CHAPTER III

PRODUCTION ANALYSIS

A General Idea of Production Methods in an Estate

a) Nursery:

The palm seeds are germinated in sand beds consisting of fine well-washed sand. The seeds planted are the freshly harvested seeds. During the time of germination an ample supply of water is necessary. When the 2 leaf seedlings appear in about 10 weeks time the seedlings are then ready for transfer to the nursery beds.

The nursery should consist of heavy clay with a good supply of water. It should also be clear of all forms of weeds. It has been estimated that for an acre of 50 palms it is necessary to plant 200 seeds in the sand beds. About half of this should germinate successfully and planted in the nursery. From there the 50 best palms are transplanted into the field.

The time taken for the seedlings to germinate and to be planted in the field is about 12 - 18 months. It is important that the time of transplanting should coincide with the rainy seasons especially in March or September. Therefore important timing is necessary in the initial planting of the seeds in the sand beds.

b) Land Preparation

At the time of the nursery practice the land should have been well ploughed, cleaned of weeds and be ready anytime for planting. The land should be flat or undulating. Sloping areas or steep areas are not recommended for oil plam cultivation. The land will be planted with the young palms at the rate of about 49 palms per acre. The period of planting should coincide with the rainy season so that the palms can be assured of a constant supply of water. The palms are planted in a triangular manner with a 32 ft distance separating each palm.

c) Maintenance and Manuring

Maintenance of the ground cover is important. Weeding is necessary until the cover has been well established. When a cover has been well established weeding will then be carried on around the palm only. Natural ground covers should be encouraged. This can be done by a method of selective weeding i.e. clearing the unwanted weeds such as lalang, thorns and other forms of shrubs.

Pruning of the leaf is necessary. When the fruit bunch is harvested the leaf below the bunch should be pruned. This is done by the chisel (when the tree height is low) or the harvesting knife and the bamboo pole (when the tree is high). The leaf is severed close to the trunk.

Manuring is used when the soil lacks mineral matter. Manures help to increase the yield of the palms. The type and quantity of the fertiliser to be used will depend very largely on the type of soil the palms are grown on. In most cases the manures are applied around the palms so that the roots get full benefit of the manure.

d) Harvesting and Differences in Yield

The fruit bunches ripen in the fourth year after pollination has taken place between the male and female flowers of the palm. The time of pollination to the time of ripening takes about six months. When the fruit bunches ripen the fruits are red in colour. Ripe fruits tend to fall off from their bunches. When this happens it is a sign that the fruits are ripe and are ready for harvesting.

Harvesting should be carefully done so as not to crack or bruise the fruits. Cracking, bruising or over ripening of fruits causes some of the oil to break down into free fatty acids which then reduces the content of oil in the fruit. The price and the quality of palm oil decreases as the content of fatty acid increases. Thus to produce optimum yields the fruit bunches should be carefully harvested and carefully transported to the factory for processing. Harvesting and processing of the fruit bunches are often done on the same day so as to prevent the formation of excessive free fatty acids.

Harvesting methods are similar to those of pruning. Thus either a chisel or a harvesting knife is used depending upon the heights of the palm concerned. The leaves below the fruit bunches are first cut off. Then the stalk of the fruit bunches are severed with either the chisel or the harvesting knife.

The yield of the palm would depend upon the following:- soil conditions, manuring, age of trees, drainage, technique of management. Variations in these factors will have an effect on the yield of the palm. Table 3-1 gives the estimated yields of palms of varying ages.

TABLE 3-1

ESTIMATED YIELDS OF PALM TREES

Age of Palm (Yrs.)	Fruit Bunches per palm/annum (Katis)+	Fruit Bunches /acre/annum (Pikuls) +	Palm Oil /acre (Pikuls)*	Palm Kernel /acre (Katis)
4	45	22	3 - 3½	80
5	90	44	6½ - 7	170
6	135	67	10 - 10½	255
7	150	75	11 - 11½	280
8	180	88	13 - 13½	330
9	195	96	14 - 14½	355
10 or more	200	98	14½ - 15	370

Source: Agricultural Leaflet No.34 "The Oil Palm" pp.17
* rate of extraction of oil estimated to be between 12 - 15% per acre of fruit bunches.
+ 1 kati = 1.1/3lb.
+ 1 pikul = 133.1/3 lb.

e) Transport of Fruit Bunches

The speed of transport is important if one is thinking in terms of high extraction rates. If the fruits are not processed within the same day, free fatty acids would form. Road and railways are the main forms of transport. These systems have their advantages and disadvantages.

(1) Advantages of rail transport:

(i) fruit bunches are loaded in cages and these are also used as a storage area. Thus less bruising of bunches is involved.
(ii) transport and upkeep charges are relatively small.
(iii) Speedy form of transport.

(2) Disadvantages of rail transport:

(i) enormous capital outlay involved in the construction of the railway network.

(3) Advantages of road transport:

(i) great flexibility-can reach any destination as long as there are roads.

(ii) next to fresh fruit bunches any other sort of goods can be carried e.g. the transport of harvesting

tools from nearby towns or the transport of labourers from the houses to the harvesting area.

(iii) Moderate capital outlay in relation to railways.

(4) Disadvantages of rail transport:

(i) bunches cannot be stored in the lorries - too expensive way of storing.
(ii) operating costs are comparatively higher than those in the railways.

No matter what system of transport is used, the main emphasis will be on correct timing between harvesting and factory extraction of oil. The form of transport must be capable of removing the freshly harvested fruits to the factory for immediate oil extraction.

f) Diseases and Common Pests

The main diseases encountered by the oil palm are:- stem rot, bud rot and crown disease. Stem rot is the decaying of the trunk of the palm. There is no cure for this. The only prevention is for the decayed palm to be destroyed to avoid the disease spreading. Bud rotting is the decaying of the young unopened leaves. To prevent this from spreading, the decayed leaves should be pulled out. Crown disease is a mechanical injury caused by the Rhinocerous Beetle to the young leaves of the palm. When the leaves open they are twisted. Thus the destruction of the Rhinocerous Beetle will remedy the situation.

The main insect pests can be identified as the Rhinocerous Beetle, the Red Stripe Weevil and the Nettle Caterpillar. Animal pests are pigs, porcupines and rats. Crows also cause damage to the fruits.

g) Extraction of Oil and Kernel Production

The extraction of oil involves the following stages:

(1) Sterilisation of the Bunches

Efficient sterilisation is important for two reasons. Firstly, it loosens the fruits from the bunch which will facilitate the stripping process. Secondly, it frees the fruits from enzymes which produces free fatty acids. It has been found that sterilisation for 15 - 30 minutes at 30 pounds per square inch of steam pressure inactivates the enzymes in the fruit.

(2) Mechanical Stripping of the Bunches

This stage involves the separation of the fruit from the stalk of the bunch. Care should be taken in stripping the fruits so that they are not bruised. This is to

reduce the free fatty acid content in the fruit and thus increase the oil content.

(3) Mashing the fruit

The mashing of the fruit loosens the pericarp from the nut. This ruptures the cells within the fibrous matter and facilitates the removal of the oil. There should be efficient mashing of the fruit for otherwise the recovery of oil will be reduced.

(4) Separation of the Oil from the Mashed Fruit

Two methods can be used for the separation of oil from the fruit. They are either the centrifuging or the hydraulic press methods. The main aim of these methods is to achieve a high recovery of oil. There is very little difference between the two methods but many estates favour the use of the hydraulic press. Many new estates install the hydraulic press instead of the older centrifugal extractors.

(5) Washing and Purification of the Crude Oil

The crude oil which has been separated from the fruit is washed and purified to clean the oil from impurities. A small loss of oil is to be expected but this does not matter much, since the quality of the oil depends upon its purity.

Palm Kernel Production Involves the Additional Stages:-

(6) Separation of Nuts and Pericarp Residue

This stage involves the separation of the nuts from the pericarp residue whose oil has already been extracted. The nuts are then dried to remove the moisture content. They are then cracked and the kernels are removed from the fragments of the shell.

(7) Drying of Kernels

The kernels should be well dried to reduce the moisture content in the kernels to below 8 per cent. If there is a high water content in the kernels they tend to be discoloured and this would increase the free fatty acid content thus reducing the oil content. This process is therefore aimed at a high recovery of clean and unbroken kernels.

(8) Second Solvent Extraction on Pressing of Pericarp Residue

Further extraction of oil takes place on the pericarp residue. This is to prevent any wastage of oil. The oil is extracted until the pericarp residue is dry and it is assumed that no more oil exists in the residue.

Equipment Used - Types of Processing - Rate of Extraction

In 1962 various estates in the Federation reported various types of processing equipment used. Altogether 30 estates out of 68 estates reported using some processing equipment. The processing equipment are of two types - The centrifuges and the hydraulic presses. Both methods are used for extracting the oil from the fruit. Table 3-2 shows the oil palm equipment owned by states.

TABLE 3-2

TYPES OF PROCESSING EQUIPMENT - BY STATES. 1962

States	Total Oil P. Estates	Centrifuges	Hydraulic Presses
Johore	9	9	36
Kedah	0	0	0
Kelantan	2	2	0
Malacca	0	0	0
Negri	4	0	1
Pahang	4	3	0
Penang & Province	2	3	0
Perak	9	4	17
Perlis	0	0	0
Selangor	38	29	6
Trengganu	0	0	0
Total	68	50	60

SOURCE: AGRICULTURAL CENSUS REPORT No. 16

A glance at the table tells us that most centrifuges are used in Selangor while hydraulic presses are the common processing equipment in Johore and Perak. The need for a press of optimum capacity is necessary. The equipment used should not be too large or too small. It is considered that the minimum economic size of a factory would be two- 3 ton presses (or four 1½ ton). Working on a basis of 8 hour shifts per day, the equipment would be able to produce 5,000 tons oil per annum. This quantity can be derived from the fruit of 4,000 acres of palms. The rate of yield would then be 1¼ tons of oil per acre of palm.

The estimated cost of the factory with two 3-ton presses, would be about £260,000. This would represent a cost per acre of £65 if the estate is 4,000 acres in size.

Rate of Extraction

The average rate of extraction for palm oil as given in the agricultural census report No.16 is 16.8% (oil to bunch weight). It ranges from a low level of 16.3% to 17%. The highest rates are experienced in Selangor where the centrifuges are used. But this is no basis to judge the usefulness of the equipment since the yield is dependent on factors such as age of trees, time wasted, type of planting material used. Similarly in Perak the rate of palm oil extraction is 16.9%, Johore 16.6%. Palm kernel extraction is also given in the table following.

TABLE: 3-3

RATE OF EXTRACTION - BY STATES 1962

States	Palm Oil Extraction (Oil to bunch wt.)	Kernel Extraction (Kernel to Bunch wt.)
Johore	16.6 %	4.6 %
Perak	16.9 %	4.7 %
Selangor	17.0 %	4.6 %
Average:	16.8 %	4.6 %

SOURCE: AGRICULTURAL CENSUS REPORT. No. 16.

Development of Oil Palm Planting

The procedure of oil palm planting can be classified as follows:- a) Planning, b) estimating the costs c) Execution.

a) Planning

Planning is a very important feature in any oil palm scheme that is to be undertaken. Considerations such as the type and availability of planting material, the fertility of the soil, climatic conditions, area of land and its nearness to communication lines, the location of the factories, labour, and costs of production have to be taken into account when planning any oil palm scheme. A good plan would make the execution of the scheme much easier. It should be remembered that all plans should lead to the execution of the scheme in such a way that costs are minimised and that maximum efficiency is achieved from the planting and factory processes.

(b) Estimating the Costs

Costs can be estimated for an estate of 5,000 acres in size. The estimate shall comprise only the overhead costs. The costs are in terms of planting, factory, fixed assets and general expenses for the duration when the palms are still immature. This is approximately 4 years. The schedule below gives the estimated costs per acre of oil palm.

Activity		Per Acre
1. Planting - clearing of land and maintenance for 4 years	-	800
2. Factory - including storage tanks	-	400
3. Other Fixed assets e.g. transport equipment, roads and housing	-	300
4. General Expenses - secretarial, general transport, medical etc.	-	250
		$1,750
Add. - Contingencies unforseen e.g. manuring		250
		$2,000 per acre

(c) Execution of the Plans

This area involves the setting up of land sites, choosing the actual location of the area for planting and for the factory site. It is estimated that 55 palms per acre is the suitable number of palms. The seeds are planted. Then comes the maintenance part of it. After 4 years, harvesting begins and processing of the fruits results in the actual production of the oil. This stage is then the actual stage of production.

Operating Costs and Average Net Returns

The analysis of the cost of production of palm oil and palm kernels is on the assumption that the estate concerned is 5,000 acres in size. The operating costs shown are assumed to be applicable to most estates of 5,000 acres in size. Moreover, the operating costs are those incurred during a period of peak production.

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a) Palm Oil

It is estimated that the costs of production of palm oil (under the stipulated conditions mentioned above) is about $250/= per ton of palm oil. They can be shown in table 3-4.

TABLE 3-4

COSTS OF OPERATION (PALM OIL)

(in dollars)

	Cost per ton (Palm Oil)	Percentage
Field upkeep	30	12
Harvesting	50	20
General Charges	30	12
Factory Costs	90	36
Amortisation	20	8
Depreciation	30	12
Total	$ 250	100

An analysis of the costs show that factory costs account for about 36% of the total operating costs. The factory costs incurred involve such costs as fuel, factory wages, storage costs, water, and other similar costs. Also included are the collection costs such as transport of the fresh fruit bunches and the costs of forwarding the oil to the bulking installation. Thus it can be seen why the total factory costs account for such a high percentage of operating costs.

Harvesting costs are also important and account for 20% of operating costs or $50 per ton of palm oil. Harvesting costs account for such a high percentage because of the laborious and intricate jobs involved. It involves the careful pruning of the leaves, followed by the harvesting of the fruit. Experienced labourers are needed for this job and the wage rates paid out to them are comparatively higher than for the other labourers working in the field.

Field upkeep costs involves such costs as manuring weeding and the control of pests and diseases. These costs amount to about $30 per ton of oil and accounts for 12% of operating costs. General charges are costs

such as general transport, stationery, office costs, and secretarial costs. These are about $30 per ton of oil and also account for 12% of operating costs. The operating costs also include amortisation charges of approximately $20 and depreciation charges of $30 per ton of palm oil. The overhead cost per acre is $2,000. The oil palm factory is expected to have a life of about 30 - 40 years and depreciation charges are equally charged to these years of its life.

To estimate the profit per ton of palm oil, one must have the selling price figure for palm oil. Assuming the F.O.B. selling price of palm oil to be approximately $600 per ton we can then calculate the net returns per ton of oil. The net profit per ton of palm oil would therefore be $600/= less $250/= which is $350 per ton. Again, assuming that one acre of oil palm produces 1.3 tons of palm oil, the value of the oil would be 1.3 x 600 which is $780/= per acre. The operating costs for 1.3 tons would then be 1.3 x 250 which is $325/=. Thus the net returns per acre of oil palm on palm oil would be $780/= less $325/= which is $455/=. The net figure, value would vary with charges in the operating costs, charges in price and with changes in the yields per acre. A lower yield would bring in a smaller return and vice versa. Similarly a higher cost would bring in a smaller return and vice versa.

b) Palm Kernel

Under the same conditions, the operating costs for palm kernels would be about $150 per ton of palm kernels. The costs can be broken up into the following as shown in table 3-5.

TABLE 3-5

COSTS OF OPERATION (PALM KERNEL)
(in Dollars)

Activity	Cost per ton (Palm Kernel)	Percentage
Field Upkeep	15	10
Harvesting	25	16.7
General Charges	20	13.3
Factory Cost	60	40.
Amortisation	10	6.7
Depreciation	20	13.3
	150 p. ton of palm kernel	100.

The relative importance of the costs is very much similar to that of palm oil. Factory costs account for 40% of total operating costs. Thedetailed costs of these activities are similar to those mentioned under palm oil. Assuming again that we know the F.O.B. selling price of palm kernels, we can calculate the net return per ton of palm kernels. Let us assume the price per ton of palm kernel to be at a steady level of $300/= per ton. That $300/= less $150/= which is $150/= . Again if the average yield of palm kernels is approxmiately 0.7 tons per acre of oil palm the value of this would be 0.7 x 300 which is $210/=. The cost for 0.7 tons would be 0.7 x 150 which is $105/=. Thus the net return is $210/= less $105/= which is $105/= per acre. This net return is only an average figure. It can vary with variations in costs, prices and yields.

The net return, on an acre of oil palm can now be found by adding the net returns from both palm oil and palm kernel. The net return from palm oil is $455/= and the net return from palm kernel is $105/=. Thus the total net return per acre is $455 plus $105/= which is $560/=. One must remember that this is a return for a yield of about 2 tons of oil per acre. The return would be lower if yields were lower holding other variables constant. It would also change with either changes in prices or in costs.

Production of Palm Oil and Palm Kernels - States of Malaya

This section deals with the trend of production of the country, the acreage and the ownership and control of estates in Malaya.

(a) Acreage: States of Malaya

As has been mentioned in Chapter I the main areas of oil palm are in Johore, Selangor and Perak. There are however certain other areas being developed for oil palm cultivation such as Pahang, Negri Sembilan and Province Wellesley. Table 3-6 gives an idea of the oil palm acreages by states.

From table 3-6 it is seen that Johore leads the list in oil palm acreage with 46 % of total acreage. Selangor has 31 % and Perak 18%. The table also gives the areas of mature and immature mixed oil palm. Mature areas are the areas which have oil palm in bearing. The immature area mixed is one where there are immature palms and mature

TABLE 3-6

OIL PALM ACREAGE: BY STATES - 1960

(in acres)

State	Total	Per-centage	Mature Areas	Per-centage	Immature Area Mixed	Per-centage
Johore	58929	46	40389	42	18540	58.
Selangor	40707	31	30618	32	10089	30.
Perak	24059	18	19486	20	4573	13
Pahang	3139	2	3041	3	98	-
Negri Sembilan	2734	2	2273	2	461	1.
Province Wellesley	982	1	729	1	253	1.
Kelantan	640	-	440	-	200	1.
Total	131,190	100	96,976	100	34,214	100

Note: States not included do not have any areas of oil palm land.

Source: Ministry of Agriculture Report No.16 "Estates".

palms in bearing. However most of the palms in these areas are immature. An analysis shows that Johore accounts for 42% of mature areas and 58% of immature areas mixed. The figures for the rest of the states are also given.

(b) Acreage: Federation of Malaya

The rate of increase in the total acreage of the oil palm is tremendous. In 1917 when the first commercial oil palms were planted there were only 215 acres. At present there are about 153,000 acres (1962). The tremendous increase in the total acreage can be accounted for by various reasons. Firstly most rubber estate owners have realised the comparative advantage of oil palm over rubber. The bright future in the oil palm industry coupled with a bleak future in the rubber industry has made most rubber estate owners shift to

the cultivation of oil palm. Thus when the rubber trees age the land is used for planting oil palm instead of planting new rubber trees. Secondly, the F.L.D.A. Schemes have accounted for various oil palm smallholdings. Table 3-7 gives oil palm acreages for the Fed. of Malaya.

TABLE 3-7

OIL PAIM ACREAGE: FEDERATION OF MALAYA

Year	Acreage (in acres)
1917	215
1929	31,625
1947	78,000
1959	126,000
1960	135,000
1961	141,000
1962	153,000

Source: Monthly Statistical Bulletin - March 1964.

(c) Ownership and Control of Estates:

Of the 153,000 acres in 1962, it has been estimated that 100,000 acres are in bearing and the remainder 53,000 acres are immature areas. The total acreage of 153,000 acres can be subdivided into approximately 68 estates. Most of these estates are under the control of various agency houses. Table 3-8 supplies the details of the ownership of the oil palm areas.

TABLE 3-8

OWNERSHIP DISTRIBUTION OF OIL PAIM ACREAGE

Company	Acreage (Acres)
Guthrie Agency (M) Ltd.	34,000
Socfin Co. Ltd.	30,000
Harrisons & Crosfield Ltd.	20,000
Barlow and Co.(M) Ltd.	18,000
Danish Berram River Companies	15,000
Malayan Estate Agency Group Ltd.	13,000
Total:	130,000

The number of estates under the control of the above companies have also increased over the past years. In 1957 there were only 58 estates. This has increased to 68 in 1962. See table 3-9.

TABLE 3-9

NUMBER OF ESTATES PRODUCING OIL PALM

Year	No. of Estates
1957	58
1958	61
1959	62
1960	62
1961	63
1962	68

(d) Production of Palm Oil and Kernels: States of Malaya

There is a strong correlation between the acreage and the production of oil palm fruits. Thus once again Johore, Selangor and Perak are the main producers of the fruit. Johore produced 171785 tons of fresh fruit bunches (F.F.B.) in 1962. Selangor produced 141590 tons and Perak produced 63157 tons. See table 3-10

TABLE 3-10

PRODUCTION OF F.F.B. BY STATES:
(in tons)

State	F.F.B.
Johore	171785
Selangor	141590
Perak	63157
Pahang	6073
Negri Sembilan	4982
Province Wellesley	0.
Kelantan	870.
Total	388457

Source: Census of Agriculture. Report No.16 - "Estates".

(e) Trend of Production: Federation of Malaya

Malaya's oil palm production has increased at a great rate since 1954. The increase in output is accounted for by the following reasons.

(i) The increase in acreage,
(ii) Increases in yields due to the planting of higher yielding varieties (the Tenera seeds and the Pisifera seeds)
(iii) the application of better harvesting techniques, improved husbandry and the increases in rate of the oil extraction processes. Table 3-11 shows the production of palm oil and palm Kernels on a nationwide scale: (Also see figure 3-1)

TABLE 3-11

OIL PALM PRODUCTION - FEDERATION OF MALAYA
(in '000 tons)

Year	Oil Palm	Kernel	Total
1954	54	14	68
1958	70	18	88
1959	72	19	91
1960	90	24	114
1961	93	24	117
1962	106	28	134
1963	124	30	154

Source: Monthly Statistical Bulletin.

Palm oil production has more than doubled within a period of 10 years from 1954 - 1963. In fact palm oil production has increased by 230% since 1954. Compared with the progress of other agricultural products, palm oil production seems to be increasing at a faster rate. For the same period rubber increased only by 40% while coconut oil production has decreased by 2%.

Palm kernel production has also increased by more than 100% from 14,000 tons in 1954 to 30,000 tons in 1963. This is better than the rate of progress of the other agricultural crops.

Seasonal Variation of Palm Oil Production

It can be seen that palm oil production varies throughout the months of the year. There is a distinct peak in production in the months of June and July. There is a slightly lower peak in March. The lowest months of production are in December, January and February. Figure 3-2 gives the seasonal variation in production of palm oil. Refer Appendix I.

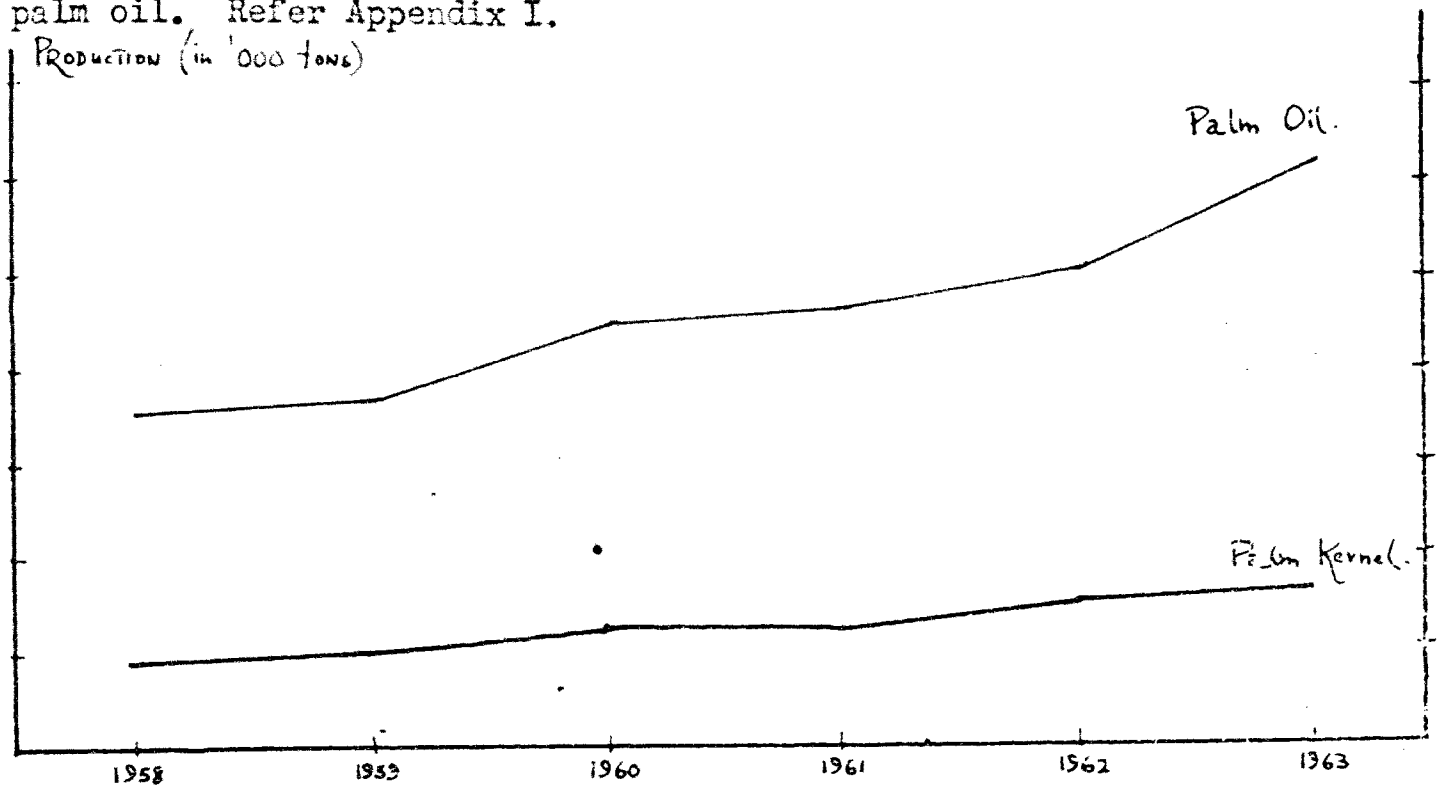

DIAGRAM 3-1 : PALM OIL AND PALM KERNEL PRODUCTION

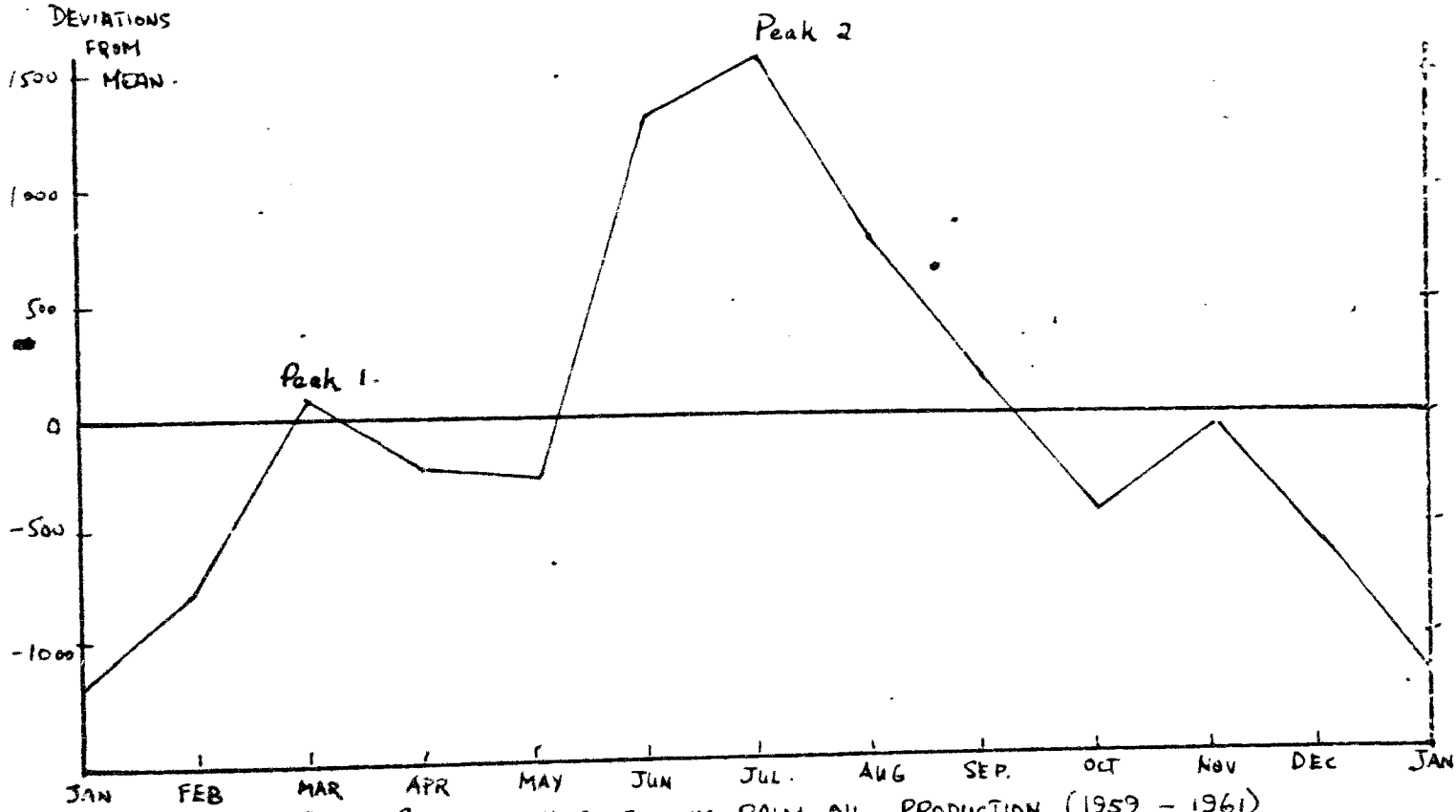

DIAGRAM 3-2: SEASONAL VARIATION IN PALM OIL PRODUCTION (1959 - 1961)