government (1982) but these prices were well above corresponding prices on the world market in 1982 and in previous years.

The processing industry is small and only kernels are produced into end-products as refined kernel oil, soap and detergents. A palm-oil refinery is under construction. The need for a refining industry is limited as most of the crude palm oil is sold to domestic consumers who are accustomed to use the crude palm oil directly. Non-factor inputs such as fertilizers, vehicles and processing equipment are imported.

The government plays a major role in the oil-palm sector as main producer, through determination of the prices for palm oil and kernels, and through control of exports. The government plans to expand the oil-palm area on smallholdings around existing estates.

Economic parameters of the oil-palm sector in Cameroon (1982).

Resources used	
Land under improved oil palm	55 000 ha
area in production	39 400 ha
estimated area under semiwild oil palm	100 000 ha
total area as share of area under permanent crops	19 %
Labour for estates	13 400 man-year
for area in production	9 100 man-year
Non-factor inputs for production and marketing	
domestically produced	US$ 3.6 million
imported	US$ 5.8 million
Output	
Improved palms, estates and smallholders	
crude palm oil (73 000 t)	
88 % at domestic price	US$ 31.7 million
12 % at f.o.b. price	US$ 3.4 million
palm kernels at domestic price (13 000 t)	US$ 2.5 million
total product (86 000 t)	US$ 37.6 million
value added by estates and smallholders	US$ 28.2 million
value added by sector	US$ 31.8 million
Semiwild palms (estimated)	
crude palm oil (32 000 t)	US$ 15.8 million
palm kernels (33 000 t)	US$ 6.3 million
total product (65 000 t)	US$ 22.1 million
Productivity primary producers with improved oil palms	
Gross return per hectare	US$ 950
Value added per hectare	US$ 720
Gross return per man-year	US$ 4130
Value added per man-year	US$ 3100
Destination products	
Crude palm oil	
domestic market	89 %
export	11 %
Palm kernel products	
domestic market	90 %
export	10 %

Sources: see previous tables; own estimates

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Currency equivalents and price indices in Cameroon (1960-1983).

	Exchange rate (CFAF per US$)	Consumer price index (1980 = 100)
1960	247	.
1965	247	34
1970	278	37
1971	277	38
1972	252	41
1973	223	46
1974	240	53
1975	214	60
1976	239	67
1977	246	76
1978	226	86
1979	213	92
1980	211	100
1981	272	111
1982	329	126
1983	381	145

Source: IMF (1984)

6 Oil palm in Ivory Coast

6.1 Background

Ivory Coast is one of the larger countries in West Africa with a total land area of 322 500 km^2. The total population is 8.9 million (1982) and so the population density is 25 people per square kilometre. Over 50 people per square kilometre are found in districts with larger towns, Abidjan, Aboisso, Man, Korhogo and in the central part of the country bordered by the districts Bouaké, Dimbokro, Divo and Daloa.

The GNP per person was $950 in 1982. Agriculture, industry and services account for 26, 23 and 51 %, respectively, of the GDP in the same year. Of the active population, 79 % works in the agricultural sector.

The agricultural area is 3.8 million hectares, of which 2.7 million hectares is arable and 1.1 million hectares is under permanent crops. The major crops are listed in Table 6.1.

Semiwild oil palms occur widely in the south, but most of the production is from planted oil palms on estates and smallholdings. Ivory Coast was the second producer of palm oil in Africa after Nigeria in 1982 with an estimated production of 177 000 t or 2.8 % of world production.

Agricultural products account for 75 % of exports. Main export crops are cocoa and coffee. Oil-palm products, cotton, pineapple and banana are of lesser importance. Nevertheless Ivory Coast is the largest exporter of oil-palm products in West Africa.

6.2 Ecology

The climate in Ivory Coast is influenced by two air masses: the hot, dry and dusty continental air mass and the humid Atlantic air mass. The line between the two systems moves north-south during the year. In the coastal area, this results in a humid climate, with an annual rainfall around 2000 mm and two short dry periods, one from December to February and one around August. The rainfall decreases and the duration of the dry periods increases northwards. In the north, there is one dry season from December to June and an annual rainfall around 1000 mm. The rainfall pattern in the transitional zone varies from one continuous raining season in one year to two shorter raining seasons in another year. The west is mountainous and receives more rain than the other parts at the same lati-

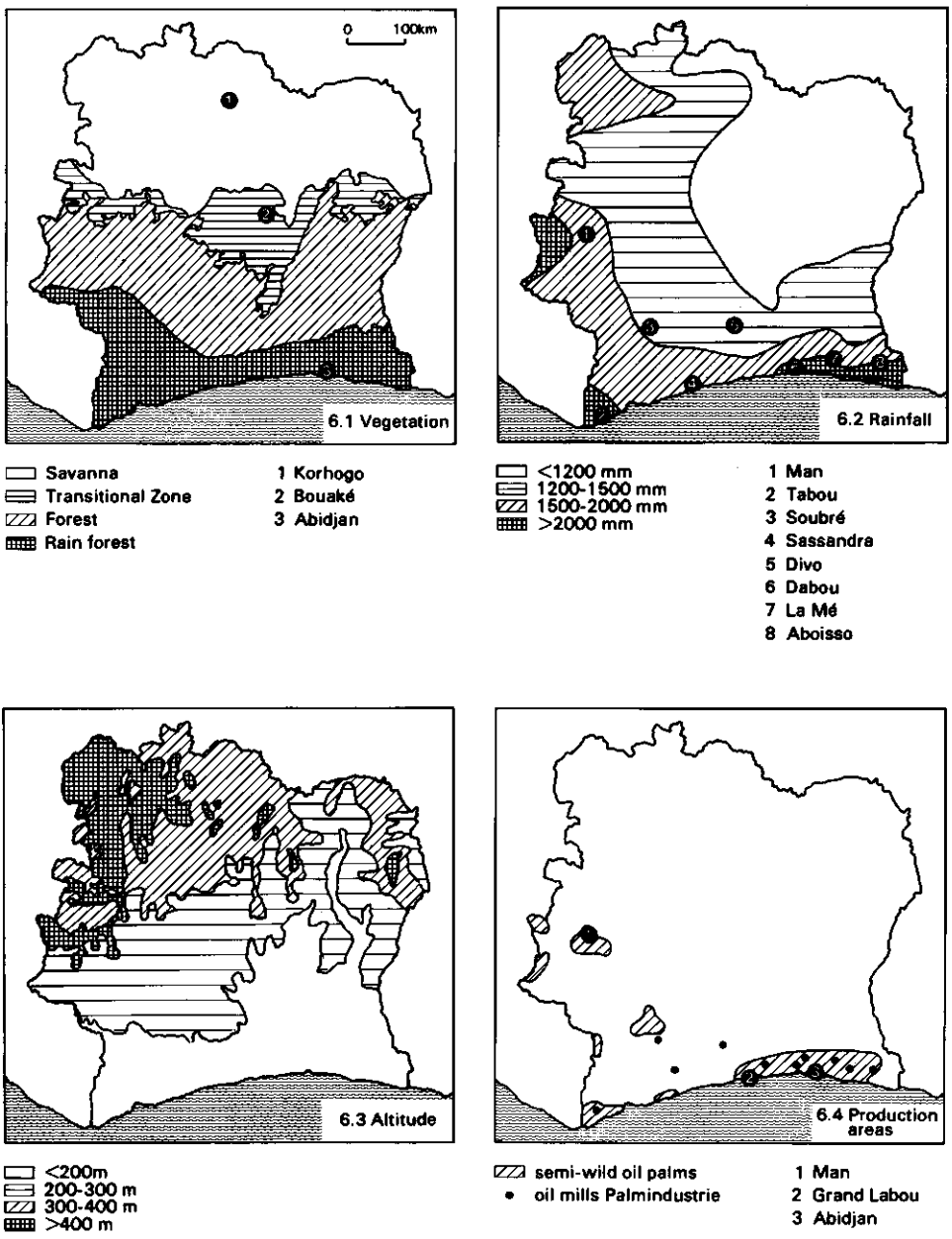

Fig. 6.1–6.4. Vegetation (6.1), average annual rainfall (6.2), altitude (6.3) and production areas (6.4) in Ivory Coast. After Les Atlas Jeune Afrique (1983) Asselman (1980).

Table 6.1. Average area harvested, yield and national production of major crops over 3-year periods.

Crops	Area (1000 ha)		Yield (kg/ha)		Production (1000 t)	
	1969-1971	1979-1981	1969-1971	1979-1981	1969-1971	1979-1981
Food crops						
maize	333	600	773	475	257	285
plantain	700	800	933	1010	653	808
rice (paddy)	286	461	1170	1150	335	532
roots & tubers	555	834	4130	3830	2290	3190
Oil crops						
coconut (nuts)	.	.	.	.	49	155
cotton (seed)	40	119	525	613	21	73
oil palm (palm oil)	68[2]	101[2]	650	1500	44	150
(kernels)			310	330	21	33
groundnut	52	63	800	846	42	53
Beverages						
cocoa	405	680	482	590	195	401
coffee	664	1060	366	275	243	291
Other crops						
cotton (lint)	40	119	350	454	14	54
rubber	14	54	.	.	11	21
sugar-cane (sugar)	.	19	.	5580	.	106
pineapple	.	300	.	1100	127	332

1. Planted area with improved palms.
Sources: FAO (1971-1983), Ministère de l'Agriculture (1981)

tude. The natural vegetation reflects the climatic conditions. In the south is a zone of rain forest and forest; the central part is a transitional zone between forest and savanna; the north is wooded or open savanna (Figure 6.1).

The rainfall isohyets are shown in Figure 6.2. The area with rainfall over 1500 mm annually is a potential area for oil-palm cultivation. Table 6.2 lists average monthly rainfall for selected places with an annual rainfall of more than 1500 mm. The figures per month show periods of 2–4 months with rainfall less than 100 mm per month for all stations, indicating water deficits. The annual water deficits for three stations are as follows: Grand-Drewin, near Sassandra, 639 mm; Dabou 177 mm; and La Mé 211 mm (Pillet-Schwartz, 1973). These deficits limit yield of oil palm to a considerable extent. According to information from the research station at La Mé, the maximum yield of oil palms in Ivory Coast with an annual water deficit of 250 mm is 17 t of f.f.b. per hectare, while the same sort of palms produce 25 t of f.f.b. per hectare in Malaysia with optimum rainfall.

The temperature in the part of the country receiving more than 1500 mm rainfall annually depends to a large extent on altitude. At altitudes below 200 m (Figure 6.3), the temperatures range from 25 °C to 30 °C throughout the year which is suitable for oil palms. The temperatures in the eastern part, around Man, are low-

Table 6.2. Distribution of monthly rainfall for selected stations (mm)[1].

	J	F	M	A	M	J	J	A	S	O	N	D	Total
1 Man	16	56	114	159	158	199	202	261	314	158	42	21	1710
2 Tabou	52	47	88	133	415	533	155	82	220	203	195	145	2268
3 Soubré	33	55	139	166	173	245	107	100	220	191	119	53	1601
4 Sassandra	23	24	74	104	295	510	156	22	48	100	142	87	1585
5 Divo	27	78	161	186	214	307	138	62	166	215	120	68	1745
6 Dabou	34	41	122	160	284	587	287	29	75	190	152	100	2061
7 La Mé	35	63	129	142	265	479	218	40	99	198	177	84	1920
8 Aboisso	33	69	122	159	236	386	207	84	137	221	162	75	1821

1. The periods of observation for the monthly data and the isohytes on Map 6.2 are different which results in the position of Soubré and Divo in the area with less than 1500 mm.
Source: Eldin & Daudet (1971)

er, 22–27 °C, and these lower temperatures limit the suitability for oil palm in this area.

Very few data are available on duration of sunshine but records kept at the research station in La Mé show averages of 1600 to 1700 h/year, with 4 months with less than the 150 h, which is considered necessary for optimum production. No data are available on the effect of the restricted duration of sunshine on the yields.

Soils in the south are ferralitic with a low content of nutrients, which are leached out by the heavy rainfall. These soils are generally suitable for oil palm if large amounts of gravel or hard pans are absent.

The climate in the south-east and south-west is suitable for oil palm, although production is to some extent restricted by water deficit in some months. The central southern part and areas further inland must be considered only marginally suitable because of a larger water deficit. The soil conditions of a specific site may improve the suitability for oil palm if the soil has a good water-retention capacity, or they may exclude oil-palm cultivation if there are large amounts of gravel or a hard pan near the surface.

6.3 The oil-palm sector

6.3.1 History

The oil palm is indigenous in West Africa. Wild and semiwild palms are used in the countryside for various purposes. Palm oil, produced in the villages, and palm kernels were exports in colonial times. Poisson (1904) gives export figures for West Africa in 1900 and mentions an export of 4300 t of palm oil and 3100 t of kernels for Ivory Coast in 1900. Exports of oil and kernels were between 2000 and 12 000 t annually for both in the period 1900 to 1950.

The first plantations started in 1912 but these were natural palm stands that had

been cleaned and maintained. After World War I, competition on the world market from oil and kernels from estates in Sumatra, Malaysia and Zaire was felt and attention was given to the improvement of local processing techniques and simple presses were introduced. In 1922, a research station for oil palm was established in La Mé. World recession and World War II, however, provided no climate for expansion and exports during the 1950s were in the same range as in the period 1900 to 1950.

The situation changed after independence in 1960. The government wanted to diversify agricultural exports and the research station was requested to develop a seed-production block of 500 ha. The research station itself became part of the IRHO, Institut de Recherches pour les Huiles et Oléagineux (Research Institute for Oils and Oil Crops) in Paris in 1945, and it developed into the main research station for oil palm in French-speaking countries.

6.3.2 Recent developments

The bulk of the estimated production of 280 000 t of f.f.b. in 1960 was from semiwild oil palms scattered in more or less dense stands in the southern part of the country and around Man in the west (Figure 6.4). According to Meunier (1968) quoted by Pillet Schwarz (1973), there were more than 300 000 ha with 60 to 150 semiwild palms per hectare in 1967. These palms were only partly harvested. More recent information on the semiwild oil palm is not available. Besides the semiwild oil palms, there were about 5000 ha of improved oil palms in 1960, partly on the research stations of IRHO, and partly on some old private estates.

The government decided to diversify the economy and the reliance on two export commodities, cocoa and coffee. Oil palm and coconut palm were chosen as new crops as the climate was favourable and as land, after being logged in forest concessions, was available in plenty. In 1963, SODEPALM was established as an autonomous statutory corporation by the government to develop oil palm and coconut palm on estates and smallholdings. Two other companies, Palmindustrie and Palmivoire, were established in 1969 jointly by the government and by the private firms Sogescol (part of Socfin, Société Financiére des Caoutchoucs S.A.) and the Blohorn Group (a large plantation company in Ivory Coast). The three companies mentioned formed the Sodepalm Group, with Sodepalm in charge for coconut palm estates and oil palm and coconut smallholdings, Palmindustrie as owner of the mills, and Palmivoire managing the oil-palm estates and mills and in charge of marketing oil and kernels. The government took complete control of Palmivoire and Palmindustrie in 1976 and transferred all responsibilities except marketing to Sodepalm. Marketing was transferred to the Stabilization Fund for Agricultural Produce (Caisse de Stabilisation et de Soutain des Prix des Productions Agricoles, CSSPA). Under the new arrangements, Sodepalm operated with an approved budget based upon cost calculations per tonne of product. This system proved not so successful, especially as production declined with unfavourable

weather. In 1978, the Sodepalm Group was once more reorganized and Palmindustrie was entrusted with all activities regarding oil palm and coconut estates and the processing of estate and smallholders products. Sodepalm became the regional development organization in charge of all extension activities to individual farmers in the palm-growing region. Recently the marketing activities were transferred back to Palmindustrie and a management contract was signed with Unipalm, a combination of three plantation companies: Socfin, Sodeci and Terres Rouges.

Besides the strong drive of the government to stimulate palm-oil production, the existence of the IRHO research station in La Mé was a major factor in the development of the oil-palm sector. The research station developed and provided all the D × P planting material as well as scientific and technical support. The development of the area under improved palms since 1960 is indicated in Table 6.3. The area increased most between 1965 and 1970, so that now (1985) almost half of the planted area is 15–20 years old, well beyond the most productive stage. The total area has changed little since 1979, as Palmindustrie did not undertake any new plantings.

Production figures are listed in Table 6.4. Production of fruit bunches from the semiwild oil palms is an estimate without recent information about number of trees or age. The bunches from these palms are processed in the villages for home

Table 6.3. Area under improved oil palms per group of producers (1000 ha).

	Producer				Total
	Palmindustrie/Sodepalm		IRHO	others	
	plantations	smallholders			
1960	–	–	.	.	5.2
1965	8.2	2.7	.	.	21.0
1970	37.3	17.6	.	.	68.2
1975	42.9	27.9	.	.	81.0
1976	43.9	31.9	.	.	88.3
1977	48.3	34.9	.	.	93.0
1978	51.7	37.9	.	.	100.0
1979	51.7	37.9	5.0	5.4	100.0
1980	51.6	37.9	5.1	5.7	100.3
1981	51.7	37.9	5.2	6.1	100.9
1982	51.6	37.9	5.1	6.0	100.6

Sources: Ministère de l'Agriculture (1981), Palmindustrie (1981)

Table 6.4. Production of fruit bunches from semiwild palms and fruit bunches, crude palm oil and kernels from improved palms (1000 t).

	Semiwild palms	Improved palms		
	fruit bunches	fruit bunches	crude palm oil	kernels
1960	.	.	14	17
1965	.	.	18	16
1970	257	223	61	21
1975	255	712	153	36
1976	255	719	144	30
1977	250	605	126	26
1978	250	676	138	31
1979	250	598	123	26
1980	200	880	182	38
1981	200	712	145	34
1982	200	785	160	35

Sources: see Table 6.3

consumption and production figures do not enter the statistics. Production of bunches, and thus oil and kernels, from improved palms varies considerably, probably because of differences in rainfall, as the area in production has remained fairly constant since 1980. More detailed production data for the main producers are listed in Table 6.5. Data from Palmindustrie for 1979 and 1980 show that yields for plantations and smallholders ranged from 9 to 12 t of f.f.b. per hectare and 5 to 7 t of f.f.b. per hectare, respectively, which indicates a yield below average in 1981. Overall data for 1982 reinforce this impression of the yields in 1981. The yield difference between plantations and smallholders of Palmindustrie is marked, the more so, as determinants such as planting material and climate are similar for both producers. Better upkeep, and more systematic and complete harvesting on estates are the main reasons for the difference. Production by smallholders not processed in Palmivoire factories is not included in the statistics, explaining part of the difference in yield.

The estates and smallholders of Sodepalm/Palmindustrie developed from east to west in a narrow belt in the south. A major factor in the development of estates was the availability of sufficient labour, mainly from Upper Volta and other neighbouring countries. The position of the mills of Palmindustrie is indicated on Figure 6.4. Smallholders are included in the service network within a range of about 20 km from the mills. Now, most of the areas suitable for oil palms in the coastal area from the east to Grand Lahou and around Tabou are within reach of the mills. New development plans concentrate on the expansion of the smallholder sector as the existing infrastructure of mills still has excess capacity.

Table 6.5. Area, production and yield per group of producers in 1981.

Producers	Area (1000 ha)		Production (1000 t)			Yield (t/ha)		
	productive	not yet productive	f.f.b.	c.p.o.	kernels	f.f.b.	oil	kernels
Palmindustrie[1]								
plantations	46.7	5.0	454	129	31	9.7	2.0	0.5
smallholders	34.8	3.1	183			5.3	1.1	0.3
IRHO[2]	4.5	0.8	36	.	.	8.1	.	.
Others	5.1	1.0	39	.	.	7.6	.	.
Total/average	91.1	9.8	712	145	34	7.8	1.5	0.4

1. The f.f.b. of smallholders are processed in factories of Palmindustrie; total oil and kernel production was higher due to the processing of 20 000 t f.f.b. bought from others than smallholders.
2. Including trials and blocks used for seed production.
Source: see Tables 6.3 and 6.4

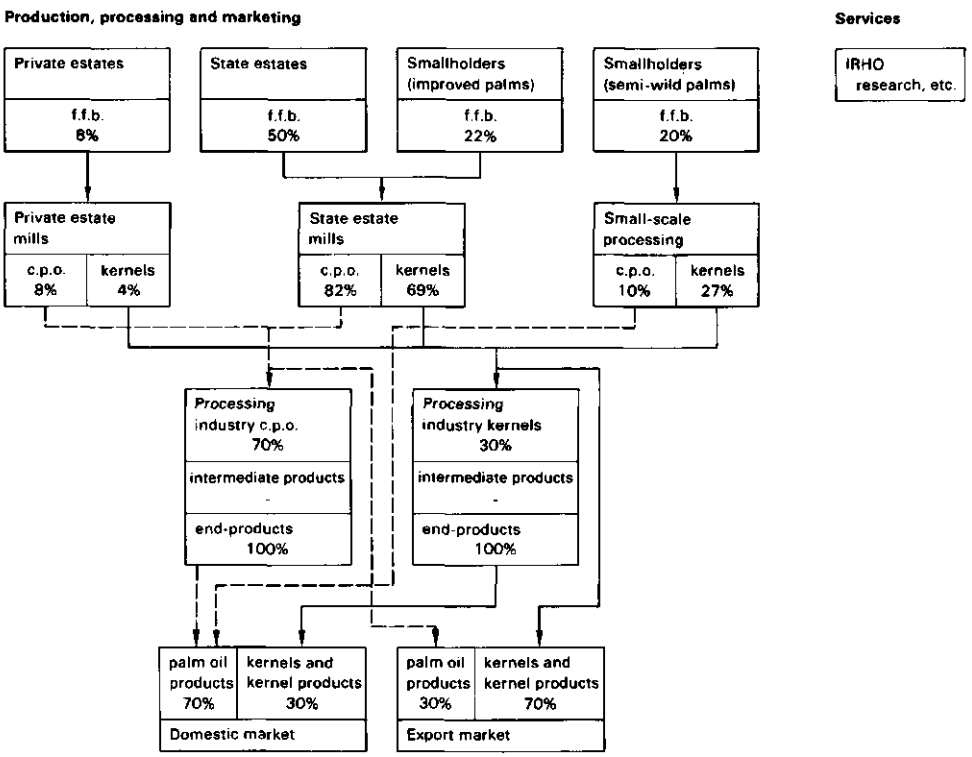

Fig. 6.5. The oil-palm sector in Ivory Coast, 1982. Broken line, apl oil and palm-oil products; solid line, kernels and kernel products.

6.3.3 Organization

The government has played a major role in the development of the modern oil-palm sector. Palmindustrie, a parastatal, controls half of the planted area and 90 % of the processing. The role of smallholders is limited to production of fruit. A small number of private estates produce fruit and one of them operates a mill.

The refining industry and the processing to soap are privately owned. Palmindustrie operated a crushing mill for kernels and copra, but activities stopped through technical problems.

The price of fruit is fixed by the government. Export of oil-palm products and import of vegetable oils are regulated by the government too.

The oil-palm sector is outlined in Figure 6.5.

6.4 Production of crude palm oil and kernels

6.4.1 Production factors

Land for oil-palm cultivation is still available in the south. The population density ranges from 20–50 people per square kilometre in this area. Government estates were allocated unused land at the time of development, 1962–1979. In addition, land was available for the rural population to start oil-palm smallholdings with an area of 2–5 ha. Population density in the south is increasing at a rate higher than average and so the availability of land for further expansion may become more restricted.

Labour for the estates is not a special problem but most of the work force is from countries bordering Ivory Coast, especially Upper Volta. The costs of labour, 1982, are CFAF 880/d for estate labourers and CFAF 1200/d for foremen on the estates.

Capital for the development of the public estates and the development of the attached smallholdings is from domestic sources such as government, private capital, self-generated funds, BNDA, CAA and from the external financiers: IBRD, FED, EIB and CCCE.

6.4.2 Producers and production systems

As in most African countries, three production systems can be distinguished: production on estates, production by smallholders cultivating improved palms, and the traditional system with semiwild palms and non-mechanical extraction methods or intermediate processing technologies.

Palmindustrie with its estates and with its integrated smallholders cultivating improved palms is a corporation in which the government participates. With an area of 51 700 ha on estates, it directly controls almost half of the total area with improved oil palms in Ivory Coast. In addition, Palmindustrie has strong links

with smallholdings, 37 900 ha, around these estates. Smallholders receive financial and technical assistance to start a plantation and when the trees are bearing, fruits are collected for processing from the smallholdings at fixed dates. The total of 8600 smallholders receive these services from 20 units whose offices are on estates or near oil-mills. In total, there are 11 oil-mills with a capacity of 350 t of f.f.b. per hour to process fruit of estates and smallholders. Estates, smallholder units and oil-mills are grouped together regionally in 8 agro-industrial units, and the management of these units is responsible for the day-to-day operations of the estates mills and provision of services to smallholders. Headquarters of Palmindustrie with sections for production and management is in Abidjan.

There are a few private estates. PHCI (Plantations et Huileries de Cote d'Ivoire), Unilever Group, is the largest with 3300 ha. The IRHO, Institut de Recherche de l'Huile et les Oléagineux, is grouped under private estates, as it operates independently from the Government of Ivory Coast. The institute operates primarily as a research institute and as a producer of germinated seeds but it also produces palm oil and kernels. The research organization has three oil-palm estates for trials and production of selected seeds in La Mé, the main station, and near Dabou and Grand Dewin.

No recent information about smallholders collecting from semiwild palms is available, except an estimate of the amount of bunches produced, 200 000 t. This is almost 20 % of the total production. The oil production from these bunches must be less than 20 % of the total oil production, as the oil-extraction ratio of bunches from semiwild palms processed by traditional technologies is well below the ratio on estates. The area of semiwild palms is estimated at 100 000 ha.

Palmindustrie operates 11 oil-mills on the estates to process the fruit bunches of estates and smallholders. IRHO and PHCI have their own mills as well and the smaller private estates sell their fruits to neighbouring mills. The total installed capacity is about 400 t of f.f.b. per hour, which is sufficient for 1 200 000 t of f.f.b. per year, well above the present production.

6.4.3 Costs

The cost data refer to smallholders and estates organized in the agro-industrial units of Palmindustrie. Operating costs are from 1982/83; investment costs are partly based on data from previous years, which have been updated with the price indices and exchange rates given at the end of this country study.

6.4.3.1 Investment costs

Field establishment, smallholders. The costs include labour provided by the smallholder, materials provided as loan by Palmindustrie, overhead costs, the costs of advice and extension by Palmindustrie, and a proportion of the improvement of the road system also organized by Palmindustrie. Part of the clear-

Table 6.6. Total field establishment costs for the years 1-4.

	(CFAF 1000/ha)	(US$/ha)
Smallholders		
labour, 180 man-days at CFAF 750	135	410
materials	183	556
mechanical clearing, partly	100	304
overhead Palmindustrie	105	319
total	523	1589
Estates		
mechanical clearing, etc.	400	1216
roads	31	94
planting and maintenance	350	1064
transport	30	91
general charges	297	903
total	1108	3368

Table 6.7. Investment costs per hectare.

	(CFAF 1000)	(US$)	Share of total (%)
Field establishment smallholders (year 1-4)	523	1589	
Field establishment estate (year 1-4)	1108	3368	
Average establishment[1]	861	2617	58
Vehicles	68	207	5
Buildings	174	529	12
Oil mill	370	1131	25
Total	1473	4484	100

1. According to proportion smallholders and estates.

ing is with heavy equipment. Although these costs are paid by the government, they are included in Table 6.6. Smallholders receive a certain amount of cash as a loan as well but this is excluded.

Field establishment, estates. all felling and clearing is with heavy equipment. The general charges cover the overheads for the agro-industrial unit as well as for headquarters of Palmindustrie. The costs for smallholders and estates are given in Table 6.6.

Other investment costs. The costs per hectare for buildings, vehicles and the oil-mill for estate and smallholders together are listed in Table 6.7.

6.4.3.2 Operating costs

The operating costs below are from the 1982/1983 season in one agro industrial unit covering 15 % of the area of Palmindustrie.

Production of fruit bunches by smallholders. Smallholders produce fruit bunches and transport them to the roadside. The staff of the extension group attached to each estate and mill unit organizes transport to the mill and provides extension together with inputs. Table 6.8 gives production costs separately for smallholders and the agro industrial unit. No information is available about the labour input by smallholders. As average yields are considerably lower, 6.7 t of f.f.b. per hectare, labour input for harvesting as well as for upkeep and cultivation must be lower than on estates and the total labour input for smallholders is estimated at 33 d/ha. Besides his labour, the smallholder pays for fertilizers, pesticides and tools when his oil palms are in the productive stage.

Production of fruit bunches on estates. The amounts used and the costs for the main activities are listed in Table 6.9. The average yield of the estates with a total of 5473 ha, 9.2 t f.f.b. per hectare, is used for transformation of costs per hectare to costs per tonne of f.f.b.

Processing. The average costs of two factories, one of capacity 20 t of f.f.b. per hour and one of 40 t/h, belonging to one agro-industrial unit with a total input of 106 000 t of f.f.b. per year are given in Table 6.10. The average oil-extraction ratio of 19.7 % and kernel-extraction ratio of 5.1 % is used for the conversion of costs per tonne of bunches into costs per tonne of product.

General charges are given (Table 6.11) for the separate activities: production of fruit bunches by smallholders and estates, processing and for the agro-industrial unit. No data are available about the general charges from headquarters. The average yield of the agro-industrial unit including smallholders of 7.7 t of f.f.b. per hectare is used to convert costs per tonne of f.f.b. into costs per hectare.

Interest on invested capital in estate and mill, and interest cash required for working capital is estimated as follows:

Table 6.8. Production costs fruit bunches by smallholders.

	Per hectare		Per tonne	
	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)
Smallholder inputs				
labour (33 d/ha)	24.7	75.2	3.7	11.2
services, disease control, etc.	0.4	1.1	0.1	0.2
fertilizer (KCl 120 kg/ha)	7.2	21.9	1.0	3.3
other materials	0.5	1.5	0.1	0.2
subtotal	32.8	99.7	4.9	14.9
output (6.7 t f.f.b./ha)	100.5	305.5	15.0	45.6
Palmindustrie				
purchase fruit bunches			15.0	45.6
collection			3.9	12.0
Total			18.9	57.6

Table 6.9. Production costs fruit bunches by estates.

	Per hectare		Per tonne	
	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)
Upkeep and cultivation				
labour (23 d/ha)	20.0	60.7	2.2	6.6
fertilizer (KCl 210 kg/ha)	12.6	38.3	1.4	4.2
other materials	0.9	2.7	0.1	0.3
transport	5.8	17.6	0.6	1.9
subtotal	39.3	119.3	4.3	13.0
Harvesting				
labour (1.85 d/t)	15.1	45.9	1.6	5.0
materials	1.4	4.3	0.1	0.5
transport	7.0	21.3	0.8	2.3
subtotal	23.5	71.5	2.5	7.8
Transport incl. collection				
labour	2.4	7.3	0.3	0.8
transport	12.2	37.1	1.3	4.0
subtotal	14.6	44.4	1.6	4.8
Total	77.4	235.2	8.4	25.6

Table 6.10. Processing costs.

	Per tonne f.f.b.		Per tonne product	
	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)
Processing				
staff and labour	1.3	4.1	5.4	16.4
materials	2.0	6.2	8.2	24.8
other	0.1	0.2	0.2	0.7
subtotal	3.4	10.5	13.8	41.9
Forwarding and distribution	0.8	2.3	3.1	9.4
Total	4.2	12.8	16.9	51.3

Table 6.11. General charges per activity for agro-industrial units.

	Per hectare		Per tonne f.f.b.		Per tonne product	
	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)
Production						
smallholders	7.2	21.9	1.1	3.30	4.3	13.20
Production						
estates	28.7	87.2	3.1	9.50	12.6	38.20
Processing	4.5	13.6	0.6	1.80	2.3	7.10
Overhead	2.9	8.9	0.4	1.20	1.5	4.60
Total						
(weighted average)	23.2	70.5	3.0	9.10	12.1	36.80

10 % of 50 % of invested capital per hectare = CFAF 73 600 or $224
10 % of 25 % of operating costs per hectare = CFAF 4100 or $12
total interest per hectare per year = CFAF 77 700 or $236

6.4.4 Returns

Yields. The average yield of all improved oil-palm holdings has ranged between 7.0 and 10.0 t of f.f.b. per hectare since 1970. Yields of smallholders were 5–7.5 t of f.f.b. per hectare and yields on Palmindustrie estates ranged from 9.0–13.5 t f.f.b. per hectare. The yields for smallholders refer to the sales to Palmindustrie factories only. It is estimated that 10–20 % of the smallholder production is sold through private channels so that actual yields are around 6–9 t of f.f.b. per hectare. The average production was 8.4 t of f.f.b. per hectare in 1982. The oil-extraction ratio ranges between 19.1 and 22.4 % with an average of 20.4 %, so that average yield of palm oil is 1.7 t/ha. The average kernel-extraction ratio is 4.5 %, so that kernel yield is 0.37 t/ha.

Prices. The price of fruit bunches paid by Palmindustrie to the smallholders rose from CFAF 4/kg to CFAF 15/kg in the period 1965–1982 (Table 6.12). Local

Table 6.12. Prices of fruit bunches.

Period	1965-1973	1974-1976	1977-1980	1981-1982
Price CFAF/kg	4	8	10	15

Source: Ministère de l'Agriculture (1981, 1982)

Table 6.13. Production costs oil-palm products.

	Per hectare		Per tonne f.f.b.		Per tonne product	
	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)	(CFAF 1000)	(US$)
Operating costs						
bunch production	107.8	327.7	14.0	42.4	56.2	171.0
processing	26.4	80.2	3.4	10.5	13.8	41.9
forwarding	5.9	17.9	0.8	2.3	3.1	9.4
general charges	23.2	70.5	3.0	9.1	12.1	36.8
interest	77.0	236.0	10.1	30.7	40.7	123.7
subtotal	240.3	732.3	31.3	95.0	125.9	382.8
Depreciation capital						
field establishment	34.4	104.6	4.5	13.6	18.0	54.8
vehicles	13.6	41.3	1.8	5.4	7.1	21.6
oil-mill	29.6	90.0	3.8	11.7	15.5	47.1
buildings	4.3	13.1	0.6	1.7	2.3	6.8
subtotal	81.9	249.0	10.6	32.4	42.9	130.3
Total	322.2	981.3	42.9	127.4	168.8	513.1

prices for crude palm oil delivered to the refiners in Abidjan are not available exept for 1982, at which time the price was CFAF 175 000/t. The price for kernels delivered in Abidjan was CFAF 60 000/t from 1980 until 1982. These prices result in a price of CFAF 154 200/t of product or $469/t with the oil-extraction and kernel-extraction ratios as before. This price is well above the price received by the estates for crude palm oil exported (Section 6.6.3; Table 6.17) and the average price received for oil-palm products is thus below CFAF 154 200/t.

6.4.5 Review costs and returns

Comparison of costs and returns poses special problems as production costs given in Table 6.13 do not include total general charges and the average price of oil-palm products is somewhere between the price for locally delivered produce,

Table 6.14. Input-output data.

Output per hectare	Quantity		Domestic price		Value	
	(t)	ratio (%)	(CFAF/t)	(US$/t)	(CFAF)	(US$)
F.f.b.	8.4					
C.p.o.	1.7	20.4	175000	532	297500	904
Kernels	0.37	4.5	60000	182	22200	67
Total product	2.07	24.9	154200	469	319700	971

Inputs per tonne product	Quantity	Costs	
		(CFAF)	(US$)
Land	0.48 ha	p.m.	p.m.
Labour (estate)			
upkeep (23 d/ha/yr)	11.1 d	8330	25.30
harvesting (1.85 d/t f.f.b.)	7.4 d	6560	19.90
transport (0.30 d/t f.f.b.)	1.2 d	1040	3.20
mill	3.0 d	2600	7.90
subtotal	22.7 d	18530	56.30
Non-factor inputs			
from operating costs			
fertilizer (175 kg/ha)	85 kg	5100	15.50
other materials		9200	28.00
depreciation investments			
field establishment		11100	33.70
vehicles		6600	20.00
oil mill		14300	43.50
buildings		2100	6.40
subtotal		48400	147.10

CFAF 154 000/t, and the price received for exported crude palm oil and kernels, about CFAF 115 000/t. However the available data point to a situation in which Palmindustrie, the main producer in Ivory Coast, is making a considerable loss. To some extent, this loss is due to the comparatively high price of fruit bunches paid to smallholders but there are more factors influencing the total costs.

The input-output data (Table 6.14) are based on the national yield and yield factors (Section 6.4.4) and the average inputs used by estates and smallholders. The labour inputs refer to the situation on estates, as only estate data are available. The various cost items for oil-palm establishment are for a considerable part supplied by contractors and the average non- factor inputs for estates and smallholdings are estimated at CFAF 574 000/ha. This amount is used to compute the depreciation per tonne of product. Vehicles, oil-mill and buildings are bought or constructed by contractors, and the total amounts invested per hectare are used to calculate the inputs per tonne of product. The labour input is 22.7 d/t of product or 47 d/ha which corresponds with about 1 labourer for 5.5 ha. Non-factor inputs is considerable at CFAF 54 000/t, a proportion of 32 % of the total production costs.

6.5 Processing

Crude palm oil is refined and further processed in one large plant, Société Blohorn SA-HSL, and two smaller plants in Abidjan, all privately owned. The refining capacity of the large plant is 70 000 t/year. The amount of crude palm oil processed by these plants into cooking oil or soap has increased considerably since 1970 (Table 6.15). A plant processing palm-kernels and copra of Palmindustrie started operations in 1978 but technical problems caused crushing to stop in 1981 and kernels are exported again as such. One estate of Palmindustrie produced charcoal from kernel shells in the period 1976 to 1978.

Table 6.15. Processing of crude palm-oil and kernels.

	Crude palm oil		Kernels	
	(1000 t)	share of production (%)	(1000 t)	share of production (%)
1970	20	45	–	
1975	42	27	–	
1976	57	40	–	
1977	61	48	–	
1978	65	47	25	81
1979	74	60	20	77
1980	90	49	31	82
1981	107	74	13	38

Sources: Palmindustries (1981), Ministère de l'Agriculture (1981, 1982)

6.6 Marketing

6.6.1 Marketing channels

Oil-palm products are marketed in various stages. Fresh fruit bunches from smallholders and several private estates are sold to Palmindustrie mills for processing. Crude palm oil, produced mainly by Palmindustrie mills, is sold to private refiners or exported and palm kernels are almost completely dealt with by Palmindustrie. The flow of products from improved oil palms is given in Figure 6.5.

Besides the trade in oil-palm products, there is a considerable trade in locally processed palm oil. The estimated production of 200 000 of t fruit bunches from semiwild oil-palms is 16 000 t of palm oil, with an estimated extraction ratio of 8 %. In addition to the bunches from the semiwild oil palms, 22 000 t of fruit bunches from improved oil palms on smallholdings are estimated to be sold to small private traders and processors. Various other products are produced on a small scale, such as palm wine, kernel oil and soap, but no information is available about amounts, prices and costs.

6.6.2 Marketing functions

Palmindustrie takes care of the transport of fruit bunches from smallholders to their mills as well as the transport of crude palm oil by tank lorries and transport of kernels from the mills to Abidjan. Average transport costs for crude palm oil and kernels are CFAF 2700/t and CFAF 4600/t, respectively.

A bulking installation of Palmindustrie is available in the harbour of Abidjan for the export of palm oil. Further storage capacity is available at the various processing factories.

The sale of crude palm oil and kernels produced by Palmindustrie was arranged by the Agricultural Price Stabilization Fund (CSSPA). Recently this marketing function was transferred to Palmindustrie and sale to domestic processors or overseas buyers is now arranged by the marketing department.

6.6.3 Pricing, taxation and costs

The price of fresh fruit bunches is fixed by the government and changes were made from time to time (Table 6.12). The prices of exported crude palm oil and kernels are listed in Table 6.16. The border price of c.p.o. was CFAF 126 400/t ($384/t) and the border price of palm kernels is estimated at CFAF 68 000/t ($208/t), both in 1982. These prices result in a border price for oil-palm products of CFAF 116 000/t, $352/t, which is a quarter below the price for produce locally delivered. In other words, the nominal protection coefficient is 1.33.

Taxation tariffs are low: 2 % custom duty on palm oil and 4 % on palm kernels. During the period in which the Agricultural Price Stabilization Fund was in charge

Table 6.16. Prices of crude palm oil and palm kernels.

	Crude palm oil			Palm kernels		
	world market (US$/t)	f.o.b.[1]		world market (US$/t)	f.o.b.[1]	
		(US$/t)	(CFAF/1000 t)		(US$/t)	(CFAF/1000 t)
1970	260	.	.	168	.	.
1975	434	418	89	207	154	33
1976	406	343	82	230	155	37
1977	530	463	114	326	280	69
1978	600	535	121	364	.	.
1979	654	582	124	500	.	.
1980	584	559	118	345	327	69
1981	569	449	122	317	.	.
1982	445	389	128	270	.	.

1. Partly calculated from c.i.f. prices in CFAF.
Sources: see Table 6.13, World Bank (1984)

of marketing, Sodepalm/Palmindustrie received a price per kilogram of oil delivered based on the estimated and agreed cost price. Differences, positive or negative, between actual price received by the Stabilization Fund and the agreed price paid to the producer were absorbed by the Fund. Detailed information about the operations of the Fund in palm oil and kernels is not available for recent years.

The marketing costs for crude palm oil, partly estimated, for domestic and export destinations (Table 6.17) give the information required for the calculation of the border price and prices received by the estate.

Table 6.17. Marketing costs crude palm oil in 1982.

	Domestic market	Export	
	(CFAF/1000 t)	(CFAF/1000 t)	(US$/t)
Price ex estate	172.3	121.1	368.2
Transport to Abidjan	2.7	2.7	8.2
Price delivered to local buyer	175.0		
Harbour costs		1.3	4.0
Custom duty (2 % f.o.b. price)		2.6	8.0
F.o.b. price		127.7	388.4
Insurance; brokerage (1,7 % c.i.f. price)		2.5	7.6
Freight to West European port		16.2	49.0
C.i.f. price West European port		146.4	445.0

Table 6.18. Export of oil-palm products by Sodepalm/Palmindustrie (1000 t).

	Crude palm oil	Kernels	Kernel oil	Kernel meal
1970	11.2	4.3	–	–
1975	75.0	17.4	–	–
1976	93.8	30.2	–	–
1977	68.2	20.3	–	–
1978	63.1	–	11.6	11.4
1979	38.6	–	9.9	8.4
1980	79.5	–	14.1	14.6
1981	41.2	18.2	5.5	6.1

Source: Palmindustrie (1981)

6.6.4 Export and domestic consumption

The amount of crude palm oil exported rose quickly from 1970 until 1975, but has fluctuated considerably since. The amount of palm kernels exported increased in a similar way but kernel oil and kernel meal were exported during the period 1978 to 1981. Export data from the Customs Department do not specify the origin of oil exported; so only amounts exported by Sodepalm/Palmindustrie are listed in Table 6.18.

Comprehensive data are not available about the internal market in oils and fats. Data from the Customs Department show that 2000 to 5000 t of groundnut and soya oil, mainly in refined form, were imported annually at least until 1979. More recent information is not available.

6.7 Supporting services

6.7.1 Research and advisory services

The station in La Mé is the principal research station on oil palm of IRHO and one of the leading stations in the world. There are 5200 ha of oil palm on La Mé and the two substations in Ivory Coast, for research and seed production. In total, 25 researchers and over 1600 staff are employed on the 3 stations. Research activities are divided into three main programmes:

- Improvement of oil palm: genetic improvement, vegetative propagation.
- Introduction of *Elaeis melanococca* and hybridization with *E. guineensis*.
- Agronomy including pests and diseases, fertilizer trials and agronomic practices.

The total research budget for 1982 was CFAF 800 million, or $25 million. Besides research activities, pre-germinated seeds are produced from selected palms and sold to growers all over the world, a total of 4 million treated seeds were supplied in 1982. The supply of seeds is often combined with advisory services. In Ivory

Coast, the research station provides technical advise to Palmindustrie and private estates.

One private estate planted 67 ha of oil palm under irrigation in 1981 and the results of this trial could influence oil-palm cultivation in Ivory Coast and West Africa in general.

6.7.2 Supply of inputs

Most fertilizers, vehicles and processing equipment are imported. The main fertilizer used for oil palms, potassium, is all imported by Palmindustrie; 80 % of nitrogen and phosphorus fertilizers are imported. Processing mills have been built or are being upgraded by European companies operating on a turnkey basis.

6.8 Summary and economic parameters

Ivory Coast is the second producer of palm oil in Africa after Nigeria, and the fourth producer in the world with 2.8 % of the total world production. It is the only country in Africa exporting sizeable amounts of palm oil. The greater part, about 90 % of the palm-oil production is from improved planted palms on estates and smallholdings, established after 1960. Production of palm oil from fruits of semiwild palms declined relatively as well as in absolute terms.

Palmindustrie, a corporation in which the government participates, is the main producer controlling 89 % of the total area under improved oil palms. Palmindustrie operates through agro-industrial units, a combination of oilmills, estates and smallholders under one management. There are several small private estates and the main research station of the IRHO with a total area of 5000 ha for field tests and the production of germinated seeds. The area of semiwild palms is estimated at 100 000 ha.

Ecological conditions are moderate in the oil-palm area along the coast as a dry period of 2–4 months limits yield to a maximum of 2.5 t of oil per hectare, average yields being 1.6 t/ha. Production costs of palm oil and kernels were well above the corresponding world market price in 1982 but below the domestic price paid by the processing industry. The result is that local sales resulted in a profit but exports in a loss.

There are several processing plants in Abidjan and 70 % of the crude palm oil is processed, for instance into cooking oil or soap. Palm kernels are partly processed into kernel oil and meal, and partly exported as such. Non-factor inputs, such as fertilizer, vehicles and processing equipment, are imported.

Economic parameters of the oil-palm sector in Ivory Coast (1982).

Resources used	
Land under improved oil palm	100 600 ha
area in production	92 000 ha
estimated area under semiwild oil palm	100 000 ha
total area as share of area under permanent crops	18 %
Labour for estates, including oil-mills	12 900 man-year
for area in production, including oil-mills	12 000 man-year
smallholders	8 600 man-year
Non-factor inputs for production and marketing	
domestically produced	US$ 8.2 million
imported	US$ 19.9 million
Output	
Improved palms, estates and smallholders	
crude palm oil (160 000 t)	
70 % at domestic price	US$ 59.6 million
30 % f.o.b. price	US$ 18.6 million
palm kernels at domestic price (35 000 t)	US$ 6.4 million
total product (195 000 t)	US$ 84.6 million
value added by estates and smallholders	US$ 56.5 million
value added by sector	US$ 64.7 million
Semiwild palms (estimated)	
crude palm oil (20 000 t)	US$ 10.6 million
palm kernels (8 000 t)	US$ 1.5 million
total product (28 000 t)	US$ 12.1 million
Productivity primary producers with improved oil palms	
Gross return per hectare	US$ 920
Value added per hectare	US$ 610
Gross return per man-year	US$ 4100
Value added per man-year	US$ 2740
Destination products	
Crude palm oil	
domestic market	70 %
export	30 %
Palm kernels	
domestic market	30 %
export	70 %

Sources: see previous tables; own estimates

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Currency equivalents and price indices in Ivory Coast (1960-1983).

	Exchange rate (CFAF per US$)	Consumer price index (1980 = 100)
1960	247	22
1965	247	25
1970	278	32
1971	277	32
1972	252	32
1973	223	35
1974	240	42
1975	214	46
1976	239	52
1977	246	66
1978	226	75
1979	213	87
1980	211	100
1981	272	109
1982	329	117
1983	381	124

Source: IMF (1984)

7 Oil palm in Nigeria

7.1 Background

Nigeria has a Federal Government and 19 State Governments (Figure 7.1). It is the most populous country in Africa with 90.6 million inhabitants in 1982.
The total land area is 923 770 km^2 and the average population density is 95 people per square kilometre. The southern states are the most densely populated with 50 to more than 400 people per square kilometre.

The GNP was $860 per person in 1982. Agriculture, industry and services accounted for 22 %, 39 % and 30 %, respectively, of the GDP. Agriculture is the main employer with 50 % of total employment. The total arable area is 27.4 million hectares; 2.5 million hectares are under permanent crops. The major crops are listed in Table 7.1.

Table 7.1. Average area harvested, yield and national production of major crops over 3-year periods.

Crops	Area (1000 ha)		Yield (kg/ha)		Production (1000 t)	
	1969-1971	1979-1981	1969-1971	1979-1981	1969-1971	1979-1981
Food crops						
maize	1400	1710	869	904	1210	1540
millet	5020	5020	556	629	2790	3160
pulses	3970	4110	214	127	849	896
rice (paddy)	272	515	1290	1990	352	1030
roots & tubers	2610	2990	9580	9410	25000	28100
sorghum	5580	6010	652	634	3630	3810
Oil crops						
cotton (seed)	405	492	304	129	123	63
grundnut	1850	600	900	970	1660	580
oil palm (palm oil)	1800[1]	1800[1]	290	370	528	668
(kernels)			160	190	287	343
Beverages						
cocoa	683	700	382	226	261	158
Other crops						
cotton (lint)	405	492	153	67	62	33
rubber	62	32	–	–	63	48
sugar-cane (sugar)	12	16	3920	4810	47	77

1. Semiwild and planted oil palms.
Source: FAO (1971-1983)

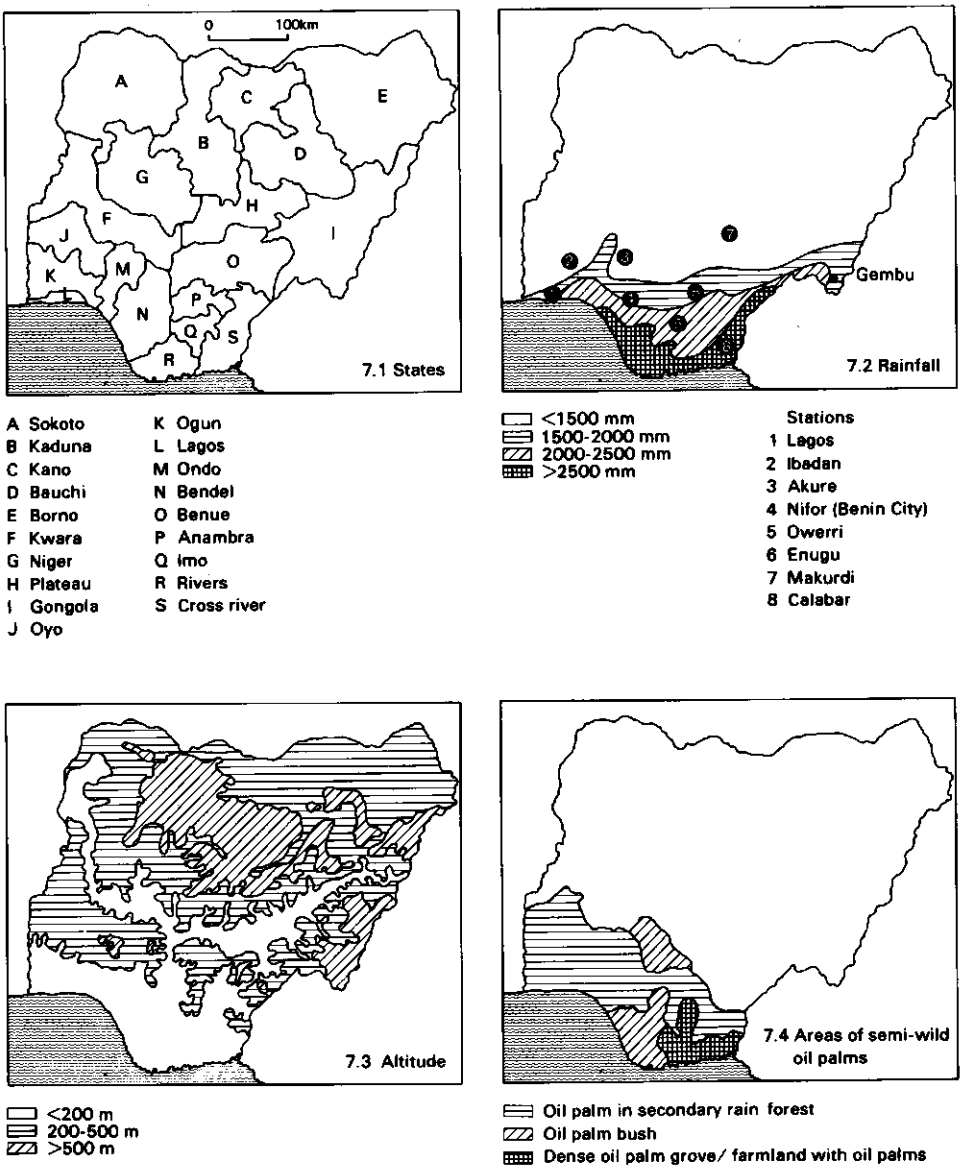

Fig. 7.1–7.4. States (7.1), average annual rainfall (7.2), altitude 87.3) and areas of semi-wild oil palms (7.4) in Nigeria. After Agboola (1979), World Bank (1979).

Nigeria is traditionally the main producer of palm oil in Africa with production based mainly on the harvesting of semiwild oil palms. The estimated production of palm oil of 710 000 t in 1982 is 12 % of the world production. Nigeria is the third producer after Malaysia and Indonesia. The total palm-oil production is used for domestic consumption. With the export of 82 000 t of palm-kernel products, Nigeria is the second exporter of this commodity in the world after Malaysia.

Nigeria is one of the OPEC countries and the export of mineral oil is of major importance. Agricultural commodities account for only 4 % of total exports. Food, grains, edible fats and oils, and live animals account for 17 % of imports.

7.2 Ecology

The climate is affected by the stable and dry air mass from the Sahara and the unstable humid air mass from the Atlantic. The intertropical front of these two air masses moves north-south during the year between latitudes 18 and 8°N. This results in a climate with a distinct dry period of 6–8 months and an annual rainfall of 750 mm in the northern part of the country and a humid climate with 3000 mm of rainfall and a short drier period in the south.

The rainfall isohyets in the southern part of the country are given on Figure 7.2. Monthly rainfall data for some selected stations are listed in Table 7.2. The rainfall at stations north of the 1500-mm isohyet, Akure, Ibadan and Makurdi, is clearly insufficient and ill-distributed for oil-palm cultivation. The dry period is less severe in the area between the 1500-mm and 2000-mm isohyets and oil-palm cultivation is possible on soils with a good water-holding capacity. The incidence of a second short dry period is more pronounced in the western part of the country and this further limits the suitability for oil palms in the areas with less rainfall than 2000 mm annually. The area south of the 2000-mm isohyet is suitable for oil palms but soils still play a role to minimize the effect of the dry period in the northern section. The average annual water deficit is 355 mm at NIFOR near Benin City. Data from other stations are lacking.

Table 7.2. Distribution of monthly rainfall for selected stations (mm).

	J	F	M	A	M	J	J	A	S	O	N	D	Total
1 Lagos	28	45	98	143	273	443	263	65	140	205	68	25	1796
2 Ibadan	10	23	90	133	148	185	153	83	175	155	45	10	1210
3 Akure	13	35	110	138	168	190	183	113	203	178	55	23	1409
4 Nifor (Benin)	13	28	88	160	195	255	328	198	293	230	58	13	1859
5 Owerri	22	45	123	198	270	303	350	310	423	273	73	20	2409
6 Enugu	18	28	70	150	255	270	195	173	315	245	53	15	1787
7 Makurdi	5	10	33	108	203	193	178	215	253	150	10	0	1358
8 Calabar	43	75	150	210	308	400	443	400	420	305	195	43	2992

Source: FAO (1965)

Temperature is not limiting in the section south of the 1500-mm isohyet as the average monthly minimum temperature is at least 20 °C. Average monthly maximum temperatures are 30 °C or slightly higher. An exception is the mountainous area around Gembu in the extreme eastern part where low night temperatures reduce the suitability for oil palm.

The soils in the areas suitable for oil palms are described as acid sands. They consist of a loose brownish top-soil and a deep largely undifferentiated subsoil with sand as the main fraction and a silt and clay content to 30 %. Oil palm will grow well but attention should be given to the nutrient status of the soils, as nutrients are leached easily. Soils used for annual crops are particularly poor in nutrients. Dressing with potassium, magnesium and, in the first years of development, nitrogen is generally required. The larger sandy fraction of the upper layer of the soil limits the water-holding capacity and periods of dry weather directly affect growth and production.

Data on radiation or duration of sunshine for stations in southern Nigeria are not available.

The overall conclusion about ecology and oil-palm cultivation is that the area between the 1500-mm and 2000-mm isohyet is less suitable as yields will be reduced by the dry period. The area south of the 2000-mm isohyet is suitable but a a drier period limits production. A soil of adequate water-holding capacity alleviates the effect of the drier period.

7.3 The oil-palm sector

7.3.1 History

Oil palm has long been a major crop for the Nigerian farmers in the densely populated forest zone. Zeven (1967) described the various palm grove types found in Nigeria and argued that an increasing population density and thus shorter fallow periods favoured the oil palm as competition from secondary regrowth is reduced.

The oil palm started to become important as a cash crop at the end of the 19th Century with the export of palm oil and palm kernels to England and other countries in Europe. Farquhar (1913), conservator of forests in Nigeria, mentioned an export from northern and southern Nigeria of 77 000 t of palm oil and 173 000 t of kernels in 1910 (Table 7.3). Oil-palm products were the main exports from Nigeria until early in the 1960s although their contribution gradually diminished from 80 % of total export value around 1910 to 18 % in 1965 (Usoro, 1974).

Production for export was initially entirely based on the fruits collected from the semiwild palm groves and on traditional processing techniques. The increase in export volume in the period to World War II resulted from more intensive harvesting. The importance of palm oil and kernels for Nigerian exports, and the emerging competition from Indonesia and Malaysia, resulted in government ef-

Table 7.3. Export of oil palm products (1000 t).

	Palm oil	Palm kernels
1910	76.9	173.0
1920	84.9	207.0
1930	135.8	260.0
1940[1]	154.2	296.6
1950[1]	167.1	380.9
1960	175.0	209.7

1. Products bought for export.
Sources: Usoro (1974), Farquhar (1913)

forts to stimulate production. Road and rail communications were improved, a campaign to plant oil palms and to replant palm groves was started in 1928 and simple hand-presses were introduced in 1931. The effect of the last two measures was negligible and it was decided in 1938 to establish the West African Institute For Oil Palm Research (WAIFOR), now Nigerian Institute For Oil Palm Research (NIFOR), near Benin City to provide a more solid base for improvements to the oil-palm industry. The research mandate covered three broad topics:

- Cultivation of oil palms on smallholdings and estates.
- Selection and breeding for improved high-yielding types of palms.
- Methods of extracting palm oil and kernels.

World War II interrupted rehabilitation and improvement programmes. In 1949, the Nigeria Oil Palm Produce Marketing Board was established to organize the market and to develop a producer price policy. Improved marketing regulations and higher producer prices increased exports. Part of the trade surpluses of the Marketing Board were channelled to Regional Production Development Boards and used for the development of oil mills and plantations. Competition from these oil mills, with a higher extraction ratio and a better quality of oil, resulted in a shift from traditional processing methods to the widespread use of hand-presses. The use of mills and the increased use of hand-presses raised the overall extraction ratio and thus production. The share of palm oil produced by mills, however, remained small, between 4.5 and 7 % of production in the period up to 1954. The development of plantations was a new phenomenon in Nigeria but its importance remained restricted as the area planted by production boards was small, a thousand hectares between 1949 and 1954. The main obstacle to large-scale oil-palm plantings was the lack of free land.

The introduction of a regional constitution in Nigeria in 1954 led to the creation of regional development boards responsible for institutional support of the oil-palm industry. The Eastern Region was the main production area and the Eastern Nigeria Marketing Board started several development schemes. Attention was focused on plantation and oil-mill development and local farmers received much less attention. The costs of investments in plantations and oil mills were paid for

from the trade surplus and producer prices declined as financial commitments increased. The effects of the investment in oil mills and plantations were small and the palm oil processed by mills was no more than 5 % of the total amount bought by the marketing board. The negative effect of lower producer prices on production was most probably greater than the increase in production due to plantations and oil mills. The total amount purchased by the marketing board declined.

Two schemes to assist smallholders in the period from 1954–1968 should be mentioned:

- The oil-palm rehabilitation schemes by the Eastern Nigeria Marketing Board, the Eastern Regional Production Development Board, the Department of Agriculture and WAIFOR.
- The development and introduction of hydraulic hand-presses.

The rehabilitation scheme resulted in replanting of 28 000 ha in 1954-1968 with the highest annual figures in 1966/1967 and 1967/1968. The introduction of the hydraulic hand-presses met with little success and the hand-screwpress remained the most widely used equipment for local extraction of oil. The Civil War, 1967–1970, seriously affected the oil-palm industry, and planting and replanting schemes came to a halt.

7.3.2 Recent developments

After 1970, the oil-palm sector must be considered within the context of the rapid change in the Nigerian economy with the petroleum boom. Exports of petroleum started in the mid-1960s and gradually increased until 1974 when prices increased fourfold and petroleum became the dominant export commodity and source of government revenue. Three effects influenced agricultural production in general and palm-oil production in particular. Firstly rapid urbanization caused a shortage of labour in the rural areas, especially of the young men who used to harvest the oil palms by climbing the tall trees. Secondly revaluation of the Naira and rapid domestic inflation made domestic production less competitive with imported products and exports became unprofitable. Thirdly investments in trade gave much quicker and higher returns than investments in palm-oil production and very little private investments were made for estates, mills or smallholdings.

At the end of the Civil War in 1970, the oil-palm sector was seriously disrupted. Virtually all estates were abandoned, processing mills destroyed and exploitation of smallholdings and palm groves had low priority as production of staple foods required all available labour. Recovery by rehabilitation, by replanting and by rebuilding processing mills was slow through lack of funds and labour. The stagnating production of oil-palm products and the increasing domestic demand caused shortages. In 1972, Nigeria became a net importer of edible oils. The Federal Government sought ways and means to revive production of agricultural export commodities and a programme started for cocoa and oil palm with assistance from the World Bank. A monitoring and evaluation unit was set up to observe the per-

formance and progress of the various projects. The oil-palm programme started in 1975. It included smallholders' schemes, privately run estates and federal estates run by consultants. Mainly by these programmes, replanting regained momentum. Table 7.4 lists the areas planted per year since 1970. An unknown proportion of the total area planted is abandoned or is beyond the productive age.

Census data on the area of semiwild palm groves are not available and estimates range from 1.2 to 2.4 million hectares. A general picture of the occurrence of semiwild palms is given by Agboola (1979) (Figure 7.3). The semiwild palms are generally intercropped and this makes it difficult to arrive at reliable estimates, expressed in hectares of pure stand. Most palm oil and kernels are pro-

Table 7.4. Area planted per year and total area of improved oil palm (1000 ha).

	Planted	Total
Before 1960	11.4	11.4
1960-1965	40.2	51.6
1966-1970	13.6	65.2
1971	2.8	67.0
1972	4.2	71.2
1973	6.1	77.3
1974	6.8	84.1
1975	6.8	90.9
1976	5.0	95.9
1977	7.9	103.8
1978	15.2	119.0
1979	10.1	129.1
1980	12.4	141.5
1981	7.6	149.1
1982	5.8	154.9

Sources: MEU (1980, 1982, 1983)

Table 7.5. Production of crude palm oil and kernels (1000 t).

	Palm oil	Palm kernels
1965	574	455
1970	540	300
1975	640	300
1976	655	296
1977	660	302
1978	670	238
1979	650	335
1980	675	345
1981	675	350
1982	700	355

Source: FAO (1971-1983)

duced on smallholdings and are traded locally. Estimated production data since 1965 are given in Table 7.5. The decrease in production of palm kernels points to less intensive exploitation of the semiwild palm groves through lack of labour for harvesting. The complementary reduction in palm-oil production is offset by increased production from planted palms and the increasing use of more efficient processing methods with a higher oil-extraction ratio than traditional methods. The various estimates of area planted, yields and total production are given in Table 7.6.

The shift from export to domestic use of palm oil resulted in losses for the regional marketing boards, as amounts handled fell. The Federal Government reorganized the marketing system in 1973 by establishing the Nigerian Produce Marketing Corporation in charge of domestic and foreign marketing. The regional marketing boards became buying agents. Another reorganization in 1977 resulted in the establishment of the Nigerian Palm Produce Board (NPPB) with responsibilities in marketing including exporting, input supply and, more generally, the promotion of the prosperity of producers. The Board operates in competition with

Table 7.6. Estimates regarding area, yield and production in 1982.

Type of production	Area (1000 ha)	Yield	Oil extraction	Production palm oil (1000 t)
		f.f.b. (t/ha)	(%)	
Improved palms	155	6	20	180
Semi-wild palms	1650	2	16	520
Total	1800			700

Table 7.7. Statutory purchases and exports of oil-palm products (1000 t).

	Palm oil		Palm kernels		Palm kernels products[1]
	purchases	exports	purchases	exports	exports
1965	171	152	461	422	1
1970	15	8	265	185	33
1975	5	–	274	174	21
1976	.	3	147	272	13
1977	3	–	186	66	–
1978	–	–	239	87	116
1979	–	–	230	69	122
1980	–	–	209	86	111
1981	–	–	194	48	97
1982	–	–	189	64	82

1. Till 1976 only figures regarding palm kernel oil, from 1978 palm-kernel oil, palm-kernel pellets and palm-kernel cake.
Source: NPPB

others on the domestic market but is exclusively responsible for export trade. Purchases and exports by the various export institutions are listed in Table 7.7. Palm-oil purchases and exports decreased drastically after 1965 and no trading activities have been reported by the NPPB in recent years. The export of palm kernels and palm-kernel products in recent years is about 40 % of the amount in 1965. The shift from the export of kernels to kernel products is due to an increased crushing capacity.

7.3.3 Organization

The importance of smallholders for production of palm oil and kernels is apparent from the data given in the outline of the oil-palm sector (Figure 7.5). There are several reasons why production of kernels is high in relation to production of palm oil by smallholders:

- The semiwild palms produce fruit with a higher kernel-to-bunch ratio than the improved palms.
- Oil extraction by smallholders is less efficient than in larger mills.

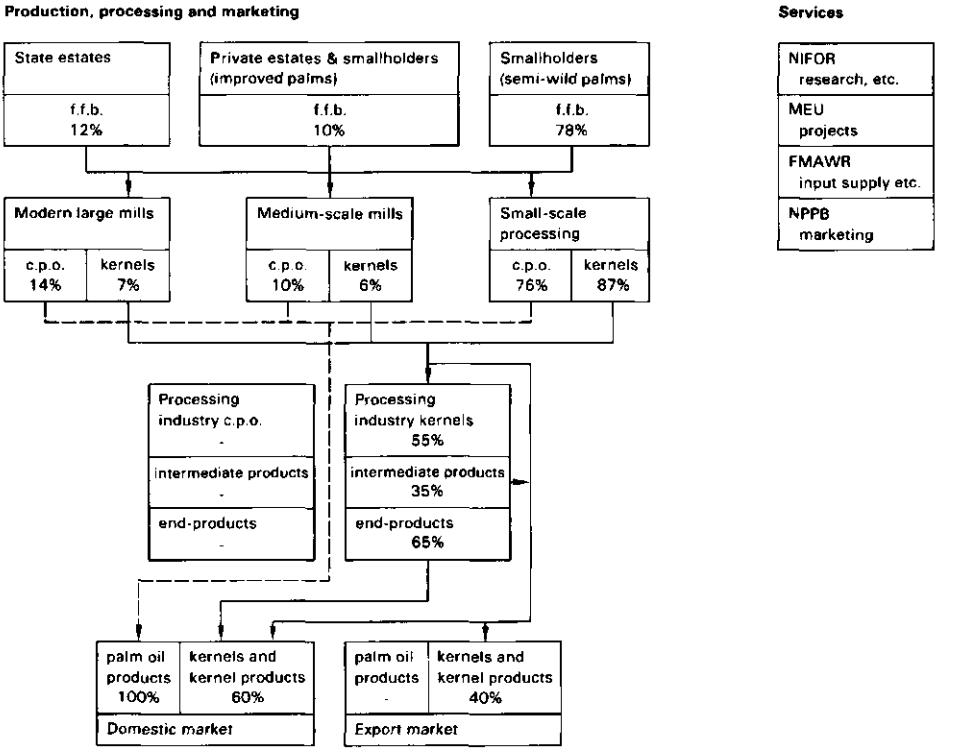

Fig. 7.5. The oil-palm sector in Nigeria, 1982. Broken line, palm oil and palm-oil products; solid line, kernels and kernel products.

– Kernels are recovered from bunches not processed for oil.

Crude palm oil produced by smallholders and mills is consumed without refining. The refining industry operates with imported crude palm oil.

The Government has an overall influence on the oil-palm sector through the establishment of guaranteed producer prices for palm oil and kernels. The guaranteed price for palm oil, however, is not longer effective, as market prices in recent years were well above the guaranteed price. The Government plays a more direct role in that part of the oil-palm sector making use of improved planting material and more modern processing techniques. Several institutions, briefly outlined in Sections 7.6 and 7.7, deal with smallholders, estates and central processing units by means of rehabilitation, replanting, and development schemes and projects.

The traditional section of the oil-palm sector, responsible for 78 % of production, is hardly reached by government institutions. Sale of palm kernels to NPPB is the main link between the traditional sector and the Government. This link is important, since it allows many smallholders to obtain a cash income for palm kernels at a guaranteed price. Palm kernels, however, are a by-product and the guaranteed marketing prospects for kernels alone is a minor factor in decisions on oil-palm cultivation, such as more intensive or less intensive utilization of semiwild palm groves, or planting improved oil palms.

7.4 Production of crude palm oil and kernels

7.4.1 Production factors

The population density in the southern part of Nigeria is high and large areas have more than 200 inhabitants per square kilometre. Virgin land is not available except in some reserves. Large expansion by establishment of estates or by settlement schemes is thus not possible. In this situation, oil palm competes with food crops for land. As the gross returns for crops like yam and cassava are higher than for semiwild or improved oil palms, the maintenance or cultivation of oil palms is not attractive.

Labour is a major problem for estates and an unknown but apparently considerable proportion of established estates are overgrown or not harvested through lack of labour. Determination of labour costs is difficult under these circumstances as a certain wage rate may be not attractive enough to satisfy labour requirements. However the government minimum wage for unskilled labour in 1981 was ₦ 1500 per year or ₦ 6 per day, and various reports mention rates of ₦ 5.80–7.00 per day for 1980–1984 and these amounts are indicative.

The bulk of the palm oil and kernels are produced by smallholders and capital requirements are met from their own financial means. Development projects obtain finance from the Federal and State Government and from external sources such as the World Bank. Financial constraints on the Federal and State Govern-

ments caused irregular and uncertain funding of the oil palm projects which had adverse effects on investment programmes.

7.4.2 Producers and production systems

Crude palm oil and kernels are produced in diverse production systems. The differences result from the use of semiwild palms or improved palms, and production on estates or on smallholdings. The producers are classified according to production system and type of ownership (state or private).

Government estates. There are about 70 000 ha of estates owned by the Federal Government or by state governments.

Private estates and smallholders; improved palms. An estimated area of 85 000 ha has been planted by smallholders in several smallholders' projects and by private estates. Smallholdings range upwards in area from 2 ha and estates may reach 4000 ha. Smallholders usually sell their fruit to public mills and estates may have their own processing mills.

Smallholders; semiwild palms. The main producers in Nigeria with an estimated area of 1.65 million hectares spread over several million smallholdings in the southern part of Nigeria. The fruit bunches may be processed by the smallholders themselves, by small processing units in the villages or by state mills.

State processing mills. Several processing mills operate in areas with a concentration of smallholders. These mills are usually owned by state development agencies. Data on number of mills in operation and on processing capacity are not available.

The number of medium-scale and large processing mills in Nigeria on estates and as separate enterprises for the processing of fruit from smallholders (Aladewolu, 1985) is 85, with a total capacity of 241 t of f.f.b. per hour.

7.4.3 Costs and returns

Comprehensive data about costs and returns on smallholdings and estates, the basis for calculation of cost prices, are not available. Production on smallholdings and estates is briefly reviewed in the sections below and some scattered data on smallholder production are compiled to form a picture of costs, returns and productivity.

7.4.3.1 Smallholder production

Production of fresh fruit bunches. Most fresh fruit bunches produced by smallholders are from semiwild oil palms. The term 'semiwild' refers to the spontaneous establishment of the palms in a environment changed by human occupation. It does not mean that anybody can harvest the fruits, as the palms are owned in the densely populated areas where oil palms occur. Oil palms are a major com-

ponent of the farming system. Besides direct productive value, they are regarded as fixed assets, which can be pledged for loans or kept as a reserve for future requirements. The density of palms on a smallholding ranges from a few up to 200 per hectare. In all areas, the palms are intercropped with food crops such as cassava, yam and maize. In areas with a population density of more than 300 people per square kilometre, oil palms are cut down, as all land is required for production of food crops. Yield of semiwild palms ranges from zero, if palms are not harvested, to 5 tonnes of fresh fruit bunches per hectare for dense stands of palms. Average yield is estimated at 2 t/ha.

Labour for harvesting and transport is the main input for production of fresh fruit bunches from semiwild palms and the ratio of labour costs to price of fresh fruit bunches governs the rate of exploitation, provided alternative uses of labour are available. Young men, who harvest the fruits, are scarce in the rural areas. They have to climb the often tall palms, cutting off old leaves and cut the thick stem of the fruit bunch. Competition with food crops, such as cassava, yams and maize, and, in some areas, with tree crops, such as rubber and cocoa, determines the size of stands in the longer run and thus production in future.

Production of fresh fruit bunches on planted smallholdings is of minor importance. Planting and replanting schemes have met with little success for several reasons:

- Land is very scarce and few farmers can afford to plant the required minimum area of 1–2 ha, depending on the scheme, with oil palms only; the consolidation of parcels of several farmers into blocks of sufficient size proved very difficult under traditional systems of land tenure.
- The authorities insist on clear-felling of existing semiwild palms, from which the benefits foregone in 4–6 years are higher than the subsidies provided.
- The ratio of labour costs to guaranteed prices of palm oil is unattractive.

Several smallholder schemes are now in operation and the supply of inputs and services differs from scheme to scheme. The peasant farmers participating in programmes assisted by the World Bank receive free seed for cover crops, free seedlings, wire collars, 800 kg of fertilizer over 4 years and a cash loan of 300 over the same period.

Processing. The fruit bunches are processed by smallholders in various ways: the traditional manner, by boiling, hand-pounding and skimming the oil from the pulped mass; with hand-screwpresses or with hand-operated hydraulic presses. The efficiency of these methods is lower than of modern mills, and the overall rate of oil extraction is about 10 % for the traditional method and 15 % for the hand-presses. Furthermore these methods are labour-intensive and require substantial amounts of firewood. The quality of oil is low, according to export standards, but domestic consumers have a preference for this type of oil. The small scale of the processing units is a major advantage in transport costs, as such units operate with fruit produced nearby. Kernels are recovered from the pulped or pressed mass and are cracked by hand, a very laborious process. Various other products are

produced from the oil palm, such as baskets from the leaves and soap from oil residues and ashes.

Costs, returns and labour productivity. Information from several sources (Table 7.8) gives some insight into the smallholders' production and processing activities. The labour productivity is, 8–15 litres of palm oil per day, a main determinant in production. The price of palm oil is another main determinant: in recent years, the price on the free market was ₦ 700–900/t. The minimum wage rate is ₦ 5/d, thus an oil production of 7 l/d is required just to cover labour costs. Much of the labour required for palm-oil production is indeed hired labour, as harvesting is a specialized job and as processing requires 5–8 people, which is more than a family can supply. Investment costs of the establishment of palms and processing equipment and operation costs, other than labour, are not included in the calculation and we can safely assume that smallholder production was not attractive in past years. The situation changed drastically in 1983, as prices of palm oil increased to ₦ 4000–6000/t. The effects of these prices on production are not yet known. Besides palm oil, palm kernels are also produced but the recovery of the

Table 7.8. Labour productivity in production and processing of fruit bunches.

	Production system		
	semiwild palms	improved palms[1]	
Production of fruit bunches			
Labour input			
maintenance d/ha per year	–	32.0	
harvesting d/t	8	3.5	
Investment	–	p.m.	
Output (t/ha)	2	10.0	
Labour productivity (t/d)	0.125	0.149	
	Processing system		
	hand screw press[2]	hand screw press[3]	hydraulic hand press[4]
Processing			
Capacity (t/d)	0.5	0.8	1.5
Investment (₦)	6500	.	21500
Labour input (d/t)	10	5	5
Oil extraction ratio (%)	14	16	18
Labour productivity l.oil/d	14	32	36
Production and processing of fruit bunches			
Labour productivity l.oil/d		8-15	

1. Udom (1982).
2. Handpress developed by Agro Industrial Development Scheme Ibadan, personel communication.
3. Donker (1979).
4. Hydraulic hand press developed by NIFOR, personal communication.

Table 7.9. Annual gross returns of rootcrops and oil palm.

Crop	Yield (t/ha)	Price (₦/t)	Gross return (₦/ha)
Rootcrops	9.4	300	2820
Semiwild oil palm			
oil	0.32	750	263
kernel	0.10	230	.
Improved oil palm			
oil	1.80	750	1465
kernel	0.50	230	.

Sources: FAO (1971-1983)

kernels from the fibre mass and the cracking of the hard shells requires additional labour, traditionally female labour, and inclusion of these activities will not change the smallholders profitability to a major extent.

Oil palm competes with root crops, such as yams and cassava, for space in the more densely populated areas in southern Nigeria. Some indicative figures are listed in Table 7.9, since detailed and recent data are lacking. The semiwild oil palm gives a lower gross return than root crops; in areas with a high population density, oil palms are cut down in favour of root crops. Also an improved marketing system for root crops and transformed products, such as grain and flour, could result in cutting down of oil palms. Improved oil palms give a much higher return per hectare than the semiwild palms. But even at a yield of 10 t of f.f.b. per hectare, they cannot compete with root crops. The limited success of rehabilitation and planting schemes can be partly explained by the relatively low gross return per hectare. The long unproductive period, the inflexibility and the need for specialized, often hired, labour also affect plans to stimulate oil palm.

7.4.3.2 Estate production

The estates, ranging from 150 to more than 3000 ha, are owned by the Federal Government, State Governments, development agencies and private interests. An unknown but apparently considerable part of this area is not maintained and not harvested. Processing mills on the estates are often neglected and various reports mention that harvesting is reduced, because mills cannot cope with the potential fruit supply. Reasons mentioned for the state of affairs on the estates are shortage of labour, lack of funds for operating expenses and investment, unqualified management, and import restrictions on equipment and spares.

Serious efforts are being made to improve the estate sector and two types of estate project are being implemented.

– Nucleus estates: 5 existing estates with an area of about 11 000 ha (1981) will

be expanded to 24 000 ha. The estates will be supplied with processing mills with sufficient capacity to process fruit from smallholder schemes as well. These projects are financed by the Federal and State Governments and the IBRD.
– Estates: 3 estates will be developed into large enterprises of 12 000 ha each. The Federal Government is financing this estate-development programme.
There are no data about costs and returns of estates under normal running conditions, because of the situation described.

7.4.3.3 Centralized processing for smallholders

Several medium-scale processing mills are operating in areas with a concentration of smallholders. These mills are usually owned by government development agencies. With a capacity of about 2 tonnes of fresh fruit bunches per hour, these mills are between the hand-operated smallholders' presses and the large plantation mills, which have with a capacity of 12 t/h or more. The medium-scale mills are established to provide the smallholders with the advantages of modern processing technology, such as high extraction rate of oil, good-quality oil, more efficient use of labour and fuel, and a higher price for the bunches resulting from this. The capacity of these installations is necessarily smaller than the capacity of mills on estates, since transport costs in areas with a low yield quickly become prohibitive, because of the larger area required to supply the mill. Data on number of mills in operation, and their costs and returns are not available. The Federal Department of Agriculture and the Nigerian Palm Produce Board are now implementing a plan to establish 23 medium-scale mills and 160 motorized kernel crackers in areas with smallholders.

7.4.4 Review costs and returns

Production of palm oil and kernels is influenced by two main factors. The first is the development of the national economy in the past 15 years. The migration to the towns caused an acute labour shortage on estates and smallholdings. Plantations became overgrown with bush or at best were only partially maintained and harvested. The revaluation of the Naira and the high domestic inflation made domestic production less competitive with imported oils and fats, and imports took over most of the domestic market.

The second factor is the shortage of land in the southern part of Nigeria, due to the high population density. Virgin land is not available except in some reserves and large-scale expansion by estates or smallholders is not possible. The average area cultivated by smallholders in southern Nigeria is less than 0.5 ha and oil palm cannot compete with crops like cassava and yams, which result in higher returns per hectare. Oil palms on smallholdings must be considered as a valuable but secondary crop, which is kept as long as food requirements can be met. Replanting and rehabilitation schemes based on oil palms in pure stand on areas of 1 ha or

more will have only limited scope, since few farmers can afford to use such an area for a crop with a relatively low gross return per hectare.

Various aspects of the development of the national economy are matters of policy, which can be changed to some extent. The recent shift of attention towards agricultural production could result in economic conditions more favourable for oil-palm cultivation. The scarcity of land in the oil-palm areas cannot be changed but production on millions of smallholdings could be improved, if restrictions on minimum areas required for participation in replanting activities were removed and if intercropping were allowed between or under planted improved palms.

7.5 Processing

The processing industry is small relative to production of palm oil and kernels, partly because consumers' accept or even prefer crude palm oil. There is a refining industry producing soap, edible fat and oil, and margarine, but the industry processes imported crude palm oil as the NPPB is unable to purchase crude palm oil at the official prices and therefore cannot supply the industry.

Palm-kernel oil, and cake or pellets are produced in 4 crushing mills in Lagos and the eastern part of the country. The total amount crushed in 1981 was 125 000 t. Two mills, one in Abak and one in Umunse, are out of order. The total annual crushing capacity is 380 000 t, so that the industry operated at a third of capacity in 1981.

7.6 Marketing

7.6.1 Marketing channels

The domestic trade in oil-palm products is free and farmers may sell their produce to the NPPB at fixed prices or to private traders. The NPPB has the monopoly on export of oil-palm products.

The total production of palm oil is consumed in the country. As domestic prices are above the prices offered by the NPPB, all palm oil is either sold by producers directly to consumers or sold to private traders. The domestic demand for palm kernels is limited and the NPPB is the largest buyer. The board decides whether to export kernels or to send kernels for processing to one of the crushing mills, and whether to export palm-kernel oil or cake. A small amount of kernels, kernel oil and cake is sold to local processing industries.

7.6.2 Marketing functions of the Nigerian Palm Produce Board (NPPB)

The NPPB operates from a head office in Calabar and through a network of 17 state or area offices in production areas. The Board employs 1700 staff for marketing, extension, and operation of stores and installations. In addition, the Board

appoints buying agents, more than 700 in 1981, to purchase from producers and to sell sizeable amounts to the Board. There are 5 depots for kernels as well as inputs and 5 technical installations with a total storage capacity of 60 000 t of oil products. The main storage installations are in Port Harcourt and in Calabar.

7.6.3 Pricing and marketing costs

Prices of the main agricultural products in Nigeria are fixed by the Head of State upon advice by the Technical Committee on Producer Prices (TCPP). The Permanent Secretary of the Federal Ministry of Finance is Chairman of the Committee and members include representatives of the Federal Ministries of Agriculture and Rural Development, Cooperation and Supply, Trade, Economic Development, the Central Bank and the General Managers of the various commodity boards. The prices fixed are guaranteed producer prices, at which the marketing boards are obliged to buy all amounts offered for sale. The guaranteed producer prices in real terms for oil and kernels rose by 80 % in 1974 and then declined to just above the price of palm oil and below the price of kernels in 1970 (Table 7.10). The guaranteed producer prices, however, were well above the prices on the world market in recent years, even without incorporation of the marketing costs from producer to European ports.

Table 7.10. Prices of oil-palm products (₦/t) and the consumer price index (%).

	Crude palm oil		Palm kernels		Consumer price index
	world market[1]	guaranteed producer price[2]	world market[2]	guaranteed producer price	
1970	186	73	120	57	100
1971	186	89	103	61	116
1972	143	89	76	61	119
1973	247	98	170	64	126
1974	421	197	292	130	142
1975	267	246	127	133	191
1976	254	295	144	150	235
1977	341	355	210	150	273
1978	381	355	231	150	318
1979	394	355	302	150	356
1980	319	450	189	180	390
1981	349	495	195	200	472
1982	299	495	182	230	508
1983	362	495	261	230	547

1. Prices c.i.f. European port. Prices in dollars converted to Naira with official World Bank and IMF data on rates of exchange.
2. Price for SPO, the highest quality class.
Sources: World Bank (1984), NPPB, IMF (1984)

Table 7.11. Subsidy on palm-kernel exports at official (US$ 1 = ₦) 0.676 and shadow (US$ 1 = ₦ 1.35) rate of exchange (₦/t) (1982).

	Prices and costs	
	official rate	shadow rate
Guaranteed producer price	230	230
Estimated marketing costs[1]	225	281
Total costs f.o.b.	455	511
Export unit value[2]	135	270
Subsidy	320	241

1. An estimated 25 % of the marketing costs is in foreign exchange.
2. World market price c.i.f. = US$ 270; estimated f.o.b. US$ 200.

Despite the relatively high guaranteed producer prices for palm oil, the amounts purchased by NPPB were very small, 5000–30 000 t annually, and have dropped to zero since 1977, because of the high price on the local market, with wholesale prices 50–70 % above the guaranteed producer prices. Data on actual producer prices for palm oil since 1970 are not available but prices of ₦ 700–900/t are quoted up to 1982. The shortage of oils and fats on the domestic market has caused these high prices. The introduction of restrictive measures for the import of oils and oilseeds in 1982 resulted in a sharp increase in price of palm oil on the domestic market and prices reached ₦ 4000–6000/t in 1983.

The local demand for palm kernels is limited and the NPPB buys large amounts at the guaranteed price for export. These prices are well above the export value and thus exports are subsidized (Table 7.11). The subsidy diminishes if a shadow rate of exchange is used, but it remains considerable. The high domestic marketing costs of kernels, estimated at ₦ 225/t, a relatively high producer price and a probably overvalued Naira make export an unattractive business.

7.6.4 Export and domestic consumption

Production of fats and oils, and the situation of imports and exports have changed drastically in the past 20 years. In 1965, Nigeria was a major exporter of oils and oilseeds, and it is now a net importer (Table 7.12). The petroleum boom, resulting in rapid urbanization, higher domestic demand, inflation and a revaluation of the Naira, is the major single external factor in production and consumption. The estimated data show an increasing demand and a declining production, resulting in a net deficit met by imports since 1976. The total domestic consumption rose by an average of 4.6 %/year in 1965–1981. In the same period, consumption per person rose from 12.4 to 15.6 kg, 1.4 % per year.

The main oil crops in Nigeria are oil palm and groundnuts; minor oil-crops are sheanuts, soya beans, sesame and cottonseed. Production of groundnuts has de-

Table 7.12. Production and consumption of edible fats and oils (1000 t).

	1965	1970	1975	1980	1981
Production	1322	1131	897	961	966
Consumption	604	751	767	1224	1246
Exports	720	383	155	134	88
Imports	2	2	25	399	368

Source: FAO (1983)

Table 7.13. Production and export of main oil-crops (1000 t).

	Palm oil products				Groundnuts	
	palm oil		palm kernels		prod.[2]	export[3]
	prod.	export	prod.	export[1]		
1965	574	152	455	423	2274	727
1970	540	8	300	218	1581	543
1975	640	–	300	195	280	7
1976	655	3	296	285	500	–
1977	660	–	302	66	300	–
1978	670	–	238	203	700	–
1979	650	–	335	191	540	–
1980	675	–	345	197	570	–
1981	675	–	360	145	580	–
1982	700	–	355	146	600	–

1. Palm kernels, oil and meal.
2. Groundnuts in shell (shelling percentage 70-80%).
3. Shelled groundnut, oil and meal.
Sources: FAO (1983), World Bank (1979), NPPB

clined sharply since 1965 and there have been no exports since 1975 (Table 7.13). Palm kernels and derived products have been the main exports in the oil-crop sector since 1975, with sheanuts as minor export at around 15 000 t/year in recent years.

7.7 Supporting services

7.7.1 Research

The Nigerian Institute For Oil Palm Research, near Benin City, is the national research station for oil palms. The research mandate originally covered three broad topics:

- Cultivation of oil palms on smallholdings and estates.
- The selection and breeding for improved high-yielding types of oil palms.

– Methods of extracting palm oil and kernels.

At a later date, production of seedlings and germinated seed from improved oil palms and research into the various aspects of other palms, such as coconut, date and raffia palms, were added to the mandate. The institute has three substations and 4000 people are employed in total. On the grounds are laboratories, office blocks, a library, experimental oil-palm plantings with an area of 900 ha, an oil mill with a capacity of 6 t of f.f.b. per hour, houses and a school. Most research is at the institute and its substations; on-farm research is of minor importance in the research programme.

The Monitoring and Evaluation Unit of the Federal Department of Agriculture is in Benin City. It has four divisions: Agriculture; Economics; Training; Finance. Besides monitoring and evaluation of ongoing projects, various surveys and studies are undertaken.

7.7.2 Supply of inputs

Fertilizers, agricultural chemicals, improved seed or seedlings, and harvesting tools are the main external inputs required by producers of fruit bunches. Little of fertilizer is produced in Nigeria; almost all is imported. Several institutions are responsible for supplying one or more of these requisites to the farmers.

The Federal Ministry of Agriculture and Water Resources is responsible for the purchase and distribution of fertilizers to the states. The state ministries of agriculture deal with subsequent distribution.

NPPB has the task to 'ensure that adequate supply of fertilizers and improved seedlings and other requisite inputs are made available' and it has several stores in production areas for that task. It is the sole distributor of the 'Malayan knife' for harvesting and pruning. This tool increases labour productivity, as bunches can be cut down from the ground, as long as the palms are not taller than 8–10 m.

The Tree Crop Units in several states dealing with specific projects supply all inputs (including credit) to the oil-palm smallholders.

NIFOR is the only institute producing improved seeds and the germinated seeds are made available to the state ministries of agriculture and others, who raise them for distribution as seedlings.

Recent data on the turnover of inputs by the various institutions are not available. The apparent multiplication of tasks in supply of inputs may indicate that each institution is trying to secure supplies for their target group, as a general supply system does not function adequately. Nevertheless lack of inputs at the required time is mentioned in several reports and articles about oil-palm schemes and projects.

Processing mills and equipment are supplied by several foreign manufacturers with representatives in Nigeria. NPPB recently awarded contracts for the building of three mills on Federal oil-palm plantations. FMAWR awarded contracts for the establishment of 20 medium-scale mills in the states growing oil palm. Small

installations and equipment, such as hand-presses, small digesters and clarification tanks, are produced locally.

7.7.3 Extension

The institutions supplying inputs are also involved in extension. Multiplication of tasks here too may then lead to certain groups of farmers receiving no adequate extension, as responsibilities of the various institutions are not specific enough. The proposal to set up Agricultural Extension and Research Liaison Services closely linked to research institutes is a first effort to improve the situation in extension.

7.8 Summary and economic parameters

Nigeria is the main producer of palm oil in Africa and the third producer in the world with an estimated production of 710 000 t in 1982, which is 12 % of world production. Nigeria is the second producer and exporter of palm kernels in the world after Malaysia. In the period from 1961/1963 until 1981/1983, production of palm oil increased on average by 15 % per year, which was less than the increase in demand, so that Nigeria became an importer of palm oil in the 1970s. Production and exports of palm kernels declined in the same period.

Most of the palm oil produced, estimated at 78 %, is derived from fruits of

Economic parameters of the oil-palm sector in Nigeria (1982).

Resources used	
Land under improved oil palm	55 000 ha
estimated area under semiwild oil palm	1 650 000 ha
total area as share of area under permanent crops	71 %
Output	
Improved palms	
crude palm oil	180 000 t
palm kernels	40 000 t
Semiwild palms	
crude palm oil	520 000 t
palm kernels	315 000 t
Total oil-palm products	1 055 000 t
Destination products	
Crude palm oil	
domestic market	100 %
Palm-kernel products	
domestic market	60 %
export	40 %

Sources: see previous tables; own estimates

semiwild palms processed by manual extraction methods or by medium-technology installations. The modern sector with estates and smallholders cultivating stands of improved palms occupies 155 000 ha, 9 % of the area, and represents 22 % of production. The availability of labour, especially for estates, is a major problem and an unknown proportion of the planted area is not maintained or is incompletely harvested. The high population density, especially in the south-east part of the country, is a second negative factor in palm oil production, as semiwild oil palms are cut down to grow food crops such as yams and cassava.

The ecological conditions range from suitable in the south-east of the country to moderately suitable in production areas inland. The occurrence of a dry period or drier period in all areas limits production.

The processing industry is small relative to the production of palm oil and kernels. Most of the palm oil produced is consumed without further refining or processing, and the processing industry uses imported crude palm oil. The capacity of the crushing industry is sufficient for the entire production but operates far below capacity. Non-factor inputs, fertilizers, vehicles and large processing equipment are imported. The Federal Government and state governments are implementing several projects to revive the oil-palm sector. Attention is being paid to development of estates, smallholder schemes and improved processing facilities. The marketing and export of palm kernels is organized by NPPB, guaranteed prices for kernels being set by TCPP.

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Currency equivalents and price indices in Nigeria (1960-1983).

	Exchange rate (₦ per US$)	Consumer price index (1980 = 100)
1960	0.714	16
1965	0.714	18
1970	0.714	24
1971	0.713	28
1972	0.658	29
1973	0.658	31
1974	0.629	34
1975	0.615	46
1976	0.627	57
1977	0.645	68
1978	0.635	81
1979	0.603	90
1980	0.547	100
1981	0.614	121
1982	0.673	130
1983	0.723	156

Source: IMF (1984)

8 Oil palm in Sierra Leone

8.1 Background

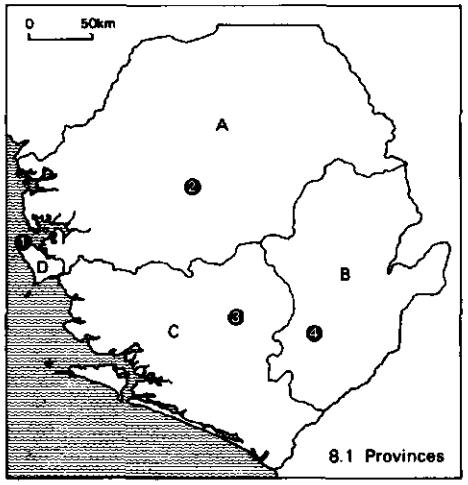
Sierra Leone is one of the smaller states in West Africa with a population of 3.2 million (1982). The country is divided into three provinces and an area: the Northern, Eastern and Southern Provinces; the Western area comprises Freetown and surroundings (Figure 8.1). The provinces are subdivided into districts, 12 in total. The total land area is 71 620 km^2, so that population density is 50 people per square kilometre. The Western Area is basically urban with a high population density. The Eastern Province has a population density of 30–100 people per square kilometre. The population density in the coastal area ranges from 30 to 60 people per square kilometre. The Northern Province has the lowest population density with 10–30 people per square kilometre.

The GNP was $390 per person in 1982. With a share of 32 % of the GDP, agriculture is the second sector after services with 48 % and before industry with

Table 8.1. Average area harvested, yield and national production of major crops over 3-year periods.

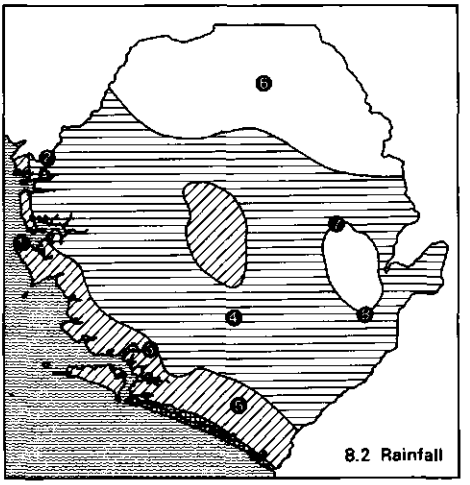
Crops	Area (1000 ha)		Yield (kg/ha)		Production (1000 t)	
	1969-1971	1979-1981	1969-1971	1979-1981	1969-1971	1979-1981
Food crops						
cassava	16	21	4700	4450	75	93
maize	20	13	984	1000	10	13
rice (paddy)	331	403	1430	1170	474	471
roots & tubers	27	31	4290	4000	117	124
Oil crops						
coconut (nuts)	.	.	.	.	4	8
groundnut	17	18	1130	1110	20	20
oil palm (palm oil)	.	.	.	.	46	47
(kernels)	.	.	.	.	60	31
Beverages						
cocoa	49	50	106	170	48	8
coffee	21	20	381	497	8	10
Other crops						
ginger	.	.	.	.	0.7	1.5

Sources: FAO (1971-1983), PEMSU (1984)



Provinces:
A Nothern Province
B Eastern Province
C Southern Province
D Western Area

Cities:
1 Freetown
2 Makeni
3 Bo
4 Kenema



<2500 mm
2500-3000 mm
3000-4000 mm
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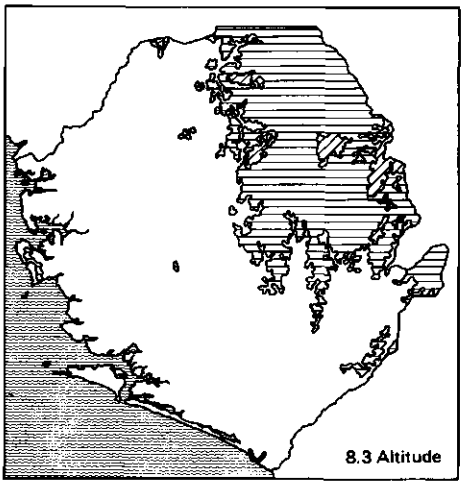
Stations
1 Freetown
2 Rokupr
3 Gbangbama
4 Bo
5 Pujehun
6 Kabala
7 Yengema
8 Daru



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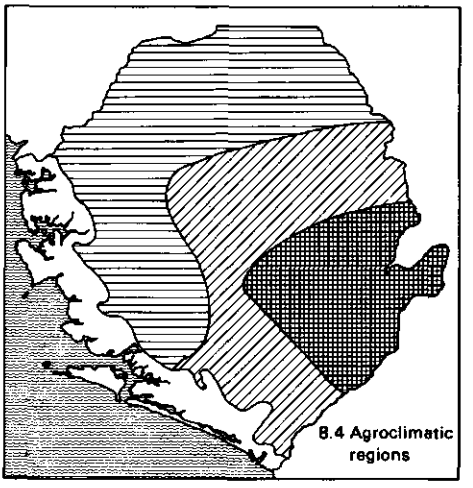

Coastel plains
Savanna woodland
Transitional rain forest and Savanna woodland
Rain forest

Fig. 8.1–8.4. Provinces (8.1), average annual rainfall (8.2), altitude (8.3) and agroclimatic regions (8.4) in Sierra Leone. After FAO (1980).

20 %. About 65 % of the work force is in agriculture.

The arable area is 1 620 000 ha and that under pernanent crops 146 000 ha. The major crops are listed in Table 8.1. After coffee and cocoa, the oil palm is the major permanent crop and the export of palm kernels contributes 8 % to total agricultural exports, which are dominated by coffee, 47 %, and cocoa, 42 %. The palm oil produced is absorbed by the domestic market. Agricultural exports account for 29 % of total exports, diamond, bauxite and rutile being the main exports.

With Angola, Benin and Liberia, Sierra Leone belongs to the group of intermediate palm-oil producers in Africa with an annual production of around 40 000 t palm oil. The estimated production of 48 000 t of palm oil in 1983 represents 3 % of production in Africa and 0.7 % of world production.

8.2 Ecology

Sierra Leone is situated between latitudes 7 and 10°N of the Equator. The climate is influenced by the atmospheric circulation of air masses over the tropics which results in two distinctive periods: the rainy season and the dry season. The greater distance from the Equator, than areas growing oil palms for instance in Nigeria and Ivory Coast, results in a more pronounced seasonal pattern. The effect of latitude on climate is considerably modified in the coastal areas by maritime influences resulting in increased precipitation and more even temperatures. The relief (Figure 8.2) shows that the greater part of the country is lowland, less than 300 m, except for the north-east, which is classified as low plateaux, between 300 m and 600 m, with some hills and mountains rising to 1000 m and more. The ecological data in this section are largely derived from the UNDP/FAO project: Land Resources Survey (LRS) in Sierra Leone.

The rainfall (Figure 8.3) in most of the country is more than 2000 mm/year, the requirement for oil palm. The distribution of rainfall over the year, however, is uneven as the result of the strong seasonal pattern (Table 8.2). The importance of rainfall distribution for oil-palm cultivation is clearly demonstrated by the data. The three most westerly stations, Freetown, Rokupr and Gbangbama all receive more than 3000 mm/year, but 6 months with a water deficit rules out oil-palm cultivation. The smaller rainfall in the north, Kabala, plus the long period with a water deficit makes this area unsuitable too. The south-eastneeds more detailed description. The water deficit in Table 8.2 is defined as evapotranspiration minus precipitation without taking ground storage of water into account. The effective water deficit therefore occurs during a period 1–2 months shorter than indicated and the deficit is reduced by an estimated 100 mm/year (FAO, 1980). The effect of ground storage of water is included in the calculation of the duration of growing periods (Figure 8.4). The region 'rain forest' demarkated by the 300-day growing period isoline must be considered as suitable for oil-palm cultivation and the region of transitional rain forest-savanna woodland, between the 300-day and 270-

Table 8.2. Distribution of monthly rainfall and water deficit for selected stations (mm).

	Rainfall													Water deficit	
	J	F	M	A	M	J	J	A	S	O	N	D	total	number of months	total per year
1 Freetown	9	11	17	53	172	334	770	775	510	282	104	29	3066	6	524
2 Rokupr	6	0	14	76	200	418	644	736	567	366	149	17	3193	6	528
3 Gbangbama	11	23	30	77	200	364	506	623	593	366	187	65	3045	6	609
4 Bo	13	16	62	130	242	309	425	486	458	369	172	34	2716	5	345
5 Pujehun	18	22	38	119	274	336	595	641	529	337	168	38	3115	5	433
6 Kabala	8	7	35	110	213	300	318	374	399	329	106	17	2216	5	498
7 Yengema	10	44	86	166	235	292	331	345	430	317	173	38	2467	5	355
8 Daru	8	68	177	354	262	295	314	338	407	321	180	38	2762	4	242

Source: FAO (1980)

day isolines, is marginally suitable. The region indicated as coastal plains has a growing period of less than 270 days and must be considered unsuitable for oil-palm cultivation.

The mean minimum temperatures in the north-east with an altitude of 300 m or more may drop under 18 °C during December–January. This limits the areas suitable, or marginally suitable, for oil palm to the southern part of the rain-forest zone and the south-west of the transitional rain-forest-savanna woodland zone (Figures 8.2. and 8.4).

The annual exposure to photosynthetically active radiation increases in West Africa with increasing latitude and the average figure is around 6500 MJ m^{-2} for Sierra Leone. This is equivalent to 1500 h of sunshine stated as required for optimum production of oil palm.

The upland soils in Sierra Leone are ferralitic with a low content of plant nutrients. Most of these soils are shallow and gravelly with a low water-holding capacity. The soils are generally more suitable for perennial crops than for annuals as the closed canopy and the litter provide protection against run-off and contribute to a more efficient recycling of carbon and nutrients. Oil palm can be grown if minimum requirements in soil depth are met and if the proportion of gravel is not excessive. The hydromorphic soils occurring in valley bottoms and river plains are much more fertile but drainage is generally a problem, so these soils are generally used for rice. If drainage and water control problems can be solved, these soils are suitable for oil palms too.

In summary, the north-west of the area suitable for commercial oil-palm planting in West Africa lies in Sierra Leone. So the south-east of the country except for the coastal area, about the area east of Bo with Daru as centre, is suitable for oil palm. West and south of this area, the conditions are marginally suitable to unsuitable. Soils may prove a restriction in areas with suitable climate and as slope and previous land use are important factors, inspection on the spot is necessary to determine soil suitability.

8.3 The oil-palm sector

8.3.1 History

The oil palm is indigenous in Sierra Leone. Until now, the greatest part of the palm oil consumed in the country has been produced by traditional methods from fruit bunches of semiwild oil palms. According to the Agricultural Statistical Survey of 1965/1966, the number of oil palms was 138.8 million; other sources mention 40 million trees. These numbers would mean that an equivalent of 0.3 to 1.0 million hectares at normal planting density is under oil palm. This seems to be very high in relation to the total arable area of 1.6 million hectares. There are not any reliable and recent data about number of palms, area under palms, harvesting intensity nor production per tree. Palm wine is widely used as beverage and as tapping reduces production of fruit bunches the relation between number of trees and palm-oil production is further complicated. Production figures are therefore estimates based on rather weak statistics.

In colonial times, the palm kernels became a major export commodity, alongside coffee and cocoa. The international demand for kernels and the increasing domestic demand for palm oil resulted in efforts to make more efficient use of semiwild palms. From 1934 to 1958, small oil-mills called 'Pioneer Mills', with a capacity of 1–2 t of f.f.b. per hour, were installed in areas with a concentration of semiwild palm trees. In a later stage, oil palms were planted near the mills to secure a sufficient supply of fruit bunches for the mills. Mills and later plantations were thus established in places with a concentration of semiwild palms and those areas are not necessarily suitable for commercial oil-palm plantations. Of the 9 Pioneer Mills with plantations ranging from 100 to 1700 ha, only 2 are situated in the area suitable for oil-palm cultivation, the rain-forest zone; 5 mills are in the transitional rain-forest-savanna woodland zone, which is marginally suitable for oil palm; two mills, those with the largests plantations, are in the savanna woodland zone, which is unsuitable.

8.3.2 Recent developments

After independence, the ownership or control of the Pioneer Mills and plantations passed from one institution to another which resulted in low operation efficiency. A recent inspection of Pioneer Mills (Giacovazzi di Castri, 1983) showed that the mills were either operating far below capacity or had stopped operating. The plantations were abandoned or only partly maintained.

Besides the Pioneer Mills and estates, there are four estates started in the 1960s and 1970s as integrated units of plantation and mill. Two of these estates are still in the development stage, the others are in the process of rehabilitation. One of the estates which is to be developed into a 2800-ha plantation with a mill of capacity 6 t of f.f.b. per hour is near Port Loko, an area which is climatically unsuitable

for oil-palm cultivation; the other estates are in suitable or marginally suitable areas. The total area of planted, improved, palms is estimated at about 15 000 ha (Table 8.3). The age distribution is such that a third of the area planted is more than 23 years old and thus at the end of its economic life. This area consists mainly of the plantations attached to the Pioneer Mills.

Production of palm oil and palm kernels from semiwild and from planted improved oil-palms is given in Table 8.4. About 3000 t or 6 % of production of palm oil is estimated to be from improved oil palms. This would mean an average production of 0.2 t of oil or 1 t of f.f.b. per hectare planted. This very low average figure is in line with the reports speaking of abandoned and neglected estates. The production of palm kernels is almost completely from semiwild palms.

Palm kernels are one of the export commodities and all kernels purchased by the Sierra Leone Produce Marketing Board (SLPMB) were exported until 1978. In that year the crushing mill started operations and palm-kernel oil and meal were exported as well as kernels. The amount of kernels purchased by the SLPMB declined in recent years and as an increasing share of kernel oil and meal were sold locally, the importance of palm kernels and kernel products as export commodities decreased (Section 8.6.4).

Table 8.3. Area planted per year and total area under improved oil palm (1000 ha).

	Planted	Total
Before 1961	5.1	5.1
1961-1970	2.6	7.7
1971-1975	2.0	9.7
1976-1980	4.1	13.8
1981	0.8	14.6
1982	0.7	15.3

Source: PEMSU (1984)

Table 8.4. Production of crude palm oil and kernels (1000 t).

	Palm oil	Palm kernels
1970	51	59
1975	43	54
1976	45	39
1977	41	36
1978	45	38
1979	45	41
1980	47	41
1981	48	45
1982	48	45

Sources: see Table 8.3, FAO (1971-1983)

In summary, the major proportion of the palm oil and palm kernels are produced by traditional methods. The attempts to modernize production by planting improved palms and using more modern oil-mills have not been very successful because plantations were established in unsuitable areas and because of problems with maintenance of plantations and mills, which are related to finance and management.

8.3.3 Organization

The major proportion of the palm oil and palm kernels are produced by farmers in the east and south (Table 8.5). Men usually harvest the fruit bunches and woman process the fruit in traditional way. The palm oil is used in the household, sold to consumers in the neighbourhood or sold to private traders for resale in urban areas, mainly Freetown. Women play a dominant role in the marketing of palm oil. The kernels are sold to the SLPMB through a network of buying agents.

The Pioneer Mills are owned by the SLPMB and oil produced is sold to traders, the kernels being directly transported to warehouses in Freetown. The more modern estates are partly owned and controlled by the Government, Ministry of Agriculture and the Prisons Department, and partly owned by nationals. Around the government-owned estates at Daru and Gambia-Matru, associated smallholders sell their fruit bunches to the estate mills.

The trade in palm oil is free and there are no price controls or special taxes. Palm kernels are exclusively marketed and exported by SLPMB. This parastatal organization owns and operates further a kernel-crushing plant in Freetown with a refinery for kernel oil and a feed-mill complex to produce feed mixes for pigs and poultry from kernel cake, grains and other ingredients. Purchase prices of kernels, commission for buying agents and export tax on kernels and kernel products are fixed by the government.

The oil-palm sector is outlined in Figure 8.5.

Table 8.5. Purchase of palm kernels by the SLPMB (1000 t).

	Eastern	Northern	Southern	Western Area	Total
1970/71	.	.	.	.	55.5
1975/76	10.7	16.0	17.3	0.3	44.3
1976/77	7.2	6.1	13.3	0.3	26.8
1977/78	6.5	12.1	14.4	0.3	33.3
1978/79	7.2	7.1	13.5	0.2	27.9
1979/80	11.2	6.0	15.1	0.2	27.3
1980/81	5.1	2.8	6.1	0.1	14.1
1981/82	.	.	.	.	14.0
1982/83	.	.	.	.	10.2

Sources: SLPMB (1981, 1982), PEMSU (1984)

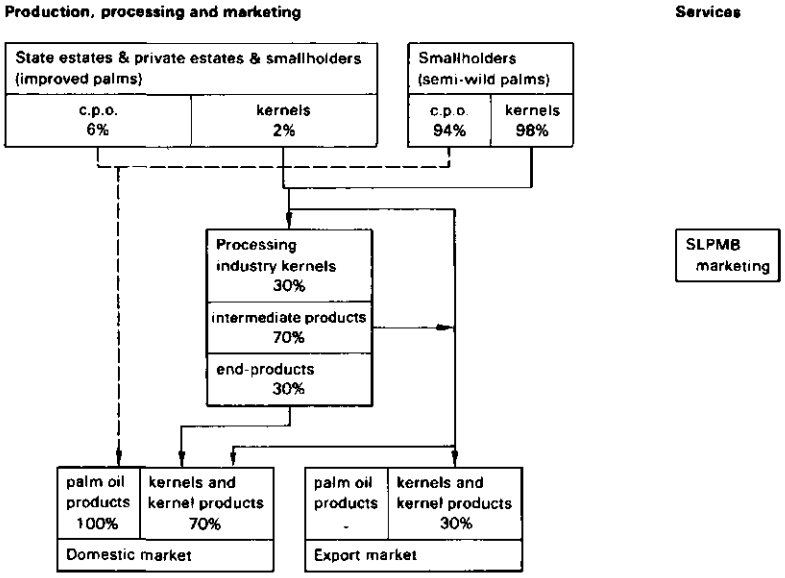

Fig. 8.5. The oil-palm sector in Sierra Leone, 1982. Broken line, palm oil and palm-oil products; solid line, kernels and kernel products.

8.4 Production of crude palm oil and kernels

8.4.1 Production factors

Land is not a scarce factor in the southern part of the Eastern Province as the population density is about 30 people per square kilometre. Food crops are mainly cultivated in river valleys. Uplands are available for tree crops.

Smallholders possess a few hectares of oil palm each and there are several estates. No mention is made of shortage of labour on either type of enterprise. The costs of labour, 1982, are Le 4.80/d and rural incomes are estimated at Le 150/year.

Smallholders' production is self-financed. The few oil-palm development projects are financed by domestic and foreign sources.

8.4.2 Producers and production systems

Two government estates were established after 1961. Their area is 3800 ha. In addition, there are 7 smaller estates, neglected to various degree, attached to Pioneer oil-mills. The total area of these estates, planted before 1960, is 5100 ha.

Two private estates with a total area of 1700 ha are in operation.

A total area of improved palms of 4700 ha is has been planted by smallholders near the two public estates. Processing is by the estate mills.

Smallholders harvesting semiwild palms are the main producers of palm oil and kernels. The processing is usually by women by traditional methods.

The estates have processing mills varying from a modern mill of capacity 15 t of f.f.b. per hour to intermediate technology mills of capacity 1–2 t/h.

Data on production costs and yields of fruit bunches harvested or produced by farmers and data on traditional processing methods are not available. This means that general conclusions about the net benefits of palm-oil and kernel production by farmers, the major group of producers in Sierra Leone cannot be made. There are no data on other perennial crops such as coffee and cocoa, which could compete with oil palm, especially in the transitional rain-forest-savanna woodland zone. So no comparison can be made.

The few data that exist on production of palm oil and kernels by the estates do not allow general conclusions about the profitability for these producers either. Data of the two largest estates in operation give, however, some insight into the potential for oil-palm cultivation. The maximum overall yields of f.f.b. obtained so far in the Gambia Matru and Daru estates were 6.8 and 9.1 t/ha, respectively. The best fields yielded 8.0 and 11.4 t/ha. These yields were obtained without proper maintenance of the estates and the conclusion by a consultancy firm that average yields of 8 t/ha on Gambia/Matru and 12.5 t/ha on Daru estates are possible, must be regarded as realistic. The yield difference between the two estates is due to the Daru estate being in the area suitable for oil-palm cultivation but Gambia Matru being in the marginally suitable area. The yield of 12.5 t/ha is acceptable for West Africa. Land is available in the east and rural incomes and wages are low with Le 150/year and Le 4.80/d. The combination of these factors leads to the conclusion that estate and smallholder development is feasible.

8.5 Processing

The palm oil produced either by traditional methods or by modern mills is sold and consumed as such in Sierra Leone and no further processing is undertaken.

Kernels are processed by the SLPMB in the crushing plant in Freetown. The crushing plant has a capacity of 80 t/d or 20 000 t/year with single-shift operation. Attached to the crushing plant is a refinery with a capacity of 15 t of kernel oil per day. The neutralized, bleached and deodorized oil is sold on the local market. The kernel cake is mixed with grain and other ingredients in the feedmill recently installed by SLPMB adjacent to the crushing plant and refinery. The resulting mixtures are sold on the local market.

Freetown has a chemical industry producing soap and detergents. Some of the raw materials are bought from the SLPMB refinery.

8.6 Marketing

The marketing of palm oil is in the hands of private traders and no data are available about amounts costs and margins. The Sierra Leone Produce Marketing Board trades small amounts of palm oil, mainly from estates. The marketing and any export of palm kernels is exclusively the right of SLPMB.

8.6.1 The Sierra Leone Produce Marketing Board

The Sierra Leone Produce Marketing Board was established in 1949 'to engage in the efficient purchase, export and marketing of various items of Sierra Leone produce specified from time to time on the Board's schedule'. Nine members of the board are appointed by the Ministry of Trade and Industry and the Ministry of Agriculture and one member is appointed by the Chamber of Commerce. The main products handled by SLPMB are coffee, cocoa and, since 1980, rice, with a total of 92 % of the turnover in 1981. Palm kernels, palm oil, ginger, groundnut and chillies are of much less important with 8 % of the turnover. One division of SLPMB deals with the palm-kernel crushing mill, the refinery and the feedmill.

Palm kernels are purchased by the SLPMB through 120 lisenced buying agents, who may in turn operate with subagents. The buying agents may deliver the kernels to the stores in Freetown or to the stores in Bonthe, Southern Province, or Pendumbu, Eastern province. The total amount of palm kernels purchased declined sharply since 1970 (Table 8.5).

8.6.2 Pricing, taxation, costs and margins

The price to be paid by the buying agent to the farmers, the buying agents' commission and the road freight allowances for kernels delivered to the stores are fixed by the government through the Inter-Ministerial Pricing Committee. The SLPMB has an advisory role to the Committee. The fixed producer prices for palm oil are only applied to the produce of the government-controlled estates and market rates were above the prices set in recent years (Table 8.6). The fixed producer prices were below prices on the world market until 1979 and remained more or less in line with these prices from 1980 onwards. The fixed producer prices in constant terms reached a maximum in 1980 and have declined considerably since. The relatively low prices in recent years undermined the financial viability of the government controlled estates. The fixed price of fruit bunches to be purchased by these estates from outgrowers ranged from Le 55/t to Le 70/t in the period from 1980 to 1983. These prices were well below the market rates. Only small amounts could be purchased, so underutilizing processing installations.

The fixed producer prices for palm kernels affect the total trade of palm kernels as SLPMB controls marketing, processing and export. The producer prices for palm kernels are announced by SLPMB twice a year (Table 8.7). These prices are

Table 8.6. Palm oil fixed producer prices.

	World market[1]	Producer price		
	current (US$/t)	current (US$/t)	current (Le/t)	constant 1980 (Le/t)
1975	434	277	250	472
1976	406	225	250	403
1977	530	261	300	423
1978	600	285	300	405
1979	654	356	375	417
1980	584	475	500	500
1981	569	516	600	488
1982	445	486	600	370
1983	501	450	750	274

1. Malaysian 5 %, c.i.f. N.W. Europe.
Sources: PEMSU (1984), World Bank (1984)

Table 8.7. Palm-kernel producer prices[1].

	World market[2]	Producer price		
	current (US$/t)	current (US$/t)	current (Le/t)	constant 1980 (Le/t)
1970	168	78	65	186
1975	207	163	146	275
1976	230	105	116	187
1977	326	104	120	174
1978	364	128	135	182
1979	500	158	166	184
1980	345	167	175	175
1981	317	139	161	131
1982	270	131	162	100
1983	362	186	347	127

1. Palm-kernel prices are quoted by the SLPMB per year starting the 1st. of July. For this table average prices per calender year have been calculated.
2. Nigerian c.i.f. U.K.
Source: SLPMB (1981, 1982), World Bank (1984)

to be paid by the buying agents, or their assistants, to the farmers.
Whether this is actually so or not, is not known. The producer prices of kernels moved fairly independently of prices on the world market, although kernels are exported. The margins resulting from price differences will be discussed below.
The prices in real terms have declined considerably since 1975, resulting in declining amounts of kernels purchased by SLPMB (Table 8.5).

The export crops in Sierra Leone are subjected to export duty. For palm ker-

Table 8.8. Palm-kernel prices, costs and tax (Leone/long ton[1]).

	1970/71	75/76	76/77	77/78	78/79	79/80	80/81	81/82	82/83
Av. prod. price	65.0	137.2	117.0	134.0	162.5	204.0	153.0	162.5	204.5
Marketing costs	37.5	46.3	48.8	69.8	76.1	80.0	73.1	99.2	.
buying agents' commission	13.0	20.8	21.3	21.2	27.5	31.0	25.0	27.5	28.8
charges SLPMB	16.0	17.0	17.8	28.9	28.9	28.9	23.0	25.2	.
road freight	3.5	6.1	6.1	7.9	7.9	8.3	9.0	13.0	.
harbour costs	5.0	2.4	3.6	11.8	11.8	11.8	16.1	33.5	.
Export duty	12	13.5	21.2	21.8	44.2	47.0	24.0	25.2	.
Total costs f.o.b.	114.5	197.0	187.0	225.6	282.8	331.0	250.1	286.9	.
f.o.b. price	120.0	135.0	212.0	218.0	442.0	470.0	240.0	252.0	.
margin	5.5	(62.0)	25.0	(7.6)	159.2	139.0	(10.1)	(34.9)	.

1. Prices etc. are quoted by the SLPMB in Leones per long ton (1016 kg).
Source: SLPMB, personal communication

nels and kernel products, the rate is 10 % of the f.o.b. price. The prices of export crops are directly influenced by the exchange rate. Various reports mention that the Leone was overvalued in recent years, especially before the devaluation to a half in 1983. An overvalued Leone results in lower producer prices and imports are in fact subsidized. The effect of the devaluation of the Leone on 1 July 1983 on palm kernels was a price increase from Le 246/t to Le 448/t and this partly offset the declining price trend in real terms.

Marketing costs and margins for palm oil are not available. An overview of producer prices, marketing costs, f.o.b. prices and the resulting margins for palm kernels are listed in Table 8.8. The marketing costs varied from 34 % to 61 % of the producer prices between 1970/1971 and 1981/1982 with an average of about 50 %. The margin, the difference between the total costs f.o.b. and the f.o.b. price obtained, varied from Le 62/t to Le 159/t. These margins are the trading surplus or deficit by the SLPMB and transferred to or collected from the price maintenance fund. There is one price maintenance fund for all export crops together. The net contribution to the fund of the palm-kernel operations in the period from 1970/1971 to 1981/1982 was Le 4 million. In retrospective, this means that the producer prices could have been 64 % of the f.o.b. prices instead of the actual 57 % or, in other terms, producer prices could have been Le 13.50/t higher during this period.

8.6.3 Export and domestic consumption

The export of palm kernels declined considerably in recent years with the decreasing supply of kernels and the increasing domestic use of palm-kernel oil and meal (Table 8.9). Between 1970 and 1982 the inflation in Sierra Leone was 460 %, so that the export value in real terms declined even more than indicated by the figures.

Table 8.9. Export of palm kernels and palm-kernel products.

	Palm kernels		Palm-kernel products		
	volume (1000 t)	value (million Le)	volume oil (1000 t)	volume meal (1000 t)	total value (million Le)
1950	68	.	–	–	–
1960	55	.	–	–	–
1970/71	60	7.2	–	–	–
1975/76	26	3.5	–	–	–
1976/77	13	1.9	–	–	–
1977/78	6	1.4	–	–	–
1978/79	5	1.4	2.0	1.2	1.9
1979/80	11	3.8	9.3	10.2	8.4
1980/81	5	1.3	3.8	4.3	2.5
1981/82	14	3.4	–	–	–
1982/83	6	1.2	–	–	–

Sources: SLPMB (1981, 1982) and personal communication, Bank of Sierra Leone (1982)

The domestic consumption of vegetable oils, resulting from production, import and export statistics, is given in Table 8.10. Consumption of about 55 000 to 60 000 t in recent years amounts to a consumption per person of 16–18 kg/year. The import of several thousand tonnes of various vegetable oils could be avoided by increased domestic production of palm-kernel oil. Production of kernels, 40 000 t/year, and the capacity of the crushing mill, 20 000 t of kernels per year equivalent to 9000 t of kernel oil per year, are both sufficient. The capacity of the kernel-oil refinery, 4000 t/year, might need further expansion, depending on the consumers' preference for refined or crude kernel oil. More attractive producer prices for kernels are, however, essential to enable SLPMB to purchase the required amount of kernels.

Table 8.10. Domestic consumption of vegetable oils (1000 t).

	1975/76	76/77	77/78	78/79	79/80	80/81	81/82
Production							
groundnut oil	4.8	4.9	4.9	5.5	4.6	4.6	6.1
palm oil	43.1	45.2	40.6	48.8	46.7	49.0	45.5
palm-kernel oil	–	–	–	2.0	11.3	5.5	.
total	47.9	50.1	45.5	54.3	62.6	59.1	51.6
Trade							
import	3.0	1.9	1.4	3.2	0.4	4.8	4.4
export palm-kernel oil	–	–	–	2.0	9.3	3.8	–
Consumption	50.9	52.0	46.9	55.5	53.7	60.1	56.0

Sources: SLPMB (1981, 1982), PEMSU (1984)

8.7 Supporting services

There is no longer any research into the various aspects of oil-palm cultivation and processing of fruit bunches in Sierra Leone. In the past, the Nigerian Institute for Oil palm Research cooperated with Njala University College on research but the contacts have not been kept on.

The inputs for the oil-palm sector, such as germinated seeds, fertilizers and processing equipment (apart from land, labour and capital) are all imported. The distribution of fertilizers and germinated seeds, imported from Ivory Coast, is handled by the Integrated Agricultural Development Projects (IADPs) in the East of the country.

The National Workshop in Freetown has developed a small palm-oil press and introduction of the press together with extension, repair services and possibly credit facilities could improve the extensive village palm-oil production.

8.8 Summary and economic parameters

Sierra Leone is one of the smaller producers of palm oil and kernels in West Africa. The palm oil and kernels produced are predominantly derived from semi-wild oil palms, whose fruits are processed by traditional methods. Efforts to modernize production by planting improved oil palms and making use of modern processing technology have met with little success so far and only 6 % of the national

Economic parameters of the oil-palm sector in Sierra Leone (1982).

Resources used	
Land under improved oil palm	15 000 ha
estimated area under semiwild oil palm	.
area as share of area under permanent crops	10 %
Output from improved and semiwild oil palms	
Crude palm oil	48 000 t
Palm kernels	45 000 t
Total oil-palm products	93 000 t
Destination products	
Crude palm oil	
domestic market	100 %
Palm-kernel products	
domestic market	70 %
export	30 %
Other parameters	
Export value palm kernels	US$ 2.8 million
as share of total value of exports	2 %

Sources: see previous tables; own estimates

production is from these more modern producers.

Ecological conditions are suitable for oil palms in the south-east and maximum yields of 12.5 t of f.f.b. per hectare are obtainable, which is acceptable for West African. The population density in the Eastern Province of 30–70 people per square kilometre indicates that land is still available for oil palm as a planted cash crop. Wage rates and incomes in Sierra Leone are comparatively low and oil palm could be attractive for farmers and investors.

The processing industry comprises a palm-kernel mill with attached refinery and feedmill owned by the Sierra Leone Produce Marketing Board and a private chemical industry producing soap and detergents. There is no refinery capacity for palm oil as palm oil is consumed as such.

Specialized services to producers of fruit bunches or palm oil and kernels are not present in Sierra Leone. The Integrated Agricultural Development Projects in the Eastern part of the country provide some inputs to farmers growing oil palms.

The government policies on producer prices, taxes and the exchange rate affect the oil-palm sector as palm kernels are partly exported and as Sierra Leone is a net importer of vegetable oil. Decreasing producer prices for kernels in real terms resulted in a decreasing supply of kernels by farmers for export and local processing and an overvalued Leone made imports of various oils relatively easy.

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Currency equivalents and price indices in Sierra Leone (1960-1983).

	Exchange rate (Le per US$)	Consumer price index (1980 = 100)
1960	0.714	24
1965	0.714	30
1970	0.833	35
1971	0.826	35
1972	0.800	36
1973	0.813	38
1974	0.855	44
1975	0.901	53
1976	1.111	62
1977	1.149	69
1978	1.053	74
1979	1.053	90
1980	1.053	100
1981	1.163	123
1982	1.235	162
1983	1.667	274

Source: IMF (1984)

9 Oil palm in Colombia

9.1 Background

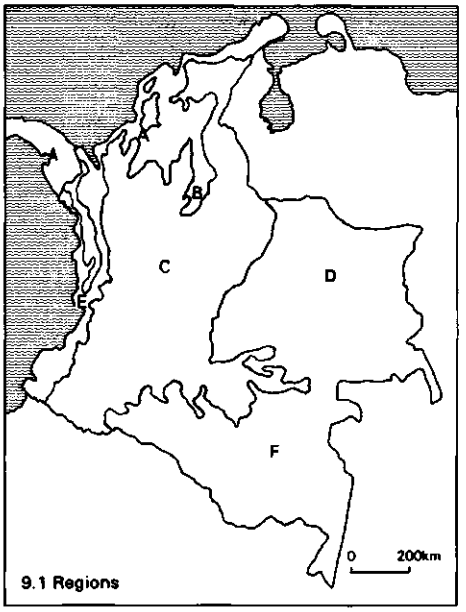
With its 1.14 million square kilometres, Colombia is the fifth largest country in Latin America after Brazil, Argentina, Mexico and Peru. The total population was in 1982 about 27 million, of which 35 % lives in the four largest cities Bogota, Medellín, Cali and Barranquilla. The capital, Bogota has about 5 million inhabitants and the other three cities each more than a million. Administratively Colombia is divided into 22 departments, 5 'intendencias' and 4 'comisarias' (in the Amazon and Orinoco area) and the special district 'Bogota'.

The GNP per person was about $1460 in 1982. The share of the major sectors in the GDP is agriculture 26, industry 32 and services (including government) 42 %. Livestock accounts for 40 % of the contribution by the agricultural sector. The

Table 9.1. Average area harvested, yield and national production of major crops over 3-year periods.

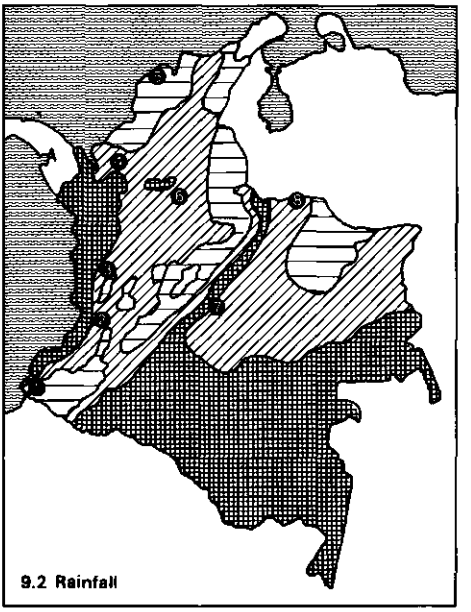
Crops	Area (1000 ha)		Yield (kg/ha)		Production (1000 t)	
	1969-1971	1979-1981	1969-1971	1979-1981	1969-1971	1979-1981
Food crops						
maize	684	620	1250	1380	856	854
rice (paddy)	260	424	2910	4350	756	1840
cassava	185	212	7480	9780	1380	2070
Oil crops						
cotton (seed)	241	186	850	960	205	179
oil palm (palm oil)	13	26	2090	2920	27	74
(kernels)			500	610	6	16
sesame seed	31	30	680	550	221	16
soya-bean seed	58	64	1950	2020	114	130
Beverages						
cocoa	45	67	430	535	20	36
coffee	817	1070	591	700	483	748
Other crops						
bananas & plantains	.	.	.	.	2410	3400
cotton (lint)	241	186	510	530	122	99
sorghum	64	219	2410	2220	153	488
sugar-cane (sugar)	241	291	4840	7460	1170	2170

Source: FAO (1971-1983)



9.1 Regions

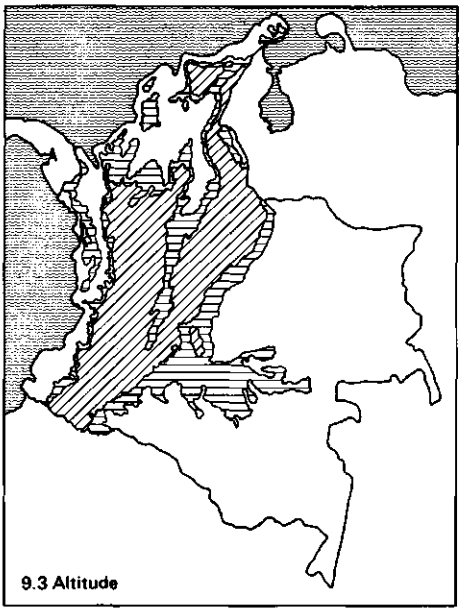
A Caribbean Lowlands
B Inter Andean Valleys Region
C Central Highlands
D Orinoco Plains
E Pacific Coast Region
F Amazon Area



9.2 Rainfall

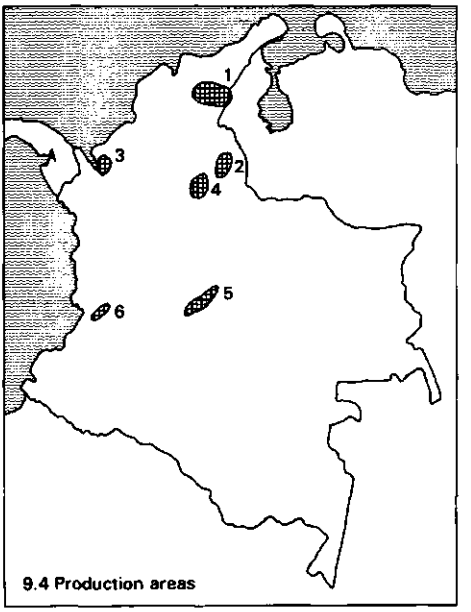
<800 mm
800-1600 mm
1600-3000 mm
>3000 mm

Stations
1 Tumaco
2 La Florida
3 Andagoya
4 Turbo
5 Barranquilla
6 Barrancaber Meja
7 Villaviciencio
8 Arauca



9.3 Altitude

<100 m
100-500 m
>500 m



9.4 Production areas

1 Magdalena Cesar
2 Norte de Santander
3 Antioquia
4 Santander
5 Meta
6 Valle
7 Narino

respective sectors contribute 26, 21 and 53 % to total employment.

The total arable area is 4 million hectares and 1.6 million hectares are under permanent crops. The main crops are shown in Table 9.1. The share of oil palm in the total agricultural production is small but it is the main oil crop with a share of 64 % of the national production of edible fats and oils in 1982. Colombia is an importer of edible oils; domestic production covered only 44 % of requirements in 1982. Coffee is the main export with a 60 % of the total value in the period 1976–1980. Other export crops are sugar, cotton and bananas.

With a production of 87 000 t of palm oil, in 1982 Colombia was the largest producer in Latin America and the seventh producer in the world with 1.5 % of the world production.

9.2 Ecology

Colombia is situated between 12°N and 4°S in the north-west of South America. The Andes Mountains cut across the country from the south-west toward the north-north-east. This barrier dissects the country into six regions: the Caribbean Lowlands, the Central Highland, the Inter-Andean Valleys, the Plains of the Orinoco, the Amazon Area and the Pacific Coast (Figure 9.1). The climate in the respective regions are characterized as dry marine, tropical highland, tropical lowland, continental, wet continental and very wet marine.

Figure 9.2 gives a general picture of the annual rainfall, and Table 9.2 provides information on the distribution of rainfall over the year. The total rainfall and the distribution are well suited to the requirements of oil palm in most of the country: only the northern part of the Caribbean Lowlands, a section of the Orinoco Plains and the eastern ridge of the Central Highlands are unsuitable.

Temperatures are closely related to altitude in Colombia (Table 9.2). Areas lower than about 500 m (Figure 9.3) must be considered suitable for oil palm and this excludes the Central Highlands from the areas suitable for oil palm.

The soils in the areas suitable for oil palm in rainfall and temperature are generally fertile, as nutrient elements are constantly being supplies by erosion from the Andes. This is especially so for alluvial soils in river valleys. Large areas of leached latosols are found east of the Andes. These are less fertile and drainage may pose problems. The Caribbean Lowlands of Colombia can be classed as suitable for oil-palm cultivation but require a soil survey.

Two diseases might be limiting factors for oil-palm cultivation in Colombia. Marchitez sorpresiva, sudden wither, was first observed and described in plantations in North Santander in 1963. Later, similar outbreaks occurred in other areas in Colombia and in other countries in South America. The disease kills the palm and plantations have been destroyed in a few years. The second disease that

Fig. 9.1–9.4. Regions (9.1), average annual rainfall (9.2), altitude (9.3) and production areas (9.4) in Colombia. After Upegui et al. (1967) and Hulsbosch (1981).

Table 9.2. Distribution of monthly rainfall and temperatures for selected stations.

	Altitude (m)	Rainfall (mm) J	F	M	A	M	J	J	A	S	O	N	D	total	Temperature (°C) min.	max.	av.
1 Tumaco	4	430	299	242	371	442	303	203	197	169	164	136	172	3128	20	32	2
2 La Florida	1789	152	143	168	187	140	98	40	32	89	267	311	284	1911	8	31	1
3 Andagoya	65	554	519	557	620	655	655	572	574	561	563	563	512	6905	17	38	2
4 Turbo	2	91	70	48	200	276	236	278	257	244	245	298	242	2485	20	39	2
5 Barranquilla	3	1	0	1	11	87	103	54	102	138	02	82	65	846	18	39	2
6 Barranca-bermeja	107	71	81	135	243	312	269	186	280	347	446	295	121	2786	20	38	2
7 Villavicencio	423	61	113	159	461	605	498	524	360	335	443	381	156	4096	13	40	26
8 Arauca	122	12	8	24	191	249	289	273	219	214	200	87	31	1797	17	40	2

Source: Schwerdtfeger (1976)

caused severe losses in plantations in Colombia and other countries in South and Central America is lethal spear rot. The causes of the two diseases are not yet known and direct control measures are not available. Field trials, however, showed that *Elaeis oleifera*, the American oil palm, and hybrids of *E. guineensis* and *E. oleifera* are resistant to both diseases and plantations of *E. guineensis* devastated by the diseases have been successfully replanted with these palms.

In summary, there are large areas ecologically suitable for oil-palm cultivation in all regions, except the Central Highlands. This is to some extent reflected in by the present distribution of oil-palm plantations, (Figure 9.4). The Instituto Colombiano Agropecuario (ICA), the Colombian Farming Institute, concluded in their national African oil-palm research plan (ICA, 1982) that about 370 000 ha have direct potential for oil-palm cultivation. The areas indicated are mainly in existing oil-palm zones. Much of the Plains of the Orinoco and of the Amazon Area are not included in the estimate given, because of other than ecological constraints.

9.3 The oil-palm sector

9.3.1 History and recent developments

The first seeds of oil palm were taken to Colombia in 1932 from palms originating in Belgian Congo. Small amounts of seed of various origin were imported later. United Fruit Company started a small plantation of 100 ha with seeds from Deli Dura palms in 1945. Cultivation of oil palm received no further attention until 1957, when the government decided to start a production programme for vegetable oil to replace imports of edible oils. Much attention was given to the oil palm in this programme as the palm uses land of little value to other food crops and because it produces the highest yield of oil per hectare. The area planted with oil

palm increased rapidly to 15 000 ha between 1960 and 1965, but the rate of planting slowed down later and the total area remained around 20 000 ha until 1974.

Two factors caused the decrease of interest in oil-palm cultivation during the second half of the 1960s. Firstly the low-priced Peruvian fish oil became important on the Colombian market. It replaced imports of other edible oils and it threatened the position of palm oil, especially after 1972 when Peruvian fish oil could be imported unrestricted under the Andean Pact. The sudden drop in fish-oil production in Peru in 1973 saved the oil-palm sector in Colombia, as other imported edible oils from non-member countries were higher priced and subject to tariffs. The second factor was the occurrence of the diseases sudden wither and lethal spear rot with their disastrous effects on some plantations.

The standstill in the oil-palm sector, and the increasing imports of edible oil, caused several government-sponsored studies in 1971. As a result, new measures were taken to make oil-palm cultivation more attractive. Plantations, defined as holdings of more than 500 ha, were offered tax exemptions for 10 years and individual farmers were encouraged to plant oil palms by provision of medium-term credit on easy terms. Further, the government made funds available to the ICA to boost research and extension activities. These stimulatory policies, and the higher prices on the domestic market of edible oils and fats, resulted in renewed interest in the oil palm. The area planted increased from nearly 20 000 ha in 1970 to more than 50 323 ha in 1983, at an average rate of 7 % per year. Production increased with the increase in area and more than 100 000 t of palm oil was produced, in 1983 with a productive area of 34 000 ha, an average of about 3 t per hectare. Table 9.3 indicates increases in area and production.

During the first years of development, oil palms were planted by individual

Table 9.3. Area under oil palm and production.

	Area (1000 ha)		Production (1000 t)		
	total	harvested	palm oil	kernel oil	kernel meal
1960	0.4	0.3	–	–	–
1965	15.0	3.2	4	.	.
1970	19.8	12.8	27	3	3
1975	23.2	17.2	51	6	7
1976	26.2	17.6	50	5	6
1977	27.7	18.5	52	6	7
1978	32.3	20.9	67	6	8
1979	33.7	23.9	71	7	8
1980	36.7	25.4	74	7	8
1981	39.7	27.7	80	7	9
1982	47.2	28.2	87	8	10
1983	50.3	34.1	104	10	11

Source: Fedepalma, various publications

farmers, in blocks ranging in area from 5 to several hundred hectares, and by larger plantations, ranging from 500 to 3000 ha. In 1965, about 40 % of the total area was planted by individual farmers and 60 % by plantations. Agronomic problems and lack of finance proved too much for many smallholders and Ridler (1977) reported that most family farms in one particular department were abandoned in 1970. Plantations with more resources and better access to agronomic expertise were better able to overcome the difficulties and further expansions of the oil-palm area were predominantly on plantations.

9.3.2 Organization

Oil palm is predominantly an estate crop and the share of small family farms in total area cultivated and total production is small. Estates operate their own processing mills and small-scale producers sell their fruit bunches to nearby mills.

The oil palm is cultivated in 4 of the 6 regions (Section 9.2). The major production area is the Inter-Andean Valleys Region with the Departments of Santander, Cesar-South and Norte de Santander. The area cultivated is about 18 000 ha or 35 % of the total in the country. The Caribbean Region follows with 15 000 ha mainly in the Departments of Magdalena, Cesar North and Antioquia. The Orinoco Region with the Department of Meta and the Pacific Region, with the Departments of Narino and Valle, are less important with about 11 000 ha and 7000 ha, respectively (Figure 9.4).

The crude palm oil produced is refined by a large refining industry producing margarine and cooking oil for the domestic market.

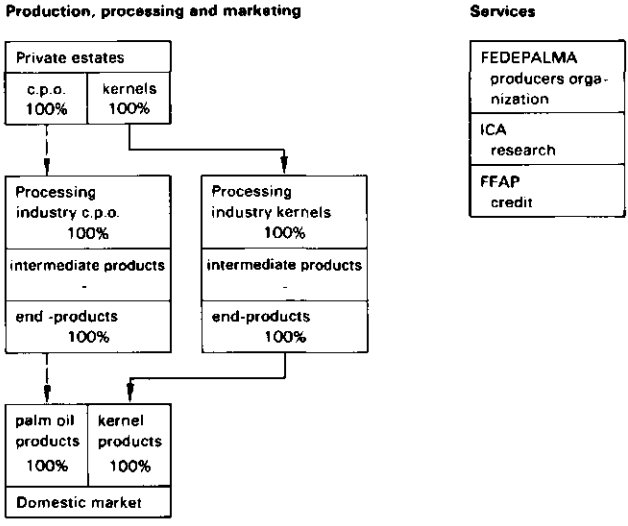


Fig. 9.5. The oil-palm sector in Colombia, 1982. Broken line, palm oil and palm-oil products; solid line, kernels and kernel products.

The trade in crude palm oil and refined products is free in Colombia, but import duty is levied on edible oils originating from countries outside the Andean Pact.

The Federacion Nacional de Cultivadores de Palma Africana (Fedepalma) is an active national organization of oil-palm cultivators, which represents the interest of the members and which plays a role in disseminating technical knowledge.

The Colombian Farming Institute (ICA) is involved in oil-palm research through the specialized substation, El Mira, near Tumaco.

The oil-palm sector is outlined in Figure 9.5.

9.4 Production of crude palm oil and kernels

9.4.1 Production factors

Land for extension of oil-palm cultivation is available. A publication by Guerra de la Espriella (1983a) mentions a list prepared by ICA of potential areas arranged by department. The total area mentioned as suitable for oil palm was 212 000 ha, classed as very suitable 75 000, suitable ha 100 000 ha and probably suitable ha but not yet exactly determined 37 000. The present land use of those areas is pasture or forest. A publication of ICA (1982) states a substantially larger potential area, 370 000 ha. The potential areas in both publications are in the existing oil-palm zones. Lack of infrastructure in the Plains of the Orinoco and the Amazon Area prevents any oil-palm development there in the near future but at least parts of these enormous areas are ecologically suitable for oil-palm cultivation.

The costs of labour on estates in 1982 were around 540 pesos/d.

Capital has been and apparently is the great bottleneck in oil-palm cultivation. Ridler (1977) states that family farms were abandoned through of lack of credit. Even if credit can be obtained, interest rates around 30 % are a disincentive for investment in perennial crops in general and oil palm with its long gestation period in particular.

9.4.2 Producers and production systems

Production of palm oil and kernels is completely a private business for farmers and estates. Table 9.4 classes farms by area planted and the processing capacity by size category used: small 1–500 ha, medium 500–1000 ha and large more than 1000 ha. Although the number of producers is not available, palm-oil production is clearly mainly an estate enterprise as 75 % of the total area belongs to estates of more than 500 ha.

9.4.3 Costs

Calculation of production costs presents special problems in Colombia, because of the prevailing inflation rates of 25–35 % in recent years. Two publications of

Table 9.4. Area under oil palm and processing capacity per size category in 1983.

Size category	Area		Processing capacity	
	(1000 ha)	(%)	tonnes f.f.b./h	(%)
1- 500 ha	12.6	25	38	20
500-1000 ha	6.2	12	36	19
more than 1000 ha	31.5	63	118	61
Total	50.3		192	

Source: Fedepalma, personal communication

Fedepalma by Guerra de la Espriella (1982, 1983), and direct information (1984) from Fedepalma are the basis for the cost data, expressed in 1982 prices.

9.4.3.1 Investment costs

Field establishment. The establishment period covers a period of 4 years plus one season or year to prepare the land and plant young palms. Seeds are imported. Controlled germination and the raising of young palms is done by the estate. Land preparation includes surveying the land, clearing, preparation of drains and the establishment of *Pueraria* as cover crop. The costs are listed in Table 9.5.

Other investment costs. The costs of infrastructure include roads, bridges, offices, workshop and houses. Tractors and trailers, and utility vans are stated under vehicles. The investment costs of the oil-mill is based on a mill of 6–8 t of f.f.b. per

Table 9.5. Field establishment costs.

	In year (1000 pesos/ha)					Total	
	0	1	2	3	4	(1000 pesos/ha)	(US$/ha)
Seed and nursery	38.9	–	–	–	–	38.9	607
Land preparation	52.0	–	–	–	–	52.0	811
Planting	22.3	1.4	–	–	–	23.7	370
Upkeep		19.8	19.8	16.8	16.9	73.3	1144
Fertilization		15.2	15.2	19.6	23.2	73.8	1151
Maintenance roads & drains		2.6	2.6	2.9	3.0	11.1	173
Maintenance equipment		2.3	2.3	2.5	2.8	9.9	154
General charges (staff)	10.4	4.1	4.1	4.1	4.1	26.8	418
Total	123.6	45.4	44.6	45.9	50.0	309.5	4828

Source: Guerra de la Espriella (1982)

Table 9.6. Investment costs per hectare.

	(1000 pesos)	(US$)	Share of total (%)
Field establishment	309.5	4828	75
Vehicles	12.2	190	3
Oil mill	70.0	1092	17
Infrastructure	20.0	312	5
Total	411.7	6422	100

hour for an estate of 1000 ha. The mill is normally built in Years 5 and 6, when the young palms start producing fruit. The total investment costs per hectare are given in Table 9.6.

9.4.3.2 Operating costs

The average annual operating costs are calculated for a period of 21 years, Year 5 to Year 25. Details about inputs for production of fruit bunches and the processing are not available. General charges are not mentioned separately but are included in the cost components given. Palm oil and kernels are sold ex oil-mill and no transport costs are born by the producer. Interest costs form a special problem in Columbia, where the prevailing interest rate is 32 %. The rate reflects the high inflation (Table at the end of this country study). Use of this rate for the calculation of interest costs would result in an overestimate. A rate of 10 % is used as an approximation of the real interest rate and this is applied to half of the invested capital per hectare and to a quarter of the annual costs as interest on working capital. The average annual costs per hectare are:

Table 9.7. Operating costs.

	Per hectare		Per tonne f.f.b.		Per tonne product	
	(1000 pesos)	(US$)	(1000 pesos)	(US$)	(1000 pesos)	(US$)
Production f.f.b.						
upkeep and cultivation	40.9	638	2730	42.5	11.2	173.6
upkeep roads and drains	2.4	37	160	2.5	0.6	10.2
harvesting	13.0	203	870	13.5	3.6	55.2
subtotal	56.3	878	3760	58.5	15.4	239.0
Processing	8.2	128	550	8.5	2.2	34.8
Interest	22.2	346	1480	23.1	6.0	94.2
Total	86.7	1352	5790	90.1	23.6	368.0

Source: Fedepalma and other sources

10 % of 411 700 pesos × 50 % = 20 600 pesos or $321
10 % of 64 500 pesos × 25 % = 1600 pesos or $25
total 22 200 pesos or $346.
For the conversion of costs per hectare into costs per tonne of fruit bunches and costs per tonne of product the following parameters have been used: average yield 15 t of f.f.b. per hectare; oil-extraction ratio 20 %; kernel-extraction ratio 4.5 %. The operating costs are listed in Table 9.7.

9.4.3.3 Production costs

The cost components outlined in the previous sections are compiled together in Table 9.8 to arrive at the total production costs. Capital costs are included through depreciation: 4 % for field establishment, 20 % for vehicles; 8 % for the oil-mill; and 5 % for infrastructure. The main components of production costs are production of fruit bunches, interest, and depreciation with 52, 21, and 20 %, of the total costs respectively.

9.4.4 Returns

Yields. Data from two sources are listed in Table 9.9. The data from Fedepalma are used as they cover a longer period and as they are supplemented by actual data on area in production (Table 9.3). In 1982, the average yields were 3.1 t/ha and of kernels 0.67 t/ha, corresponding to about 15.4 t of f.f.b. per hectare. The corresponding oil-extraction and kernel-extraction ratios are 20 % and 4.5 %, respectively.

Table 9.8. Production costs oil-palm products.

	Per hectare		Per tonne f.f.b.		Per tonne product	
	(1000 pesos)	(US$)	(1000 pesos)	(US$)	(1000 pesos)	(US$)
Operating costs						
bunch production	56.3	878	3.8	58.5	15.4	239.0
processing	8.2	128	0.5	8.5	2.2	34.8
interest	22.2	346	1.5	23.1	6.0	94.2
subtotal	86.7	1352	5.8	90.1	23.6	368.0
Depreciation capital						
field establishment	12.4	193	0.8	12.9	3.4	52.5
vehicles	2.4	37	0.1	2.5	0.7	10.0
oil-mill	5.6	87	0.4	5.8	1.5	23.8
infrastructure	1.0	16	0.1	1.0	0.2	4.5
subtotal	21.4	333	1.4	22.2	5.8	90.8
Total	108.1	1685	7.2	112.3	29.44	458.8

Table 9.9. Yields according to data of Fedepalma and Ministry of Agriculture (t/ha).

	Fedepalma			Min. Agriculture		
	palm oil	kernel oil	kernel meal	f.f.b.	palm oil	kernels
1970	2.11	0.23	0.27	.	.	.
1974	2.82	0.31	0.36	15.7	2.79	0.45
1976	2.81	0.31	0.36	14.1	2.41	0.66
1978	3.19	0.31	0.36	12.1	2.54	0.64
1980	2.90	0.28	0.32	13.8	2.65	0.65
1982	3.09	0.30	0.35	.	.	.

Sources: Guerra de la Espriella (1983), Ministerio de Agricultura (1981)

Table 9.10. Prices of crude palm oil (pesos/1000 t).

	Current	Constant 1970
1970	6.2	6.2
1975	15.6	6.1
1980	32.8	4.3
1981	40.1	4.5
1982	56.0	4.5

Sources: Departament Nacional de Planeación (1982), Mielke (1983)

In constant terms, prices of crude palm oil show a downward trend since 1970 (Table 9.10). In 1982, the price was only 69 % of that in 1970, although the current price increased 9 fold over the same period. Time series of kernel prices are not available but the average price in 1982 was 19 000 pesos/t. Calculation with the oil-extraction and kernel-extraction ratios mentioned and with the prices of crude palm oil and kernels in 1982 results in a price per tonne of product of 49 400 pesos or $771.

9.4.5 Review costs and returns

The average costs and returns outlined in Sections 9.4.3 and 9.4.4 show that palm-oil production was profitable in 1982. However two remarks are needed to put this general conclusion in perspective. Firstly, the price developments of costs and returns are relevant to the profitability of palm-oil production. If price increases for palm oil and kernels lag behind the increases in costs, palm-oil production may soon turn into a loss-maker. Secondly, the financing of investments and operating costs play a dominant role and changes in interest rates are of great importance for the financial results of an enterprise.

The input-output data (Table 9.11) are based on average costs and returns presented in Sections 9.4.3 and 9.4.4. Detailed information on labour utilization is

Table 9.11. Input-output data.

Output per hectare	Quantity		Domestic price		Value	
	(t)	ratio (%)	(pesos/t)	(US$/t)	(pesos)	(US$)
F.f.b.	15.4					
C.p.o.	3.1	20.0	56000	874	173600	2709
Kernels	0.67	4.5	19000	296	12700	198
Total product	3.77	24.5	49400	771	186300	2907

Inputs per tonne product	Quantity	Costs	
		(pesos)	(US$)
Land	0.27 ha	p.m.	p.m.
Labour (83 d/ha/yr)	22.0 d	11900	185.60
Non-factor inputs			
from operating costs			
fertilizer (820 kg/ha)	215 kg	2360	36.80
materials		2240	35.00
depreciation investments			
field establishment		1290	20.10
vehicles		640	10.00
oil mill		1470	22.90
buildings		130	2.10
subtotal non-factor inputs		8130	126.90

not available and the amount stated, 83 days per hectare per year, is based on the overall figure of 1 labourer for 3 ha. The estimated non-factor inputs during the establishment period (Table 9.5) were 122 700 pesos (46 %) and their depreciation and conversion to inputs per tonne of product results in the amount stated. Vehicles, oil-mill and infrastructure are either bought or built by contractors and the total investments are used to calculate the input per tonne.

The total non-factor inputs are 8130 pesos which is 28 % of production costs. The effects of production of palm oil and kernels on other sectors in the economy are considerable.

9.5 Processing

The national processing industry uses domestically produced crude palm oil and oilseeds, and various imported crude oils to produce end-products such as cooking oil, margarine and meal for livestock feed. The production of edible fats and oils and meal based on domestically produced primary products is listed in Tables 9.12 and 9.13. Palm oil increased in importance for the domestic production of oils and

Table 9.12. Production of edible fats and oils from domestically produced primary products (1000 t).

	Oil palm		Cotton seed oil	Soya oil	Other vegetable oil	Animal fats and oils	Total fats and oils
	c.p.o.	kernel oil					
1970	23.6	1.4	33.9	21.3	8.6	19.0	107.8
1975	33.7	2.4	35.9	27.7	10.5	23.9	134.1
1980	68.4	4.4	32.1	23.1	1.4	30.4	159.8
1981	70.9	4.6	27.7	12.6	5.4	27.4	148.6
1982	87.0		13.7	17.1	4.3	12.0	135.2

Sources: Departament Nacional de Planeación (1982), Mielke (1983)

Table 9.13. Production of meal (1000 t).

	Soya-bean meal	Cottonseed meal	Palm-kernel meal	Other meal	Total
1970	92.2	91.2	5.9	8.4	197.7
1975	122.2	96.4	11.2	9.1	238.9
1980	108.1	81.4	16.2	2.5	208.2
1981	62.3	78.3	17.6	3.0	161.2

Sources: see Table 9.12

Table 9.14. Total output of edible fats and oils (1000 t).

	Domestic origin	Imported				Total edible oils and fats
		soya-oil	fish oil	others	total	
1970	107.8	1.2	21.6	1.0	23.8	131.6
1975	134.1	7.6	17.3	14.9	39.8	173.9
1980	159.8	67.1	46.6	5.9	119.6	279.4
1981	148.6	96.2	56.1	8.0	160.3	285.0
1982	135.2	.	.	.	173.7	308.9

Sources: see Table 9.12

fats. Production of meal runs parallel to production of the respective oilseeds. The total output of edible fats and oils by the processing industry has increased considerably since 1970 mainly with the expanded capacity to refine crude palm oil and imported soya oil (Table 9.14). The crushing capacity, based on domestically produced oilseeds, remained fairly constant.

The total value of end-products increased by about 24 % in real terms between 1970 and 1980, and the value produced increased by 84 %. The result is a decline in value per tonne of end-product of 33 % (Table 9.15). The value in real terms per tonne of the primary products declined by 36 % in the period 1970–1980, re-

Table 9.15. Value of primary products and end-products.

	Primary products (million pesos)			End-products			
	oil palm current*	all products		total (million pesos)		per tonne (1000 pesos)	
		current	constant '70	current	constant '70	current	constant '70
1970-1972	220	1820	1750	2280	2190	15.1	14.5
1975-1977	780	6440	1720	8080	2160	38.8	10.4
1978	1250	10050	2070	12760	2630	56.0	11.5
1979	2060	14510	2160	18380	2730	63.7	9.5
1980	2620	17350	2070	22790	2720	81.6	9.7

* Estimated value of crude palm-oil and kernels.
Source: Departament Nacional de Planeación (1982)

flected in the prices of palm oil (Table 9.10). The share of oil palm products in the value of primary products gradually rose from 12 to 15 % in the given period. The added value of the processing industry was between 20 and 24 % of the total value of the end-products.

In 1978, the processing industry consisted of 44 enterprises, of which 25 had 80 % of the national capacity and were in three urban centres, Bogotá, Barranquilla and Cali. The total employment was 6000 in 1980, which means an increase by half over 1970.

9.6 Marketing

9.6.1 Marketing channels and pricing

Crude palm oil and kernels are sold directly by the producers to the processing industry. A quarter of the oil-palm area is owned by companies that also operate processing factories. The processors sell their end-products under brand names to wholesalers. The by-products such as meal and the non-edible fractions of fats and oils are sold to the feed stuffs industry, and the soap and cosmetics industry, insofar as such activities are not included in the refinery companies itself.

The price of crude palm oil ex estate has declined in real terms since 1970. The decline is more than that for vegetable oils in general (Table 9.16). Despite the declining price in real terms, the domestic price was 10–30 % higher than the world market price in the period 1970–1981, if the exchange rates stated by IMF are applied. In 1982, the domestic price was 96 % more than the world market price, as domestic prices increased that year while the prices on the world market dropped considerably. The relatively high price of palm oil could be the result of a new policy in the system of base prices set by the 'Junta Monetario', which came into operation in 1981 and 1982. Until 1980, the base price of palm oil was far be-

Table 9.16. Prices of crude palm oil and vegetable oils.

	Crude palm oil					Vegetable oils
	world market (US$)	local[2]				index (1970 = 100)
		current		constant 1970 (pesos/1000 t)	index (1970 = 100)	
		(US$/t)	(pesos/1000 t)			
1970	260	336	6.2	6.2	100	100
1975	434	506	15.6	6.1	98	112
1976	406	496	17.2	5.2	84	108
1977	530	612	22.5	4.9	79	101
1978	600	653	25.5	5.1	83	99
1979	654	758	32.2	5.5	89	90
1980	584	692	32.8	4.3	70	87
1981	569	735	40.1	4.5	72	86
1982	445	874	56.0	4.7	69	92

1. Malaysian 5 % c.i.f. N.W. Europe (World Bank, 1984).
2. Prices ex estate.
Sources: see Table 9.12

low the market price and the effect was zero. A new base price for crude palm oil was set in 1981 at 30 000 pesos/t which is three quarters of the market price. Detailed information about recent base prices and about the effect on market prices is not available.

Prices of oil-palm products and oilseeds produced in Colombia are in general supported by a system of import licensing and taxing of imported oils, fats and meals. The 'Comisión de Mercado Exterior de Aceites y Grasas Comestibles' was established in May 1982 to monitor imports of fats and oils.

Colombia is a large net importer of vegetable oils and the calculation of the border price as yardstick for the domestic prices of oil-palm products must start with the c.i.f. price of imported crude palm oil or other comparable vegetable oils. Soya oil is the main oil imported in recent years and c.i.f. prices were around the prices for crude soya oil, Dutch, f.o.b. ex mill quoted by the World Bank (1984). The price in 1982 was $447/t, practically the same as the price for crude palm oil, and this price plus an estimated $15/t for transport to the refinery is used as the border price, $462/t or 29 600 pesos/t. The border price for palm kernels is estimated at $285/t or 18 300 pesos/t and the resulting border price for oil-palm products, calculated with oil-extraction and kernel-extraction ratios mentioned in Section 9.4.4, is $429/t or 27 500 pesos/t. The nominal protection coefficient for oil-palm products is 49 200 pesos/t / 27 500 pesos/t = 1.79.

Table 9.17. Domestic consumption of edible fats and oils.

	Population (million)	Total consumption (t)	Consumption per caput (kg)
1960	16.4	70500	4.3
1965	18.0	100800	5.6
1970	21.1	131600	6.2
1975	23.5	173900	7.4
1980	25.9	279400	10.8
1981	26.4	285000	10.8
1982	27.0	308900	11.4

Source: see Table 9.12

9.6.2 Domestic consumption and imports

The domestic consumption of edible fats and oils rose considerably from 70 500 t in 1960 to 308 900 t in 1982, an average increase of 7 % per year (Table 9.17). The growth is a result of three factors:
- An increase in population of 2.3 % per year.
- An average rate of increase in GNP per person of 3.2 % per year combined with a positive income elasticity of 0.50.
- Declining prices of end-products (Section 9.5), combined with an estimated price elasticity of –0.51.

Domestic production rose slower than consumption and imported amounts of edible fats and oils rose steadily (Table 9.14). The import of 174 000 t in 1982 was 56 % of all edible fats and oils consumed.

Projections of future demand and production by Fedepalma (Guerra de la Espriella, 1983) show increasing import requirements of 100 000–200 000 t/year despite a projected growth in palm-oil production due to the recently planted areas. This is the basis for plans outlined by Fedepalma for the planting of 72 500 ha of oil palm in the period 1984 to 1988.

9.7 Supporting services

Research is by ICA, the Colombian Farming Institute that started operations in 1970 on the 'El Mira' Experimental Station at Tumaco. Much attention is being paid to selection of high-yielding palms.

The Federación Nacional de Cultivadores de Palma Africana, Fedepalma, was established in 1963 as a private organization to stimulate cultivation of oil palm and to represent oil-palm cultivators in discussions with government and private institutions. Fedepalma conducts workshops, undertakes specialized studies resulting in publications and issues a quarterly magazine 'Palmas'.

The inputs for production of crude palm oil and kernels, fertilizers, vehicles and

processing mills are largely imported. Of nitrogen and phosphate fertilizers, 30–50 % are produced in the country but all potassium fertilizers are imported.

Credit for the establishment of palm-oil plantings is provided by the Fondo Financiero Agropecuario (FFAP), administerred by the Banco de la Republica. Between 1972 and 1982, the fund approved finance for 28 400 ha. In 1982, the maximum amount provided for planting was 98 000 pesos/ha or about the total costs in the year of planting. In addition, further loans are obtainable from FFAP for maintenance up to 17 000 pesos/year. The interest rate was 21 %, which must be considered favourable in view of the rate of inflation. Several other credit schemes are administerred by the Banco de la Republica, such as loans for extraction mills and loans for working capital.

9.8 Summary and economic parameters

Colombia is the largest producer of palm oil in Latin America and one of the medium-sized producers in the world, with a share of 1.5 % of world production. The oil palm is a relatively new crop and planting started in the early 1960s with government effort to increase production of vegetable oils. Now, palm oil ac-

Economic parameters of the oil-palm sector in Colombia (1982).

Resources used		
Land under oil palm	47 200	ha
as share of area under permanent crops	29	%
area in production	34 100	ha
Labour for total area	15 700	man-year
for area in production	11 400	man-year
Non-factor inputs for production and marketing		
domestically produced	US$ 3.5	million
imported	US$ 7.6	million
Output		
Crude palm oil (87 000 t) at domestic price	US$ 76.0	million
Palm kernels (19 000 t) at domestic price	US$ 5.6	million
Total product (106 000 t)	US$ 81.6	million
Value added by primary producers	US$ 70.5	million
Value added by sector	US$ 74.0	million
Productivity primary producers		
Gross return per hectare	US$ 2390	
Value added per hectare	US$ 2070	
Gross return per man-year	US$ 7160	
Value added per man-year	US$ 6180	
Destination crude palm oil and kernels		
domestic market	100	%

Sources: see previous tables; own estimates

counts for 64 % of all edible fats and oils produced in the country.

Oil palm is an estate crop and three quarters of the area planted is estates with an area of 500 ha or more. There are several production areas spread over the country.

Ecological conditions are suitable in the existing production areas. Large as yet unopened areas in the Plains of the Orinoco and the Amazon have a potential for oil-palm cultivation. The occurrence of two diseases, sudden wither and lethal spear rot, causes special problems in Colombia and other Latin American countries. The favourable ecological conditions are reflected in a high average yield of slightly over 3 t of oil per hectare which is below yields in South-East Asian countries but well above the yields obtained in West Africa. Production costs of palm oil and kernels are above corresponding world market prices.

There is an extensive processing industry in the country and all palm oil and kernels are processed into end-products for the domestic market. Fertilizers are partly produced in the country; other non-factor inputs for primary production, such as vehicles and processing equipment, are imported.

Production and processing is in the hands of private enterprise but the government controls the imports of oils, fats and meals by licensing and taxation that favours the oil-palm sector.

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Currency equivalents and price indices in Colombia (1960-1983).

	Exchange rate (pesos per US$)	Consumer price index (1980 = 100)
1960	6.6	5
1965	10.5	9
1970	18.4	15
1971	20.0	16
1972	23.7	18
1973	28.2	22
1974	31.3	27
1975	30.9	34
1976	34.7	40
1977	36.8	54
1978	39.1	63
1979	42.5	79
1980	47.3	100
1981	54.5	127
1982	64.1	159
1983	78.9	190

Source: IMF (1984)

10 Oil palm in Honduras

10.1 Background

Honduras is one of the larger Central American republics with a land area of 112 000 km^2. It has access to the Atlantic and Pacific Oceans and is bordered by Guatemala and El Salvador in the west and Nicaragua in the east. The population of 4.0 million (1982) is concentrated in the North-South Corridor with San Pedro Sula and Tegucigalpa, the capital, as urban centres and along the Atlantic coast.

The GNP per person was $660 in 1982 and this is among the lowest in the Western Hemisphere. Agriculture, industry and services contribute 27 %, 27 % and 46 %, respectively, to the GDP. The major proportion of the work force, 63 %, works in the agricultural sector.

The area of arable land is 1.56 million hectares and of permanent crops 0.2 million hectares. The major crops are given in Table 10.1. Oil palm is the major oil

Table 10.1. Average area harvested, yield and national production of major crops over 3-year periods.

Crops	Area (1000 ha)		Yield (kg/ha)		Production (1000 t)	
	1969-1971	1979-1981	1969-1971	1979-1981	1969-1971	1979-1981
Food crops						
maize	283	340	1200	1010	339	343
pulses	72	74	600	530	43	39
rice (paddy)	11	20	1300	1660	14	33
sorghum	36	59	1270	740	46	44
Oil crops						
coconut (nuts)	3	4	.	.	15	28
oil palm (palm oil)	2	7	.	.	6	12
(kernels)			.	.	2	1
Beverages						
coffee	101	135	390	590	39	80
Other crops						
bananas	.	30		44000	1430	1320
cotton (seed cotton)	6	11	2140	2160	13	24
sugar-cane (sugar)	49	83	1820	2570	89	213
tobacco	5	6	1200	1300	6	8

Source: FAO (1971-1983)

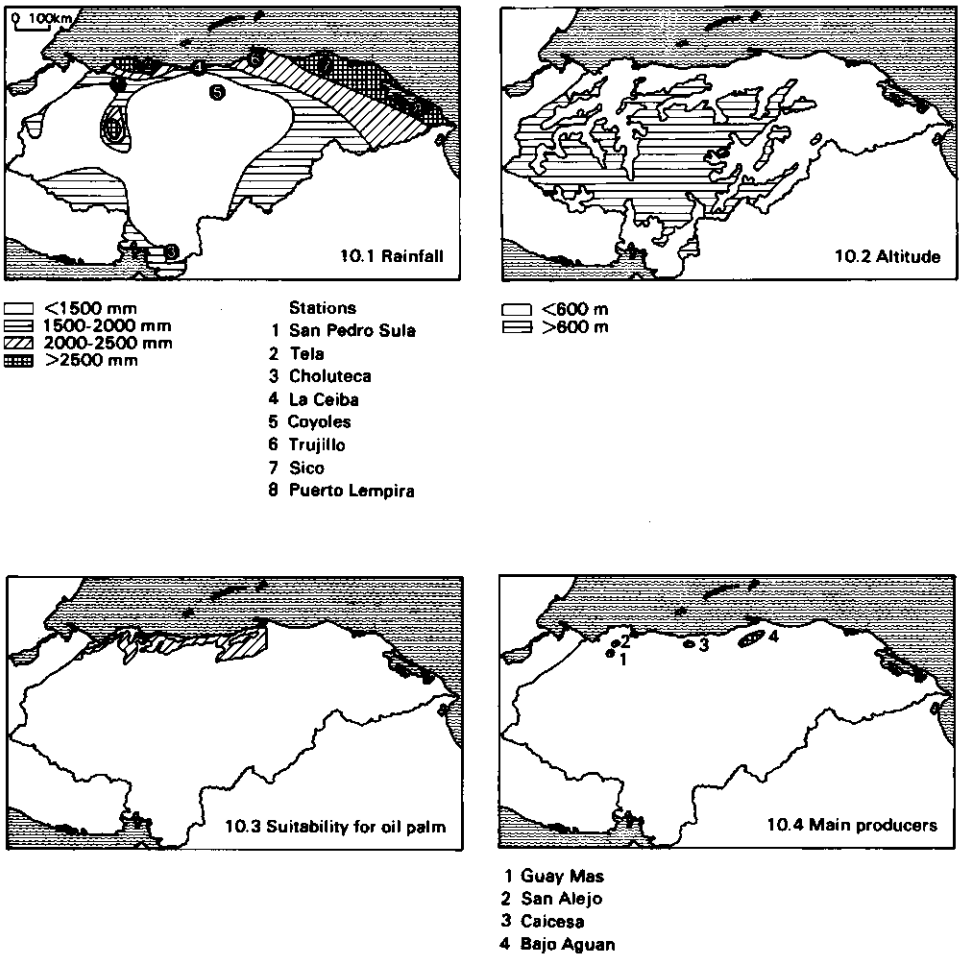

Fig. 10.1–10.4. Average annual rainfall (10.1), altitude (10.2), suitability for oil palm cultivation (10.3) and main producers (10.4) in Honduras. After World Bank (1983), UNDP–FAO (1972).

crop but the contribution to total agricultural production is relatively small, about 1 %.

Alongside crop production, livestock and forestry are important components of the agricultural sector. Primary commodities constitute 81 % of the total merchandise exports. The major ones are bananas, coffee, frozen beef, wood and sugar.

With Costa Rica, Honduras is the main producer of palm oil in Central America with a production in 1982 of 45 % of total production in this region. On a world scale, Honduras is one of the smallest producers with 0.5 % of the world production.

10.2 Ecology

Honduras is situated between 13° and 16° north of the Equator. The climate is influenced by the oceans north and south of the country and the mountainous character of much of the interior. In the lowlands and coastal areas the climate is warm tropical. The interior at higher altitude is cool tropical.

The rainfall varies widely from place to place, especially in the interior, as is shown by the 1000-mm and 1500-mm isohyets (Figure 10.1). The area with more than 1500 mm rainfall covers the northern coastal area and the eastern part of the country. The rainfall distribution over the year for selected stations in this area is given in Table 10.2. The monthly data show a reasonably well distributed rainfall for the stations along the northern coast, with only 2 months of less rainfall than 100 mm for La Ceiba and Puerto Lempira and one month of 87 mm for Trujillo. The coastal area is suitable for oil palm cultivation. The stations at some distance from the northern coast and Choluteca in the south have a pronounced dry season which rules out oil palm in those areas.

The temperature is closely related to altitude. Average mean temperatures in

Table 10.2. Distribution of monthly rainfall for selected stations[1].

	Altitude (m)	Rainfall (mm)												
		J	F	M	A	M	J	J	A	S	O	N	D	total
1 San Pedro Sula	76	68	48	45	52	66	161	148	114	156	167	131	117	1279
2 Tela	3	305	198	139	114	116	150	205	209	252	416	468	391	2967
3 Choluteca	48	0	0	5	43	269	391	180	256	392	324	49	3	1918
4 La Ceiba	5	432	229	170	72	92	153	154	138	193	414	443	368	2860
5 Coyoles	305	52	26	24	16	78	130	107	70	97	118	99	65	880
6 Trujillo	29	316	222	163	87	110	124	128	110	161	457	495	401	2773
7 Sico	20	286	103	124	120	169	266	444	262	156	278	377	486	3071
8 Puerto Lempira	12	192	108	63	80	215	359	350	262	312	370	383	230	2920

1. Period of observation 7-22 years.

the areas below 600 m are around 26 °C. Those areas, the coastal zone with the river valleys and the eastern part of the country (Figure 10.2) are suitable in temperatures for oil-palm cultivation.

The soils in the areas suitable for oil palm in rainfall and temperature are alluvial, ranging from sandy near the rivers, to clay further away from the river. The soils are generally poor and nitrogen deficiency, in particular, is common. The main constraints, however, are drainage problems and flooding in the river valleys. Surveying is therefore required to determine suitability for oil-palm cultivation.

In summary, extensive areas along the Atlantic coast are suitable for oil-palm cultivation but the aspects of flooding and drainage require further inquiry before the suitability of a particular plot can be determined.

The suitability for oil palm of the area west of Trujillo has been determined in detail by UNDP/FAO project 'Proyecto de Desarollo y diversificacion de la produccion agricola' and is shown in Figure 10.3 (UNDP/FAO, 1972).

10.3 The oil-palm sector

10.3.1 History and recent developments

A multinational plantation company, United Brands, started the first oil-palm plantation in 1944 in San Alejo. The main interest of the company was banana production but as hurricanes are a hazard to banana production in the coastal areas, the oil palm was introduced as an alternative crop. This enterprise remained the sole producer of palm oil in Honduras until 1969, when the plantation covered 3000 hectares planted with oil palms of the Dura type. In 1969, a second multinational plantation company, Standard Fruit Co., replanted a banana estate on the north coast with oil palms, as drainage problems resulted in low quality bananas and as the crude palm oil could be processed in the vegetable oil refinery of the same company.

The development of oil-palm cultivation by cooperatives is one of the results of the agrarian reform programme. The first agrarian reform law from 1962 was a response to political pressure by campesino (small farmers) movements. This law was followed by more significant and comprehensive legislation in 1972 and 1975. The main aim of the agrarian reform is to redistribute unused or poorly used land from large landowners to landless rural families. The Agrarian Reform Institute, INA, is responsible for land acquisition and distribution as well as providing comprehensive support to settler groups. In two of the settlement areas, Bajo Agúan valley and Guaymas, cooperatives started with oil-palm cultivation in 1971 and in 1976, respectively.

Neither the cooperative projects nor the multinationals are planning further substantial extension of their areas under oil palm.

Progress in terms of area and production are listed in Tables 10.3 and 10.4.

Table 10.3. Area under oil palm per group of producers (1000 ha).

	Private companies	Cooperatives	Other producers	Total
1970	3.1	–	–	3.1
1975	4.6	2.7	–	7.3
1976	4.8	2.7	–	7.5
1977	5.0	8.1	–	13.1
1978	5.0	10.1	–	15.1
1979	5.2	13.0	–	18.2
1980	5.3	13.3	–	18.6
1981	5.5	13.8	–	19.3
1982	5.9	13.8	0.6	20.3
1983[1]	5.9	14.3	0.7	20.9

1. Part of the totals refers to planned areas.
Sources: Data from private firms and reports from cooperatives

Table 10.4. Production of crude oil palm and kernels per group of producers (1000 t).

	Cooperatives[1]			Private companies[2]		
	fruit bunches	crude palm oil	kernels	fruit bunches	crude palm oil	kernels
1976	0	.	.	.	.	.
1977	3.5	.	.	.	.	.
1978	6.9	.	.	.	.	.
1979	14.0	2.8	0.4	.	.	.
1980	25.8	5.2	1.0	.	.	.
1981	52.8	9.9	1.9	6.4	12.1	3.1
1982	86.0	15.0	2.8	70.0	16.5	4.0

1. Part of the fruit bunches were sold in 1982 to private companies.
2. Production data palm oil and kernels include production from bunches purchased.
Source: see Table 10.3

The cooperative projects cultivate 70 % of the total area under oil palm. Production of fruit bunches by cooperatives in 1982 is slightly higher than production of private companies and the difference will become greater if newly planted areas reach their full production potential. The producers classified as 'other producers' in Table 10.3 are private farmers who sell their fruit bunches to mills of the private companies.

10.3.2 Organization

Palm oil is produced by 4 producers, San Alejo and Caicesa as private companies and the cooperatives in the Guaymas and Bajo Aguan areas. All producers are in the northern part of the country (Figure 10.4). The processing capacity of the private producers is 40 t of f.f.b. per hour; the capacity of the two secondary

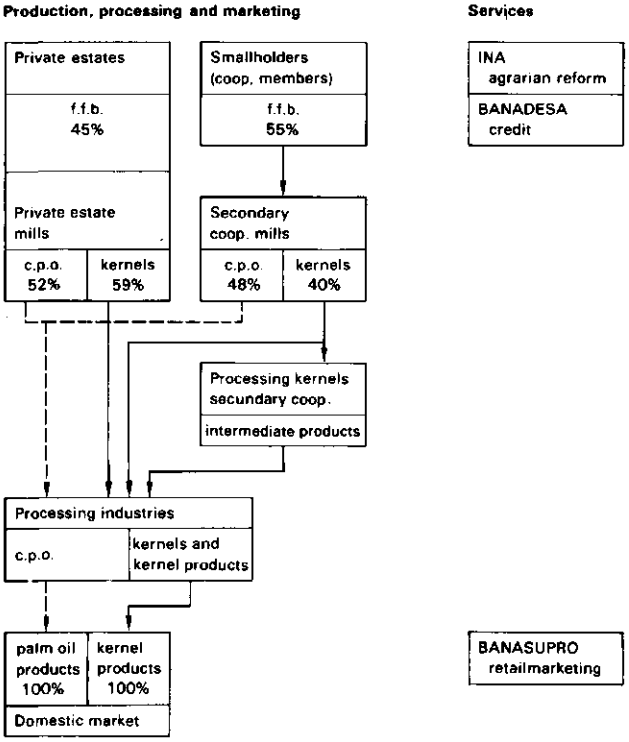

Fig. 10.5. The oil-palm sector in Honduras, 1982. Broken line, palm oil and palm-oil products; solid line, kernels and kernel products.

cooperatives will reach 80 t of f.f.b. per hour in 1985.

The crude palm oil is refined in three refineries, two of which belong to the multinational companies. Kernels are crushed in crushing plants attached to the refineries. One of the secondary cooperatives, Coapalma, operates a small crushing installation at one of their mills.

Oil-palm products such as cooking oil, margarine and by-products as soap are sold on the domestic market through private channels and through the governmental distribution channel Banasupro.

Various services to the cooperative producers are provided by international consultancy firms. The oil-palm sector is outlined in Figure 10.5.

10.4 Production of crude palm oil and kernels

10.4.1 Production factors

Land in the area with suitable ecological conditions is available along the northern coast of Honduras. The development costs, however, are high as new areas must be opened up and a drainage system must be laid out. The costs incurred by

INA in Bajo Aguán area of L 5000/ha reflect initial development costs.

The rural labour market is characterized by a surplus. Labour, temporary and permanent, can be hired as and when required. The costs of labour, however, are high relative to the GNP per person, probably because of a strong labour movement. The wage rates vary from L 17 to L 28 for unskilled and semiskilled work in the mills of Coapalma to average levels of L 14 to L 16 per day, exclusive other benefits, in the private companies.

The cooperative projects in Bajo Aguán and Guaymas were financed by domestic institutions: National Investment Corporation (CONADI) and by external organizations: the Central American Bank for Economic Integration (CABEI), the Commonwealth Development Corporation (CDC) and the Netherlands Development Finance Company (FMO).

10.4.2 Producers and production systems

Production takes place in the private sector although the government plays a major role in the smallholder production and processing cooperatives.

Two private estates own together 28 % of the total planted area. Plantations are integrated with oil mills and both estates are part of multinationals dealing with refining as well.

Production by cooperatives is organized in two stages. Primary cooperatives, of which settlers are members, produce fruit bunches and secondary cooperatives deal with processing and marketing. Primary cooperatives account for 69 % of the area planted. A primary cooperative has 20 to 100 members, with an average of 50. The land is allocated to the cooperative and crops are grown on a communal basis. The amount of land available for reallocation is different in the two areas where oil-palm cultivation is introduced. In Bajo Agúan, there was sufficient land to allocate 32 000 ha to 54 primary cooperatives with 2700 members, a ratio of 12 ha per member. In Guaymas, a total of 5800 ha arable land was allocated to the 33 primary cooperatives with 1100 members or 5.3 ha per member. The average area of oil palm per member is in both regions about 4 ha but in Guaymas there are plans to increase the total area to 5000 ha or 4.5 ha per member. The primary cooperatives in Guaymas therefore will be mainly occupied by oil-palm cultivation while the cooperatives in Bajo Agúan can produce grains, fruit and other crops too.

Each settlement region has a secondary cooperative dealing with the processing of fruit bunches and provision of supporting services to the primary cooperatives, Ecarag in Guaymas area and Coapalma in Bajo Agúan.

Independent smallholders are of limited importance as they account for 3 % of the area under oil palm only. Fruit is sold to estate mills or secondary cooperatives.

10.4.3 Costs

Detailed and comparable data on production costs for both types of producers are not available. The private companies publish annual figures without information on investments, while the information on the cooperatives refers to projects that are partly implemented and partly still being planned. The information available on the various cooperative projects is given below and reference is sometimes made to cost components of private companies. All data refer to 1982 prices.

10.4.3.1 Investment costs

Field establishment. The government played a major role in starting settlement projects through provision of infrastructure, land clearance, and guidance and assistance to groups of farmers organized in various types of cooperatives. The oil palms are established by the cooperatives on a contract basis. The costs of labour, paid to the cooperatives, for planting and maintenance during the first years are L 1700 to L 1850/ha. The overall costs for establishment are estimated at L 5000/ha.

Vehicles. The costs of vehicles to transport the fruit bunches from collection points to the oil mill are estimated at L 1.6 million for the 7800 ha planted and in production in Bajo Agúan area.

Oil mill. The required installed processing capacity per hectare is somewhat different for the two settlement areas as production of fruit bunches in the peak month is 15 % of the annual production in Guaymas and 15 % to 18 % in Bajo Agúan. Recent information about investment costs is available from both secondary cooperatives as 5 mills have been installed in the period 1978–1984. The total costs for the three mills with capacities of 25, 15 and 20 t of f.f.b. per hour in Bajo Agúan are L 60.3 million. The costs include pre-operative costs, costs for complementary facilities and cost increases during the installation period. The mills and two existing 'junior' mills of 8 t of f.f.b. per hour will be able to process the fruit of

Table 10.5. Investment costs cooperative producers.

	Total costs		Per hectare		Share of total %
	(L million)	(US$ million)	(L)	(US$)	
Field establishment (year 1-4)	–	–	5000	2500	43
Vehicles (for 7200 hectares, Bajo Agúan)	1.6	0.8	220	110	2
Oil mill[1]	77.3	38.6	5570	2785	47
Additional investments	9.7	4.85	950	475	8
Total			11740	5870	100

1. 4 mills with total capacity of 80 t f.f.b./hr for 13,870 ha.

10 200 ha. The costs of one mill in Guaymas area of 20 to 25 t of f.f.b. per hour each are estimated at L 17.0 million.

Other costs. Additional investments are done by secondary cooperatives for housing near the mills and for provision of services to primary societies. Further there are pre-operative costs of training related to the operation of the mills, which are considered investments. The additional investments for Coapalma are estimated at L 9.7 million.

The investment costs are summarized in Table 10.5.

10.4.3.2 Operating costs

Production of fruit bunches. Data on expenditures per hectare for the primary cooperatives are not available but an estimate is made on the basis of overall cost figures and the price of fruit bunches sold to the secondary cooperatives. The price per tonne of bunches is L 125 to L 140 for standard quality. These prices cover operating costs as well as depreciation and interest in investments. The secondary cooperative Coapalma deducts L 35/t for repayment and interest thus L 85/t is paid for operating costs of the primary societies. In addition to fruit bunches, loose fruit is sold at a price of L 100/t and the average price received for fruit bunches and loose fruit is given in Table 10.6. Deduction of internal transport costs for primary cooperatives in Bajo Agúan area and the estimated fertilizer costs results in an amount stated as labour income. The cost price of L 86/t is in line with the cost price of the estates of the private companies.

Transport of fruit bunches from primary cooperatives to the mills of secondary cooperatives or private mills is carried out by the primary or the secondary cooperative. costs are L 3/t to L 10/t depending on distance with an average of L 5/t.

The processing costs of the secondary cooperatives include overhead costs which appear as administration and sales costs or general charges in the cost figures of the private companies. Processing costs and general charges for three producers are listed in Table 10.7, together with the oil and kernel extraction ratios. If processing costs and general charges are added, the costs per tonne product are L 382, L 288 and L223 for the three producers, respectively, and the differences are considerable.

Table 10.6. Production costs fruit bunches by primary cooperatives.

	Bajo Agúan (L/t)	Guaymas (L/t)
Internal transport	4.4	–
Fertilizer (350 kg/ha)	22.9	22.9
Labour income	59.7	63.1
Price received[1]	87.0	86.0

1. Price after deductions for repayments and interest.

Table 10.7. Processing costs and general charges.

	Coapalma[1]		Caicesa		San Alejo	
	(L)	(US$)	(L)	(US$)	(L)	(US$)
Processing						
per tonne f.f.b.	87	43	36	18	36	18
per tonne product	382	189	148	74	146	73
General charges						
per tonne f.f.b.			34	17	19	9
per tonne product			140	70	77	38
Oil-extraction ratio		19.4%		20.3%		19.1%
Kernel-extraction ratio		3.4%		4.0%		5.5%

1. General charges included in processing costs.

Interest costs of invested capital are calculated on the basis of 10 % interest on 50 % of the invested capital and on 25 % of the annual operating costs as estimate for working capital. The interest costs for the cooperative producers are L 560/ha for invested capital and L 71/ha for working capital.

10.4.3.3 Production costs

Production costs for cooperative producers as outlined in previous sections, are lised in Table 10.8. Capital costs are included through depreciation: 4 % for field establishment; 20 % for vehicles; 8 % for oil mills; and 5 % for additional invest-

Table 10.8. Production costs oil-palm products for cooperatives.

	Per hectare		Per tonne f.f.b.		Per tonne product	
	(L)	(US$)	(L)	(US$)	(L)	(US$)
Operating costs						
bunch production	1360	680	85	43	373	186
transport	80	40	5	2	22	11
processing, incl. general charges	1392	696	87	43	382	189
interest	631	316	39	20	173	86
subtotal	3463	1732	216	108	950	472
Depreciation capital						
field establishment	200	100	13	6	55	27
vehicles	44	22	3	1	12	6
oil-mill	446	223	28	14	122	61
additional investments	48	24	3	2	13	7
subtotal	738	369	47	23	202	101
Total	4201	2101	263	131	1152	573

ments. To arrive at costs per hectare the estimated average yield at full production, 16 t of f.f.b. per hectare, is used as conversion factor.

The annual figures of the private companies show that their production costs are less than the L 1152 for the cooperatives. The difference is mainly due to higher efficiency in the processing mill, which results in processing costs of L 160–170 per tonne of product, which is less than half the costs of processing by Coapalma.

10.4.4 Returns

Yields. The average yield for the planted area of all producers rose from 6 t of f.f.b. per hectare in 1981 to 7.7 t of f.f.b. per hectare in 1982. These yields and the increase indicate that a large area is still in the first years of production and the average yield does not reflect the real production potential. The yield of specific blocks of the largest producer, the cooperatives in Bajo Agúan, give a better insight into the production levels at maturity (Table 10.9). Production in some parts of Bajo Agúan area is hampered by drainage problems and the estimated average yield of 15 t of f.f.b. per hectare, as used for the calculation of the required mill capacity seems realistic. Yields in Guaymas are somewhat higher, with an estimated average of 18 t/ha. Drainage problems and insufficient supply of fertilizers are mentioned in various reports as the main reasons for lower yields than the originally expected potential yield of 20–22 t of f.f.b. per hectare. On San Alejo estates, the yield of the newly planted D × P palms is expected to reach 22 t of f.f.b. per hectare mainly because drainage problems are absent.

Prices. The price of crude palm oil paid by the refiners in 1982 was around L 1250/t while for kernels L 400/t was paid (Table 10.10). This means a price of L

Table 10.9. Yield of fruit bunches and age of palms in Bajo Agúan in 1981.

Year[1] of planting	1971	1972	1973	1974	1975	1977
Age	10	9	8	7	6	4
Yield (t/ha)	17.94	17.21	14.45	13.03	8.53	2.31

1. No palms were planted in 1976.
Source: Ramautarsing (1983)

Table 10.10. Prices of oil-palm products in 1982.

Product	Range (L/t)	Average price (L/t)
Fruit bunch, delivered at oil mill	125- 140	125
Crude palm oil	1200-1330	1250
Palm kernels	.	400
Palm kernel oil	.	1640

1105 per tonne of product, if an average oil-extraction ratio of 20 % and an average kernel-extraction ratio of 4.1 % is used.

10.4.5 Review costs and returns

The average price of L 1105/t was slightly below the cost price per tonne of product of the cooperative producers, as calculated in the previous sections, and we must assume that a loss was made in 1982. However the cooperative producers are in the first years of operation and we may expect that increased experience at all levels will result in a more efficient production and a lower cost price per tonne of product. The cost prices of private companies are below those of the cooperative producers and both companies made profits in 1982, according to their annual figures.

The income of oil-palm cultivation for the settlers in 1982 and in 1990, at full production, is given in Table 10.11 together with the incomes obtained by labourers on private estates. The incomes of the settlers were comparatively low in 1982, as the plantations were in the first years of production. Around 1990, incomes are expected to attain levels above the wage levels of plantation labourers of the private companies. The incomes of the settlers consist of revenues from bunch production, wages earned by some members of the primary societies employed by Coapalma or Ecarag and paid to cooperatives, and the revenues in cash or kind from the land not planted with oil palms. The wages of labourers of the

Table 10.11. Estimated average annual income of settlers and labourers.

Producer and activity	1982 (L)	1990 (L)
Cooperatives in Bajo Agúan		
production of fruit bunches	1380	4150
wages from employment by secondary cooperatives	480	990
production other crops	600	600
total average income per settler	2460	5740
Cooperatives in Guaymas		
production of fruit bunches	1370	6090
wages from employment by secondary cooperatives	300	940
production other crops	300	300
total average income per settler	1970	7330
Caicesa		
wage	3500	4700
other benefits	450	450
total income per labourer	3950	5150
San Alejo		
wage	4000	5400
other benefits	450	450
total income per labourer	4450	5850

Table 10.12. Estimated input-output data for cooperative producers at full production.

Output per hectare	Quantity		Domestic price		Value	
	(t)	ratio (%)	(L/t)	(US$/t)	(L)	(US$)
F.f.b.	16					
C.p.o.	3.2	20	1250	625	4000	2000
Kernels	0.64	4	400	200	256	128
Total product	3.84	24	1106	553	4256	2128

Inputs per tonne product	Quantity	Costs	
		(L)	(US$)
Land	0.26 ha	p.m.	p.m.
Labour			
bunch production			
(1 family/4.5 ha, per family 250 d/yr)	14.5 d	.	.
processing (3 d/t product)	3.0 d	.	.
other (office)	1.5 d	.	.
subtotal	19.0 d	.	.
Non-factor input			
from operating costs			
fertilizer (350 kg/ha)	91 kg	36.40	18.20
other materials (estimated)		50.00	25.00
depreciation investments			
field establishment		31.20	15.60
vehicles		12.00	6.00
oil mill		122.00	61.00
additional		13.00	6.50
subtotal non-factor inputs		264.60	132.30

private companies are supplemented by income from a plot of land allotted and/or benefits such as free housing, schooling and other amenities or both.

The input-output data for cooperative producers (Table 10.12) are estimated for the situation when cooperatives are at full production. Data about the use and costs of materials other than fertilizers and some other non-factor costs are not available and the sub-total must be considered as indicative.

10.5 Processing

The crude palm oil produced is refined in three refineries, one belonging to the group of Standard Fruit Co. at la Ceiba, one belonging to the group of United Brands at San Pedro Sula, and a smaller independent refinery. The total capacity of these refineries is 180 t of crude palm oil per day or 55 000 t per year, which

exceeds present production and the expected production in the near future.

Kernels are crushed by one primary producer, Coapalma, which operates a crushing mill with a capacity of 3600 t/year next to one of their oil mills and by crushing installations attached to the three refineries.

The further processing of refined palm oil and kernel oil into end-products is carried out by the three refineries. The main products for human consumption are shortening, margarine and palm-kernel oil, and refined, bleached and deodorized palm oil for industrial purposes. For production of margarine imported cottonseed oil and soya oil are used in addition to palm oil. The total production of these products was 26 000 t in 1981/82 of which shortening was the main product with 23 900 t. Other products produced by the refineries from palm oil and kernels are palm-kernel cake and soap.

10.6 Marketing

10.6.1 Marketing channels

Palm-oil products were not exported until 1982. This section outlines the domestic marketing of end-products. The refineries sell 85 to 90 % of their end-products to wholesalers, who in turn supply the retail shops in the country, and 10–15 % to the parastatal BANASUPRO. This organization operates through two 'Bodega's', outlets for large-volume sales to consumers and about 110 retail shops. The aim of BANASUPRO is to provide low-income groups with basic commodities at cost price. A small proportion of the end-products of the refineries is sold directly to the food-processing industry.

10.6.2 Pricing, margins and taxation

Information on prices, marketing costs and margins of oil-palm products for a series of years is not available. The prices for products delivered at refineries in 1982 are listed in Table 10.10. In 1982 Honduras was a net importer of vegetable oils and the calculation of the border price starts with an estimated c.i.f. price of imported crude soya oil (as most likely substitute for palm oil) of L 894/t ($447/t) Additional costs to refiner are estimated at L 20/t ($10/t), which brings the border price to L 914/t ($457/t). The estimated border price for palm kernels is L 560/t ($280/t). The average border price for both products, using the oil-extraction and kernel-extraction ratios as weighing factors, is L 856/t ($428). This is below the local price of oil-palm products, L 1108/t ($554/t), and the nominal protection coefficient is 1.29. In a few years, Honduras will be a net exporter of palm oil (Section 10.6.3) and from that time border prices are calculated by subtracting marketing costs from the f.o.b. price.

A maximum retail price for shortening and other products for human consumption is fixed by the government. These prices are based on costs of refiners and

gross margins for wholesalers and retailers of about 10 %. The retail price for shortening was L 2.72/kg in 1982. The government further set quality standards for the various products and carries out regular checks.

Oil-palm products are not subjected to taxes.

10.6.3 Domestic consumption, imports and exports

Consumption data for oils, fats and derived products and imports in some recent years are brought together from various sources (Table 10.13). The totals given must be seen as an approximation of the volume consumed. Consumption per person in 1982 was 10 to 11 kg, of which 9 kg were edible vegetable oils. Palm oil and palm-kernel oil account for 95 % of these edible vegetable oils. The total volume imported remained 4 000 to 5000 t/year and the increased production was easily absorbed by the domestic market.

The various projections of future demand are based on annual increases of 4–5 %, due to a population growth of 3 %/year and a modest increase of income per person. If demand increases by 4.5 %/year, the total amounts required to satisfy the domestic market in 1985 and 1990 will be 47 000 t and 58 000 t, respectively. The estimated production of palm oil and palm-kernel oil based on the area planted in 1982 is 60 000 t in 1985 and 73 000 t in 1990. This means that Honduras will become a palm-oil exporter before 1985. Production costs of palm oil and kernels of the largest producer were well above prices on the world market in 1982 and export subsidies will most likely be required. A second possibility is export of refined end-products to Central American countries. This would reduce the international competition, as specialized products can be offered and the available refining capacity would be better utilized.

Table 10.13. Domestic consumption of fats, oils and derived products and importation (1000 t).

	1975	1978	1982
Consumption			
vegetable oils			
coconut oil	2.0	0.4	.
cottonseed oil	4.6	3.3	1.3
palm oil	9.1	15.0	31.5
palm-kernel oil	2.5	1.6	2.7
other	0.7	0.6	0.4
subtotal	18.9	20.9	35.9
animal oils and inedible products	12.0	13.3	5.0
total	30.9	34.2	40.9
Importation			
vegetable oils	1.9	1.0	3.3
animal oils, fats and grease	2.4	4.1	1.7
total	4.3	5.1	5.0

Sources: FAO (1971-1983), various other sources

10.7 Supporting services

Supporting services are provided by several institutions. The institutions cannot be grouped under headings such as research or extension, as they provide various services. Therefore each institution in the oil-palm sector will be briefly discussed.

Instituto Nacional Agrario (INA), National Agrarian Institute is a semiautonomous institution with the legal status of corporate body; its responsibility is to implement the national agrarian policy. Main duties are:

- To plan, programme and put into effect the national agrarian reform.
- To be aware and resolve all questions connected with the tenure, recuperation and distribution of all land affected by the agrarian reform.
- To promote the economic, social, cultural and technical improvement of the small farmer class.
- To arrange for and administer the internal and external resources required for the execution of its functions.

The budget of INA in 1981 was L 47 million of which L 26 million came from the government and L 21 million from external sources. The staff totalled nearly 2000 employers in the same year.

Since 1978, INA has concentrated its resources on the potentially most productive areas including the Bajo Aguán area. INA played a central role in the planning, financing and implementation during the first years of the settlement projects. For the oil palm, the tasks include:

- Land clearance.
- Supply of inputs to the cooperatives.
- Extension.
- Establishment and management of the processing mills.
- Formation of and guidance to primary and secondary cooperatives.

The development of new settlement projects, which could result in the establishment of new areas planted with oil palm, is not now being considered, as the financial and management capacity of INA is already stretched to its limits.

Banco Nacional de Desarollo Agricola (BANADESA), financed the agricultural inputs in the cooperative projects of Bajo Agúan and Guaymas. Details on terms and conditions of the loans provided are not available.

Several other financial institutions, the Corporación Nacional de Inversiones (CONADI), and national branches of the Inter-American Development Bank (IDB), the Central American Bank for Economic Integration (CABEI), the Commonwealth Development Corporation (CDC) and the Netherlands Development Finance Company (FMO) are involved in the channelling of external finance to the oil-palm sector.

Advisory services to the palm-oil producers are provided by the IRHO, France and H.V.A. International B.V., a Netherlands consultancy firm.

10.8 Summary and economic parameters

Honduras is the main producer of palm oil in Central America with 45 % of its production, but it is one of the small producers on a world scale with 0.5 % of world production. Production of palm oil started on private estates in 1944 but the great expansion of the area under oil palm came in the 1970s when cooperatives started with large-scale planting in new settlement areas.

Cooperatives, primary cooperatives for production of fruit bunches and secondary cooperatives for the processing, and private companies, owned by multinationals, are the main producers with 68 % and 29 % of the area planted, respectively. Production is concentrated in the north-west of the country along the Atlantic coast.

Ecological conditions are suitable and yields of 3–4 t of oil per hectare are obtained from mature stands of oil palm. Average production is lower, because a large proportion of the productive area is in the early years of production. Drainage problems in some areas limit production. Production costs for cooperative producers are high and they could hardly survive without the high domestic price for crude palm oil and kernels.

The crude palm oil and kernels are processed by private industries in the country into end-product for the domestic market. The rapidly increasing production makes exports from 1983 onwards necessary. Non-factor inputs such as fertilizers, vehicles and equipment are imported.

Economic parameters of the oil-palm sector in Honduras (1982).

Resources used		
Land under oil palm	20 900	ha
as share of area under permanent crops	11	%
Labour for total area	4800	man-year
cooperative producers	3800	man-year
estate companies	1000	man-year
Non-factor inputs for production and marketing		
domestically produced	US$ 1.0	million
imported	US$ 3.1	million
Output		
Crude palm oil (31 500 t) at domestic prices	US$ 19.7	million
Palm kernels (6800 t) at domestic prices	US$ 1.4	million
Total product (38 300 t)	US$ 21.1	million
Value added by primary producers	US$ 17.0	million
Value added by sector	US$ 18.0	million
Destination products crude palm oil and kernels		
domestic market	100	%

Sources: see previous tables; own estimates

The government played a decisive role in the establishment of cooperative producers but these are now operating fairly independently.

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Currency equivalents and price indices in Honduras (1960-1983).

	Exchange rate (L per US$)	Consumer price index (1980 = 100)
1960	2.00	37
1965	2.00	43
1970	2.00	47
1971	2.00	48
1972	2.00	51
1973	2.00	53
1974	2.00	60
1975	2.00	64
1976	2.00	67
1977	2.00	72
1978	2.00	77
1979	2.00	87
1980	2.00	100
1981	2.00	110
1982	2.00	121
1983	2.00	133

Source: IMF (1984)