HUNTING TECHNICAL SERVICES

Blue

183L MALAYSIA Johor Tengah

W.P. OIL PALM

WORKING PAPER

OIL PALMS

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WORKING PAPER

OIL PALMS

INTRODUCTION TO AND OBJECTIVES OF THIS PAPER

The objectives of this paper are to:

(i) calculate the profitability of an oil palm scheme located in South East Johor and on some of the soils common in the Johor Tengah and Tanjong Penggerang areas;

and, (ii) examine the sensitivity of oil palm profitability to variations in inputs, outputs, and prices, but particularly to variations in the fresh fruit bunch (FFB) yield per acre and the FOB price of palm oil.

This paper consists of two brief sections and an Appendix. The first summarises the assumptions, cost calculations and profitability analysis while the second sets out in a little more detail the cost, price and yield assumptions. A more detailed assessment of the market for oil palm products is contained in the Appendix. All calculations are shown so that those people with sufficient interest (and patience) can do further research and sensitivity analysis on the basis of this paper.

1 SUMMARY

Assumptions: The basic assumptions used in this paper are:

Clearing of the scheme in 1971;

Planting of the scheme in 1972;

A scheme size of 10,000 cleared acres or about 8,500 planted acres located about 40-50 miles from an exporting point at Johor Baharu or Singapore;

Commercial labour costs, including fringe benefits, for unskilled labour of an average of \$5 per day for weeding and maintenance work and \$165 or about \$6.50 per day for heavier work such as harvesting. This averages overall to about \$150 per month.

A''most likely' price for palm oil (FOB Singapore or Johor Baharu) of \$420 falling fairly smoothly to \$344 in 1990;

A 'most likely' price for palm kernels of \$370 per ton in 1975 falling smoothly to abour \$344 in 1990;

A planting density of 60 palms per acre;

An initial yield from current plantings of 2 tons FFB per year in year 4 (1975) rising to a peak of 10 tons FFB in year 8 (1979).

Profitability to the Private Sector before Corporation Tax

The cash flows and present values at various interest rates are shown in Table . The rate of return to the private sector form current planting is 9.5 percent, based on above assumptions. If more optimistic prices are assumed with levels 10 percent above the most likely the rate of return rises to 14 percent per annum. With prices 10 percent below the 'most likely', the rate of return falls to about 5 percent per annum. (Fig. 1)

These rates of return are based on the present tax, rent and duty structure applicable to a private company investing in Johor State. Figure I also shows the rates of return if the private company is exempted from paying export duty, land premium and rent.

Return to the national economy

If, however, a shadow wage of $40 per month is applied to all labour being paid less than $180 per month (assumed to be unskilled labout), and if all major taxes and duties are excluded from the costs, the rate of return to the national economy can be calculated. (Fig. 1) The rates of return for the various price assumptions are shown below:

	Rate of return to the economy (percent p.a.)
Most likely prices	25
Optimistic prices	28
Pessimistic prices	22

The EPU has stated that the return from the 'worst' public sector investment undertaken must be at least 10 percent p.a. when valued at social prices. Very little information is available on the rates of return from various major economic activities in West Malaysia. The logging and sawmilling industries probably give a rate of return (after using a "shadow wage" for unskilled labour) of well over 25 percent per annum. Rubber is likely to give a return to the national economy using shadow prices of something like 20 percent or more from new plantings. The marginal road improvement projects identified in a recent EPU paper are likely to give a rate of return of between 17 percent and 22 percent when shadow wages are used. The tourist project in Tanjong Penggerang recommended by the South East Johor Project is estimated to give a rate of return of at least 21 percent per annum in social terms.

Even if oil palm and rubber schemes are 'charged with a share of all those infrastructural costs which in the absence of the schemes could have been avoided, and which might amount at social prices to say something like $250 per planted acre, the rate of return from oil palm at social prices would still be at least 20 percent per annum using the most likely oil and kernel prices.

Comparisons with other oil palm studies

A number of studies of oil palm profitability have been carried out in recent years as follows:

World Bank Report on Jengka;
CDC study by Little and Tipping;
Bevan and Goering I;
Bevan and Goering II;

The copy of the World Bank report available to the South East Johor Project is incomplete and does not give a rate of return for oil palm.

The CDC paper is not comparable with this paper. The CDC paper looked at the profitability of oil palm over the past as well as the future, whereas this paper considers the profitability of oil palm planted in 1972.

A comparison of the Bevan and Goering papers with this one is however shown below:

	Peak yield (FFB tons per acre)	Oil price ($per ton) Year 4	Oil price ($per ton) Year 9	Financial Rate of Return % p.a.)
Bevan and Georing I	10	600(1970)	500(1975)	17
Bevan and Goering II[1]	10	425(1972)	425(1977)	16
This paper	10	420(1975)	380(1980)	9

[1] Lower development and production costs were assumed than in the Bevan and Goering I paper

This paper gives a much lower rate of return than the Bevan and Goering II paper, because considerably higher production costs are assumed. The present values (at an interest rate of 15 percent per annum) of each of the cost and benefit categories are shown in Table 1.

TABLE 1 Net Present Value of Commercial Costs - Bevan and Goering and this Study

	Present Value at 15% p.a. - $/acre	
	Bevan and Goering II	This Paper
Revenue less export duty	3,300[1]	2,920
Distribution cost	(350)	(170)
Establishment costs and land charges	(911)	(666)
Mill - installation cost	(337)	(360)
- operating cost	(324)	(310)
Maintenance and fertiliser	(464)	(1,020)
Harvesting	(287)	(540)
Management/Administrative costs	(520)	(410)
Net present value	107	(556)

(1) Not shown in the Bevan and Goering paper, but assumed to be about $3,300, since this figure would give an internal rate of return of about 16 percent per annum which is specified in the paper.

The lower revenue is due to the lower prices assumed for both oil and kernels in this paper. The distribution cost is higher in the Bevan and Goering paper, because their oil palm plantation was assumed to be about 200 miles from a port, whereas this paper assumes that the plantation is about 40-50 miles from a port.

The difference in establishment costs is due to the Bevan and Goering paper including the initial maintenance costs in 'establishment costs', whereas this paper includes them in the maintenance and fertiliser costs. The mill installation and operating costs are very similar. The maintenance and fertiliser costs in this paper are higher, even after some of the costs have been transferred to the 'establishment' heading. There are three reasons for this;

(i) a higher fertiliser application per palm has been assumed in this paper;

(ii) higher wage rates have been assumed in this paper.

Reason (ii) also accounts for the difference in harvesting costs.

Variation of the rate of return with the planting data

The 'most likely' price for palm oil falls from $420 per ton in 1975 to $380 in 1980. It is difficult to say whether the rate of return from oil palm will be lower, if planted in 1975, than if planted in 1972, because almost certainly wage rates will have changed by 1975, and yields or more precisely yield expectations may well be higher. For example if it is assumed that by 1975 prices and price expectations are still in line with the 'most likely' predictions in this paper, but that wages have risen by 6 percent and yield profiles or expected yields have risen by about 8 percent, the rate of return (in financial terms) from plantings in 1975 will be 9 percent per annum about the same as the rate of return from 1972 plantings. (The rate of return in social terms would on the other hand, have risen from about 25 percent per annum to about 26 or 27 percent per annum).

The cost and revenue structure for oil palm

Table 2 summarises the cost and revenue structure for oil palm and facilitates the calculation of a rate of return using almost any set of assumptions. For example, the table shows how sensitive the rate of return is to variations in yield, since a large proportion of the total costs are fixed regardless of the yield. The table also shows that oil and kernel prices could be about 35 percent lower than the 'most likely' prices assumed in this paper and yet the oil palm scheme would still give a social rate of return of 15 percent per annum. The final column in the table shows that the government could pay interest on a loan of 5 percent per annum, repay the loan and pay all unskilled labour a constant wage of $125 per month even if the prices for oil <u>and</u> kernels were as much as <u>40 percent</u> lower than the 'most likely' prices assumed in this paper. Even if the oil palm scheme were 'charged' with the costs of infrastructure (at say $250 per acre), the prices could still be <u>35 percent</u> below the 'most likely' prices assumed in this paper to give a 'target' wage of $125 per month.

Labour requirements

The labour requirements of oil palm are discussed in detail in section 2.14 of this paper. The year-by-year requirements for a peak yield of 10 FFB tons per acre are shown in Figure 2. On the basis of this sort of yield, oil palm gives fulltime employment to weeders and harvesters on the basis of about 10 planted acres per worker. If other activities are included, the fulltime acreage falls to about 9. The labour demand over the life of the scheme is fairly constant. The seasonal variations are also small, with employment demand probably being slightly greater in April and October.

The World Bank report on Jengka stated that - "The maximum size of holding that the average family can manage is about 10 acres, and thus there is little scope for improving incomes by increasing holding size without the employment of non-family labour." The validity of this statement will depend on the composition of the family when the head of the family starts work on the scheme.

Replanting

Section 2.15 examines the likely optimum life of new oil palm plantings. Oil yields from successive plantings have been increasing at the rate of about 5 percent per annum over the past 5 or 6 years. If a 3 percent rate of increase in yield with each successive year's new plantings and the decline in the oil price to about $340 per ton in 1990 are assumed, the optimum life for oil palms planted in 1970 is likely to be at least 25 years. With a faster rate of technical improvement (of say 5 percent or 6 percent per annum), the optimum life is shortened but only by about 2 or 3 years.

TABLE 2

COST AND REVENUE STRUCTURE OF OIL PALM

BASIS OF VALUATION	FINANCIAL			SOCIAL	'TARGET' WAGE (1)
YIELD	'LOW' (PEAK OF 10 FFB TONS PER ACRE)			'LOW'	'LOW'
DISCOUNT RATE	5	15	25	16	5
	$ PER TON FFB				
REVENUE AT PORT - OIL	73	73	73	73	73
- KERNELS	16	16	16	16	16
EXPORT DUTY	(7)	(7)	(7)	-	-
VARIABLE COSTS (2)					
- DISTRIBUTION	(5)	(5)	(5)	(4)	(4)
- PROCESSING - OPERATING	(6)	(6)	(6)	(4)	(5)
- HARVESTING/COLLECTION (3)	(15)	(15)	(15)	(6)	(12)
- FERTILISER	(6)	(6)	(6)	(6)	(6)
SURPLUS PER TON FFB	50	50	50	69	62
YIELD (PRESENT VALUE OF FFB TONS)	88.3	35.7	17.7	35.7	88.3
	$ PER ACRE				
SURPLUS	4,460	1,790	880	2,455	5,500
FIXED COSTS ('RECURRENT')					
- WEEDING/MAINTENANCE	(1,080)	(620)	(440)	(186)	(1,030)
- FERTILISER	(361)	(180)	(114)	(180)	361
- RENT/PREMIUM	(230)	(140)	(110)	-	-
- PROCESSING - OPERATING	(220)	(110)	(60)	(70)	(150)
- MANAGEMENT/GENERAL MAINTENANCES	(670)	(350)	(230)	(350)	(670)
FIXED COSTS ('CAPITAL')					
- CLEARING/PLANTING/ROADS	551	526	506	344	480
- PROCESSING MILL	(420)	(360)	(300)	(333)	(420)
- GENERAL BUILDINGS/EQUIPMENT	(60)	(60)	(60)	(60)	(60)
NET PRESENT VALUE	4,868	(556)	(940	912	2,329

(1) To 'Unskilled Labour' of $125 per month - All taxes and duties are excluded from the costs

(2) Rounded to nearest $ per FFB ton

(3) Not strictly variable but assumed to be variable for simplicity.

2 DETAILED CASH FLOWS AND ASSUMPTIONS

2.1 Organisation, Size, Phasing and Location Assumptions

The cash flows and present values at 5,15 and 25 percent per annum for the peak yield of 10 tons FFB per acre is shown in Table 3.

All costs are those that it is thought a private company developing in South East Johor would have to pay under present cost and export duty conditions. The wage assumptions made are somewhat higher than current wages in the oil palm industry but make allowance for - (1) South East Johor, or at least Tanjong Penggerang, being fairly remote and higher wages probably having to be paid to attract sufficient labour; and (2) the housing cost being borne by the employees themselves. Housing costs are excluded since one of the main recommendations mady by the SEJP study team is that village development should be separated from the development of the principal economic activity.

The total size of the scheme is assumed to be 10,000 acres of which about 85 percent is assumed to be planted, allowing about 15 percent which is unsuitable for development or is taken up by roads, drains, etc. The profitability of the crop is not very sensitive to the size of the scheme, provided that the scheme is above, say, 10,000 acres.

The timing of the plantation development is assumed to be as follows:

Year (October-Sept)	Activity
1	Clearing, silt-pitting, platforming, temporary road construction, establishment of cover crops;
2	Planting seedlings in the field, construction of permanent roads, and infrastructure. Palm oil mill construction begins;
3	Construction of housing, offices, and palm oil mill continues;
4	Harvesting begins.

TABLE 3

CASH FLOWS - ($ PER ACRE PLANTED) - FOR A 10,000 OIL PALM SCHEME - 'MOST LIKELY' PRICE - PEAK YIELD OF 10 FFB TONS PER ACRE

YEAR:-	1 (1972)	2	3	4 (1975)	5	6	7	8	9 (1980)	10	11	12	13	14 (1985)	15	16	17	18	19	20 (1991)	PRESENT VALUES (1) ($ PER ACRE) AT ANNUAL INTEREST RATES OF:- 5%	15%	25%
YIELD (FFB TONS PER ACRE)	-	-	-	2	5.5	7	8.5	10	→												88.3	35.7	17.7
EXTRACTION RATE (%):©																							
- OIL	-	-	-	16	17	18	19	20	→												-	-	-
- KERNELS	-	-	-	4½	→																-	-	-
YIELD - TONS PER ACRE																							
- OIL	-	-	-	0.32	0.94	1.26	1.62	2.0	→												17.3	6.8	3.4
- KERNELS	-	-	-	.09	.23	0.30	.36	.43	→												3.8	1.6	0.8
PRICE $ PER TON FOB																							
- OIL	-	-	-	420	410	400	390	385	380	376	372	368	364	360	356	353	350	347	344	341	-	-	-
- KERNELS	-	-	-	370	368	366	364	362	360	358	356	354	352	350	349	348	346	345	344	343	-	-	-
REVENUE ($ PER ACRE)																							
- OIL	-	-	-	134	358	504	632	770	760	752	744	736	728	720	712	706	700	694	688	682	6,410	2,610	1,300
- KERNELS	-	-	-	33	85	110	131	156	155	154	153	152	151	150	150	150	148	148	148	147	1,350	550	280
- TOTAL	-	-	-	167	470	614	763	926	915	906	897	888	879	870	862	856	848	842	836	829	7,760	3,160	1,580
EXPORT DUTY (7½%)	-	-	-	13	35	46	57	69	69	68	67	67	66	65	65	64	64	63	63	63	580	240	120
DISTRIBUTION COST ($20 PER TON OF OIL AND KERNELS)	-	-	-	8	23	31	40	49	→												420	170	80
CLEARING (150/GROSS)	175	-																			180	180	180
PLANTING	121	120	-																		235	225	217
ROADS	45	-	100	-																	136	121	109
LAND RENT/PREMIUM	59	14	→																		230	140	110
PROCESSING - CAPITAL	-	157	157	156	-																420	360	300
PROCESSING - OPERATING - MANAGEMENT	-	6	6	6	14	→															150	70	40
- RENT & RATES	-	6	→																		70	40	20
- PRODUCTION LABOUR (1.6 FFB PER TON)	-	-	-	3	9	11	14	16	→												140	60	30
- MAINTENANCE, FUEL, ETC (4.0 FFB PER TON)	-	-	-	8	22	28	34	40	→												350	140	70
LABOUR FOR WEEDING, MAINTENANCE, ETC																							
- ACRES PER WORKER	-	(10.0)	(11.5)	(12.5)	(15.0)	(16.7)	(23.0)	→													-	-	-
- $ PER ACRE AT $1,584 PA/WORKER	-	158	138	127	106	95	69	→													1,080	620	440
FERTILISER ($30 PER ACRE FROM YEAR 2 + $6/TON FFB)		30	30	42	63	72	81	90	→												891	400	224
LABOUR - HARVESTING AND COLLECTION																							
- ACRES PER WORKER	-	-	-	(30)	(21)	(19)	(18)	(17.5)	→												-	-	-
- $PER ACRE AT $1,980 ($165 PM)	-	-	-	66	95	105	110	113	→												1,100	470	250
OTHER COLLECTION COSTS (FUEL ETC) - $2/TON FFB	-	-	-	4	11	14	17	20	→												180	70	40
GENERAL - BUILDINGS AND MACHINERY - CAPITAL COST	40	20	-																		60	60	60
- MAINTENANCE AND SUPPLIES	-	-	15	→																	170	80	50
- MANAGEMENT	20	40																			500	270	180
TOTAL COSTS (INCLUDING EXPORT DUTY)	(460)	(551)	(506)	(508)	(453)	(491)	(511)	(555)	(555)	(554)	(553)	(553)	(552)	(551)	(551)	(550)	(550)	(549)	(549)	(548)	6,892	3,716	2,520
NET CASH FLOW ($ PER NET ACRE)	(460)	(551)	(506)	(341)	17	123	252	371	360	352	334	335	327	319	311	306	298	293	287	281	868	(556)	(940)

FIGURE 1 - RATES OF RETURN FROM OIL PALM

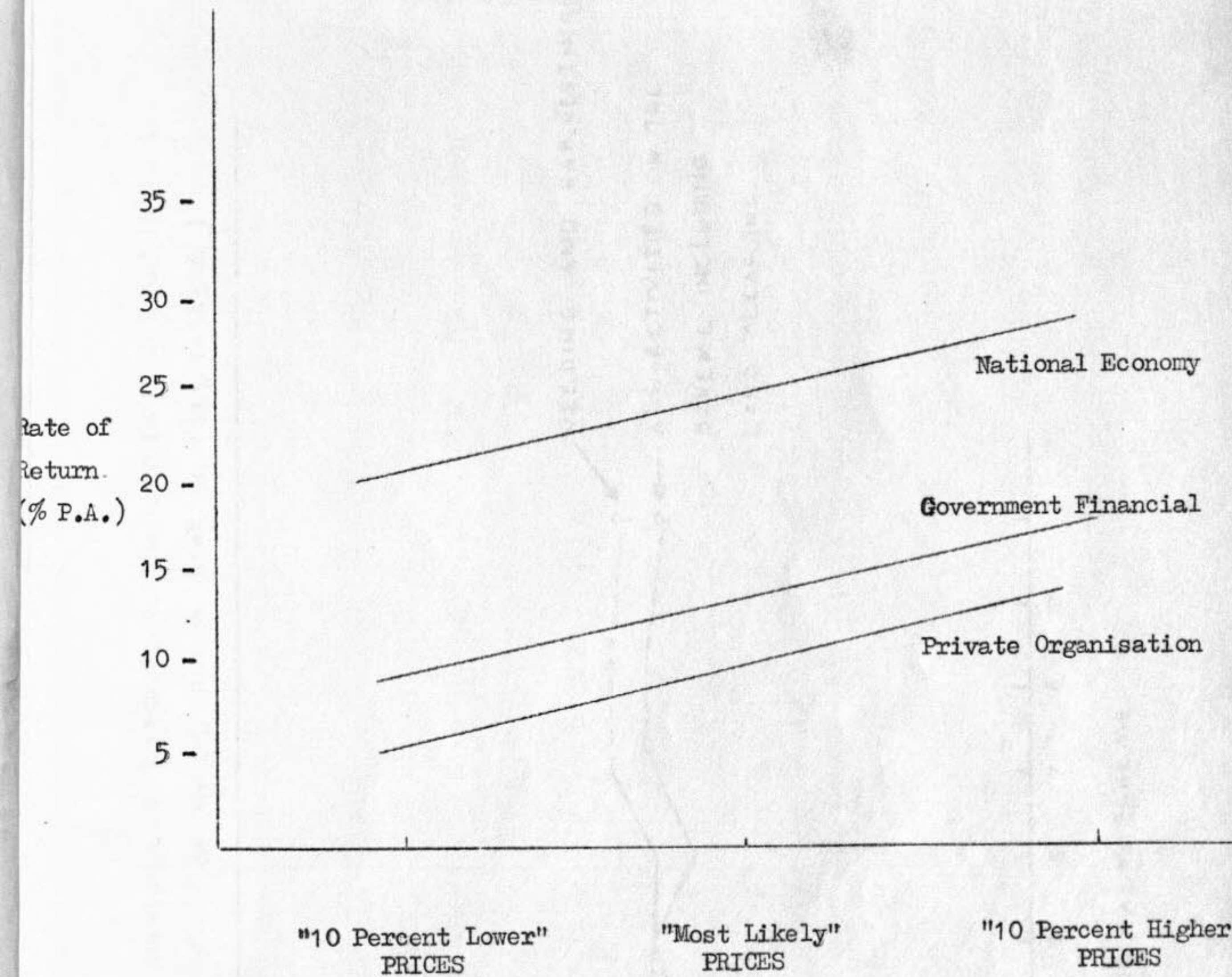


FIGURE 2. UNSKILLED LABOUR REQUIREMENTS OVER THE LIFE OF AN OIL PALM SCHEME (SEE TABLE 6)

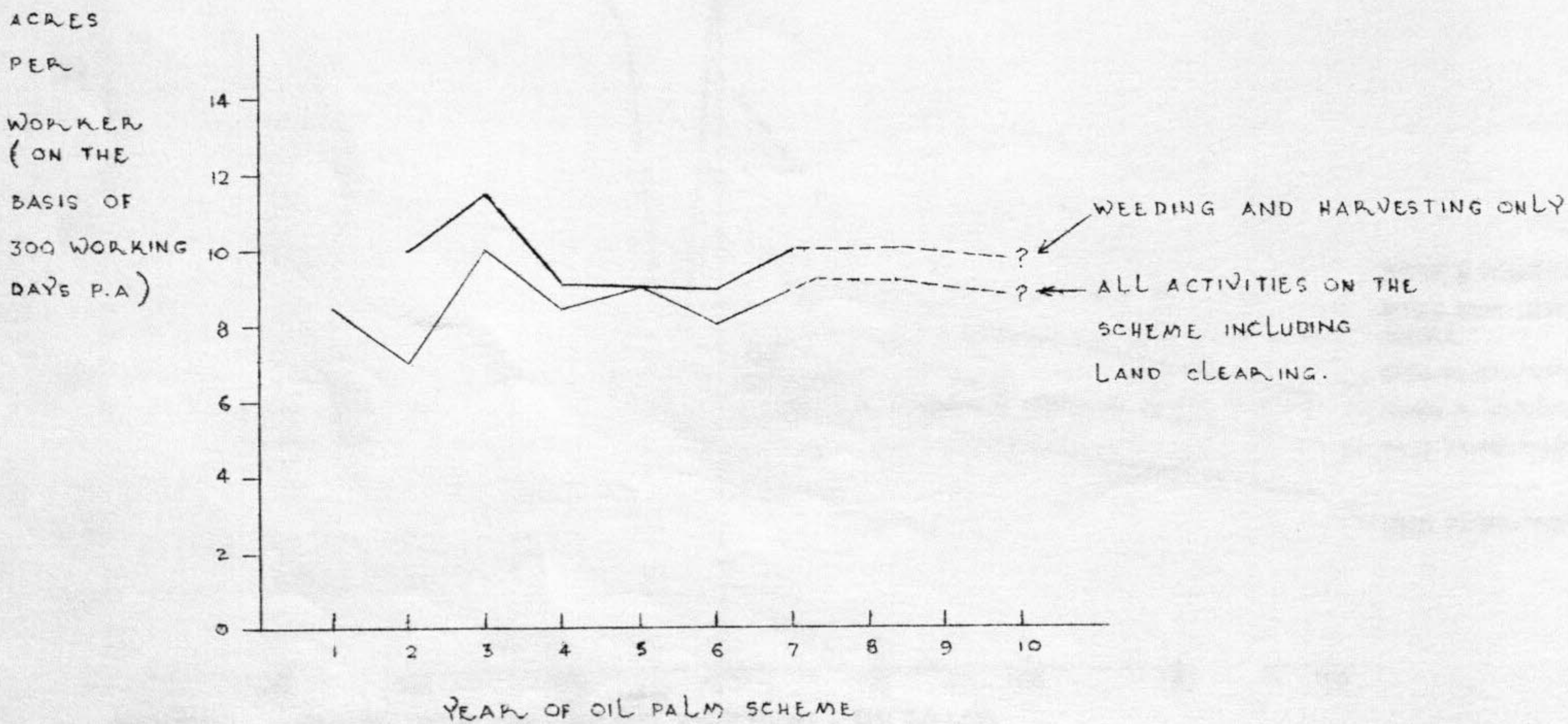
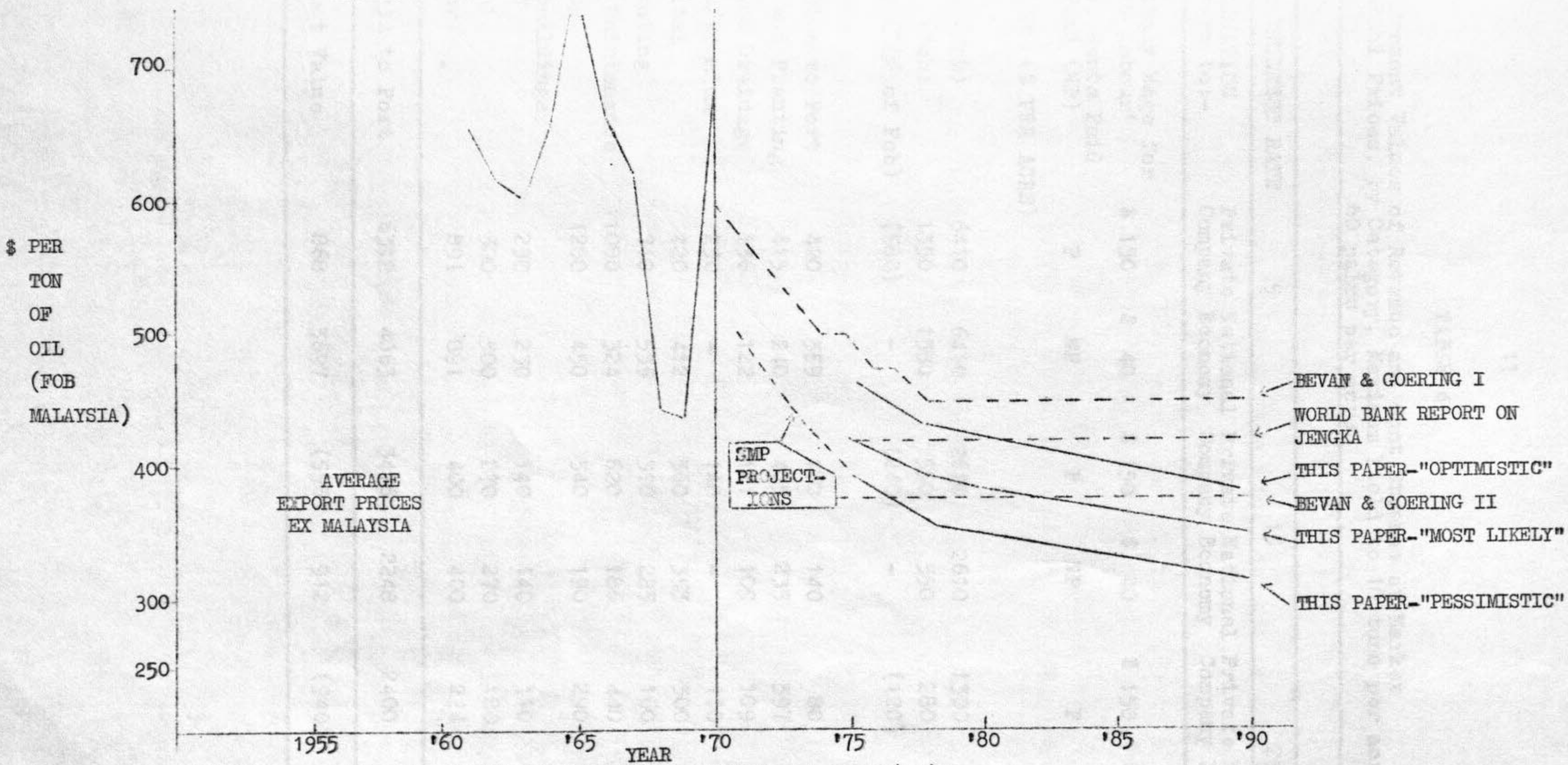


FIGURE 3 - PALM OIL PRICES - PAST AND FUTURE



SOURCES:- 1969-70 SMP EXPORT COMMODITY PROJECTIONS - EPU 8/12/70
1961-69 TABLE 3.1 STATISTICAL APPENDIX, WORLD BANK REPORT ON MALAYSIA

TABLE 4

Present Values of Revenue and Cost Streams at Market and Social Prices, by Category, Maximum Yield to 10 tons per acre, 60 palms per acre.

COUNT OF INTEREST RATE	5		15		25	
SIS OF VALUATION e of Return to:-	Private Company	National Economy	Private Company	National Economy	Private Company	Nationa Economy
rage Monthly Wage for unskilled labour'	$ 150	$ 40	$ 150	$ 40	$ 150	$ 40
ort Duty, Rents Paid (P)/Not Paid (NP)	P	NP	P	NP	P	NP
SENT VALUES ($ PER ACRE)						
EVENUE						
il Sales (Fob)	6410	6410	2610	2610	1300	1300
ernel (Fob)	1350	1350	550	550	280	280
ort Duty (7½% of Fob)	(580)	-	(240)	-	(120)	-
TS						
istribution to Port	420	359	170	140	80	66
learing and Planting	415	240	405	235	397	230
oads Paths Drainage	136	122	121	109	109	98
and Rent/Premium	230	-	140	-	110	-
ill Capital	420	412	360	353	300	294
ill Operating	710	535	310	225	160	118
eeding, Maintenance	1080	324	620	186	440	132
arvesting	1280	450	540	190	290	98
eneral Buildings, Equipment	230	230	140	140	110	110
anagement	500	500	270	270	180	180
ertilizer	891	891	400	400	224	224
otal Costs to Port	6312	4063	3476	2248	2400	1550
et Present Value	868	3697	(556)	912	(940)	30

The plantation is assumed to have one central oil mill and is assumed to be located in Johor Tengah or Tanjong Penggerang about 50 miles from a palm oil exporting point near Johor Baharu. The peak distribution cost is about $50 per acre, and if this is doubled because of an approximate doubling in the distance the rate of return on oil palm is reduced by something like 2 percent p.a. An oil palm scheme located about 100 miles from a port would therefore, other costs being equal, show a rate of return about 2 percent p.a. lower than that shown in this paper.

The present values for some of the alternatives examined in this paper are shown in Tables 4 and 5 at discount rates of 5, 15 and 25 percent p.a.

2.2 Gross Revenue and Export Duty - Prices and Yields

The appendix looks at "The market for oil palm products" in more detail. This section briefly looks at past prices and summarises the future prices assumed in this paper.

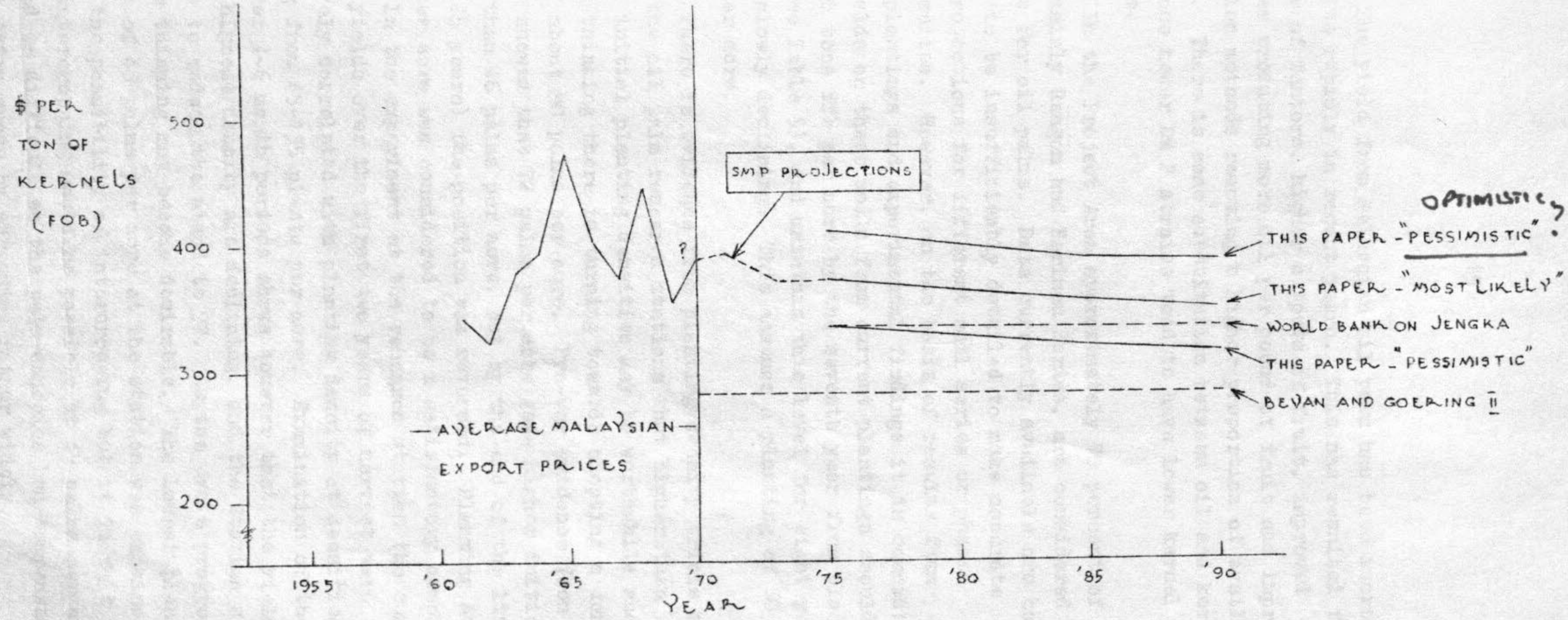
Prices

Recent prices for palm oil have been around £100 per ton, CIF London, 5 percent free fatty acid (FFA) content. Allowances or penalties are paid or imposed for lower or higher FFA values being calculated at 1 percent of the contract price for each 1 percent variation in FFA content from 5 percent. Since the average FFA content from Malaysia is about 3 percent, and the freight cost to Europe is about $60 per ton, recent net FOB prices at Malaysian ports have been about $700 per ton of oil. Past palm oil prices and the assumed 'optimistic', 'most likely' and 'pessimistic' prices are shown in Figure 3 on page 18.

The most likely price assumption of $420 per ton FOB in this paper is about the same as that assumed in the CDC, Bevan and Goering and World Bank papers. The 'optimistic' and 'pessimistic' prices are 10 percent above and below the 'most likely' prices respectively.

The past and assumed future prices for palm kernels are shown in Figure 4. The 'optimistic' and 'pessimistic' prices are 10 percent above and below the 'most likely' prices respectively. Export duty on both palm oil and kernels is 7½ percent of the FOB values.

FIGURE 4 PALM KERNEL PRICES - PAST AND FUTURE.



SOURCES:— 1961 - 68 - TABLE 3.1, STATISTICAL APPENDIX, WORLD BANK REPORT ON JENGKA
1969 - 70 - SMP EXPORT COMMODITY PROJECTIONS - EPU 8/12/70

Yields

The yield from Malaysian oil palm has been increasing quite rapidly in recent years. This has resulted from a number of factors, higher outputs of fruit, improved varieties producing more oil per pound of fruit and improved extraction methods removing a higher proportion of available oil. There is some substitution between oil and kernels since newer Dx P strains tend to have lower kernel contents.

In the Project Area approximately 70 percent of soils, mainly Rengam and Harimau Series, are considered suitable for oil palms. Data currently available are considered to be insufficiently detailed to make accurate yield projections for different soil series or phases within series. However, on the basis of results from recent plantings and experimental findings it is considered that yields on these soils from current plantings should reach 10 tons ffb per acre by the seventh year from planting (see Table 5), and maintain this level for eight years before slowly declining. This assumes a planting of 60 palms per acre.

There is evidence from planting density trials at one of the oil palm research stations that higher than present initial planting densities may be worthwhile and present thinking there is turning towards adopting a density of about 90 palms per acre. Pre-war evidence from Sumatra showed that 72 palms per acre gave higher initial yields than 46 palms per acre, but by the end of the life cycle (25 years) the position was reversed. Planting at 58 palms per acre was considered to be a satisfactory compromise. In the experiment at the research station the cumulative yields over the first two years of harvest were positively correlated with planting density at densities ranging from 45-135 plants per acre. Examination of these data over 4-6 month periods shows however that the yields at the highest density are declining, and the Station staff propose to reduce the stand to 92. As the cycle progresses further thinning may become desirable. The lowest planting density of 45 palms per acre at the station was examined to assess the possibility of intercropping but it is felt that while intercropping would be possible at 45 palms per acre, it would be difficult as the palm canopies had compensated for the extra space by spreading rather widely.

TABLE 5 Alternative Yield Curves Taken For Evaluation Purposes

Year of Scheme	Projection 1 60 Palms Per Acre (Tons FFB/Acre)	Projection 2 90 Palms Per Acre (Tons FFB/Acre)
1	clear	clear
2	plant	plant
3	-	-
4	2	3
5	5.5	8
6	7	10
7	8.5	12
8	10	12
9	10	12
10	10	12
11	10	12
12	10	12
13	10	12
14	10	12
15	10	12
16	9.8	11.8
17	9.6	11.6
18	9.4	11.4
19	9.2	11.2
20	9.0	11.0
21	8.9	10.9
22	8.8	10.8
23	8.7	10.7
24	8.6	10.6
25	8.5	10.5

An alternative set of planting density and yield assumptions were used as an indication of possible future developments in the industry. Assuming a density of 90 palms per acre yields were taken to a peak of 12 tons as indicated in Table 5. The resulting costs and revenues are detailed in Table 6. The net present values of these cost and revenue streams, discounted at 5, 15 and 25 percent are shown in Table 7. The rate of return at market prices is 14 percent, compared to 9 percent at the lower yield level. If this yield could be obtained from only 60 palms per acre, the return would increase by a further percentage point, to 15 percent.

In this paper, the profitability calculations have been based on a yield which, following the peak year, remains constant. The profitability is therefore to that extent overstated, but the calculations have also been based on a 'life' for the scheme of 20 years, equivalent to a life for the palm of about 19 years, whereas the estimated optimum life of the palm is at least 25 years, (see section 2.15 of this paper). The assumptions of a constant yield beyond the peak year and a 19 year life for the palm almost exactly balance each other out for the two yield assumptions and the most likely prices taken in this paper.

TABLE 6

Cash Flows ($ per acre planted) for a 10,000 acre Oil Palm - 'Most Likely' price "High" - Peak Yield of 12 per FFB tons per acre

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	PRESENT VALUES(1) ($ PER ACRE) AT ANNUAL INTEREST RATES OF:- 5%	15%	25%
YEAR:-	(1972)			(1975)					(1980)						(1985)					(1991)			
YIELD (FFB TONS PER ACRE)				3	8	10	12	→													110.1	45.7	23.1
EXTRACTION RATE (%):-																							
- OIL				16	17	18	19	20	→												-	-	-
- KERNELS				4¼	→																-	-	-
YIELD - TONS PER ACRE																							
- OIL				.48	1.36	1.80	2.28	2.4	→												21.4	8.8	4.4
- KERNELS				.13	.34	.43	.51	→													4.7	1.9	1.0
PRICE $ PER TON FOB																							
- OIL				420	410	400	390	385	380	376	372	368	364	360	356	353	350	347	344	341	-	-	-
- KERNELS				370	358	366	364	362	360	358	356	354	352	350	349	348	346	345	344	343	-	-	-
REVENUE ($ PER ACRE)																							
- OIL				202	558	720	889	924	912	902	893	882	875	862	852	848	840	833	826	818	7,990	3,340	1,700
- KERNELS				48	125	157	186	185	184	183	182	181	180	178	178	177	176	176	175	175	1,670	680	360
	-	-	-	250	683	877	1075	1109	1096	1085	1075	1063	1055	1040	1030	1025	1016	1009	1001	993	9,660	4,020	2,060
EXPORT DUTY (7½%)	-	-	-	19	51	66	81	83	82	81	81	80	79	78	78	77	76	76	75	74	720	300	160
DISTRIBUTION COSTS ($20 PER TON OF OIL & KERNELS)	-	-	-	10	34	45	56	58	→												520	220	110
CLEARING (150/GROSS)	175	-																			180	180	180
PLANTING	121	180	-																		290	280	270
ROADS	40	-	100	-																	50	40	30
LAND RENT/PREMIUM	59	14																			230	140	110
PROCESSING CAPITAL	-	167	167	166	-	-															450	370	310
PROCESSING - OPERATING - MANAGEMENT	-	6	6	6	14	→															150	70	40
- RENT & RATES	-	6	→																		70	40	20
- PRODUCTION LABOUR ($1.6 PER TON FFB)	-	-	-	5	13	16	19	→													180	70	40
- MAINTENANCE, FUEL, ETC. ($4.0/TON FFB)	-	-	-	12	32	40	48	→													440	180	90
LABOUR FOR WEEDING, MAINTENANCE, ETC.																							
- ACRES PER WORKER	-	(10.0)	(11.5)	(12.5)	(15.0)	(16.7)	(23.0)	→													-	-	-
- $ PER ACRE AT $ 1584 P.A/WORKER	-	158	138	127	106	95	69	→													1,080	620	440
FERTILISER ($30 PER ACRE + $6 PER TON FFB FROM YEAR 2)	-	44	44	62	92	104	116	→													1,200	550	310
LABOUR - HARVESTING AND COLLECTION																							
- ACRES PER WORKER	-	-	-	(26)	(18)	(17.5)	(17)	→													-	-	-
- $ PER ACRE AT $ 1980 ($165 PM)	-	-	-	76	110	113	116	→													1,140	500	270
OTHER COLLECTION COSTS (FUEL, ETC) - $2/TON FFB	-	-	-	6	16	20	24	→													220	90	50
GENERAL - BUILDING & MACHINERY - CAPITAL COST	20	40	-																		60	60	60
- MAINTENANCE AND SUPPLIES	-	-	15	→																	170	80	50
MANAGEMENT	20	40	→																		500	270	180
TOTAL COSTS (INC. EXPORT DUTY)	415	635	480	564	543	588	618	622	621	620	620	619	618	617	617	616	615	615	614	613	7,650	4,060	2,720
NET CASH FLOW ($ PER NET ACRE)	(415)	(635)	(480)	(314)	140	289	457	487	475	465	455	444	437	423	413	409	401	394	387	380	2,010	(40)	(660)

(1) PRESENT VALUE ARE ROUNDED TO NEAREST $10.

Table 7. Present Values of Revenue and Cost Streams by Category at Market and Social Prices Maximum Yield 12 tons per Acre, 90 palms per acre

1. Discount or Interest Rate	5		15		25	
2. Basis of Valuation						
Rate of Return to:	Private Company	National Economy	Private Company	National Economy	Private Company	National Economy
Average Monthly Wage for 'unskilled labour'	$150	$40	$150	$40	$150	$40
Export Duty, Rents Paid P/Not Paid (NP)	P	NP	P	NP	P	NP
3. Present Values $ per Acre						
Revenue						
Oil Sales (Fob)	7990	7990	3340	3340	1700	1700
Kernel (Fob)	1670	1670	680	680	360	360
Export Duty (7½% of Fob)	(720)		(300)		(160)	
Costs						
- Distribution to Port	520	421	220	175	110	90
- Clearing and Planting	470	285	460	280	450	275
- Roads Paths Drainage	136	122	121	109	109	98
- Land Rent/Premium	230	-	140	-	110	-
- Mill Capital	450	440	370	363	310	304
- Mill Operating	840	630	360	270	190	143
- Weeding, Maintenance	1080	324	620	186	440	132
- Harvesting	1360	475	590	210	320	109
- General Buildings, Equipment	230	230	140	140	110	110
- Management	500	500	270	270	180	180
- Fertilizer	1200	1200	550	550	310	310
Total Costs to Port	7016	4627	3841	2553	2639	1751
N.P.V.	1924	5033	(121)	1467	(739)	309

Castration

The planting density trials have been combined with an examination of the effects of castration, that is the monthly removal of male and female inflorescences and small bunches, to delay the first harvest until about 36 months from planting. Comparison of the yields of the castrated and uncastrated plots shows that the initial loss of yield in the former was made up within the first year. However in the castrated plots the 6-monthly yield fluctuations are greater than in the uncastrated plots, and it seems that yields beyond the second or third year of bearing may be no greater on castrated than on uncastrated plots. The advantages of castration are therefore the delay in the construction of the palm oil factory and higher yields in the 4th and 5th years after planting, while the disadvantages are the greater fluctuations and peaking in yields (which would require a greater mill capacity for any given annual yield) and the delay in yield. Calculations done on the basis of the present rather scanty data suggest that castration would not be worthwhile. This paper therefore assumes that the palms are not castrated.

Extraction Rates.

The extraction ratio for oil has risen from just over 16 percent in 1960 to around 19 to 19½ percent in the last few years. The newer D x P trees giving a larger mesocarp will push up the extraction ratio, so some further improvement can be expected for this reason. The FLDA uses a ratio of about 20 percent but refer to it as conservative compared with the 'standard' rate of 22 percent. But the Sorca report says that FLDA's estimates for extraction rates are on the high side, and suggests that actual rates are about 90 percent of the estimates (Appendices 6-9, Sorca). This paper assumes that the peak extraction rate is 20 percent rising as follows:-

Year of Harvesting	Estimated extraction rates (percent)
1	16
2	17
3	18
4	19
5	20

2.5 Planting costs

Ground preparation and planting costs are given in various sources as being between $200 and $240 per acre planted. The costs assumed in this paper are:-

	$ per planted acre	Year in which the cost is incurred
Ground preparation:-		
- platforming (12 platforms per acre @ $1.5)	18	
- silt pitting (15% of area @ $60 per acre)	9	
- terracing (10% of area @ $110 per acre	11	
- lining and holing	20	
- total ground preparation	58	1
Cover crops - (including maintenance for the first 3 months)	63	1
Planting materials (60 plants @ $1.5 per plant)	90	2
Planting (@ $0.5 per plant)	30	2
	241	

2.6 Capital costs of roads, drains and paths - planted area only

This section includes the cost of the access road to the mill, the cost of draining the planted area and the costs of all harvesting roads. All costs of providing the village infrastructure are excluded (see 2.7).

The costs of drainage, the mill access road, and harvesting roads is assumed to be about $50 per acre. The whole of this is assumed to be incurred in year 3 of the scheme.

2.7 Village costs

One of the principal South East Johor Project recommendations is that the financing and construction of the village facilities should be separated wherever possible from the main economic activity. The costs of these village facilities will therefore, with the acceptance of these recommendations, be borne, as far as mosques, community halls, police posts, etc. are concerned, by the

Government and as far as housing and probably water supply are concerned by the individual worker. In this paper, the housing costs are assumed to be paid for by the individual worker, but, to attract workers financing their own houses, it is assumed that the company developing the plantation would have to pay slightly higher-than-average wages. The wages assumed in this paper are therefore slightly higher than average. If a worker finances his own house costing say $1,600, (something like $1,700 when the preparation of the houselot is included), the cost per month if repaid at an interest rate of 5 percent per annum over 20 years would be $11. The cost per month if repaid over 20 years at an interest rate of 10 percent per annum would be about $17.

2.8 Land rent and premium

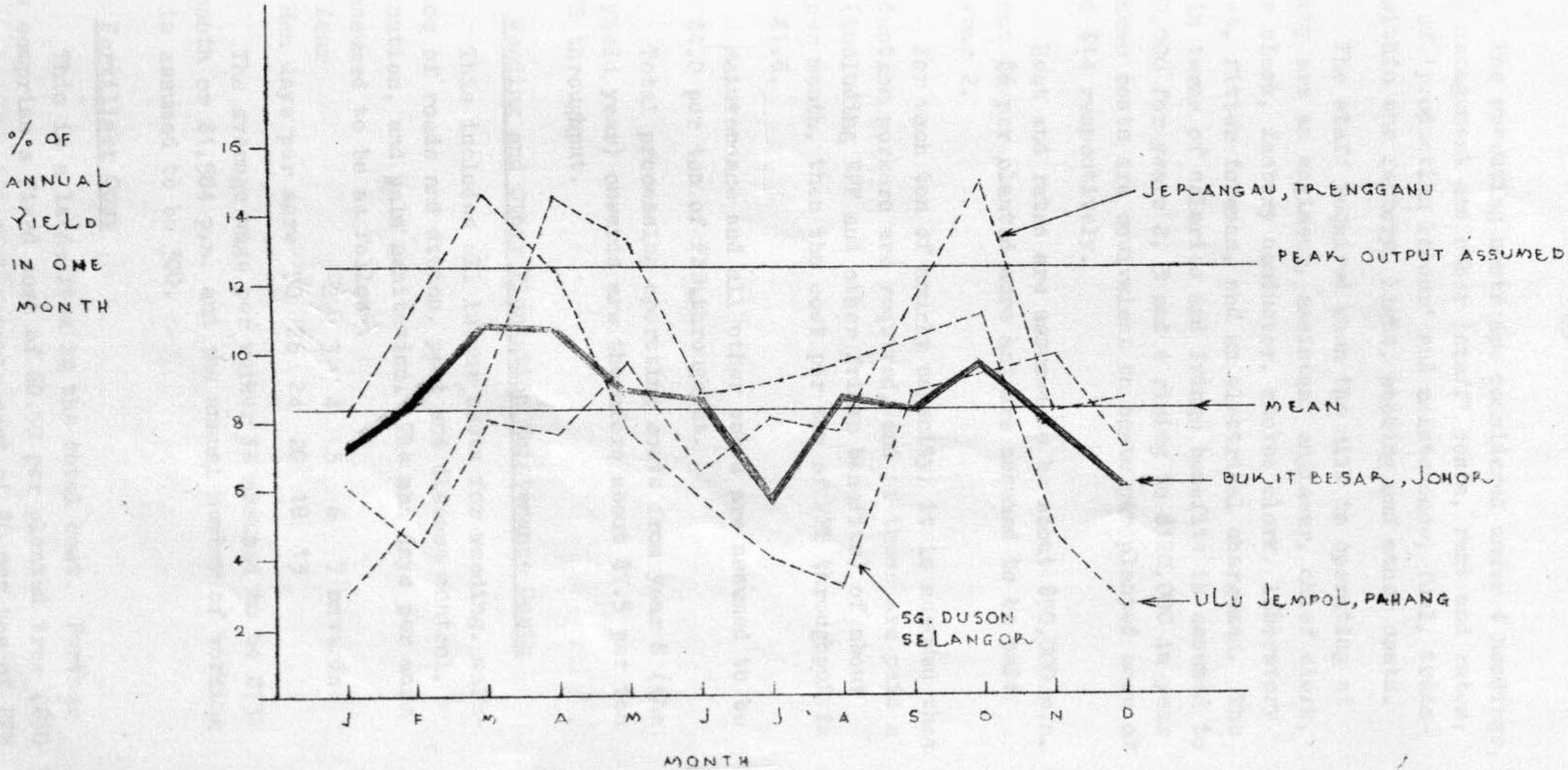
A land premium of $50 per acre ($59 per planted acre) in year 1 and a rent of $12 per acre ($14 per planted acre) from year 2 onwards are assumed.

2.9 Processing costs

The capacity of the palm oil mill is calculated on the basis of 480-working hours in the peak month (two 8-hourly shifts per day), an output in the peak month equivalent to about 1/8th of the annual output, (Fig. 6, which suggests that peaking is less pronounced in Johor than in the east coast states), and a capital cost of between about $160,000 and $180,000 for each FFB ton per-hour capacity. (Fig. 7, which shows some actual costs for various palm oil mills and the costs assumed in this paper).

The hourly capacity required for a peak annual yield of 10 FFB tons per acre would be about 22 whereas the capacity required for a peak yield of 12 FFB tons per acre would be between 26 and 27 tons. The costs per planted acre are therefore $470 and $500 for the 10 and 12 tons per acre peak yields respectively. These costs are assumed to be spread equally over years 2, 3 and 4 of the scheme.

FIGURE 6 : PEAKING IN FFB YIELDS ON FLDA OIL PALM SCHEMES (1968)



SOURCE:– FROM FIGURES IN SORCA REPORT

The operating costs are considered under 4 headings, namely management and other 'staff' costs, rent and rates, costs of 'production labour' and maintenance, fuel, transport within the factory, light, packing and other costs.

The staff required when the mill is operating at capacity are an engineer, assistant engineer, chief clerk, junior clerk, factory conductor, stores clerk, laboratory analyst, fitter foreman, and an electrical chargeman. The cost in terms of salaries and fringe benefits is assumed to be $50,000 for years 2, 3 and 4 rising to $120,000 in year 5. These costs are equivalent to costs per planted acre of $6 and $14 respectively.

Rent and rates are assumed to be about $50,000 p.a. or about $6 per planted acre and are assumed to be paid from year 2.

For each ton of hourly capacity, it is assumed that 3 production workers are required, and if these are paid a wage (including EPF and other fringe benefits) of about $165 per month, then the cost per ton of FFB throughput is about $1.6.

Maintenance and all other costs are assumed to be about $4.0 per ton of FFB throughput.

Total processing operating costs from year 8 (the peak yield year) onwards are therefore about $7.5 per ton of FFB throughput.

2.10 Weeding and Other Plantation Maintenance Costs

This includes all labour costs for weeding, maintenance of roads and drains, pest and disease control, pollination, and palm sanitation. The man days per acre are assumed to be as follows:

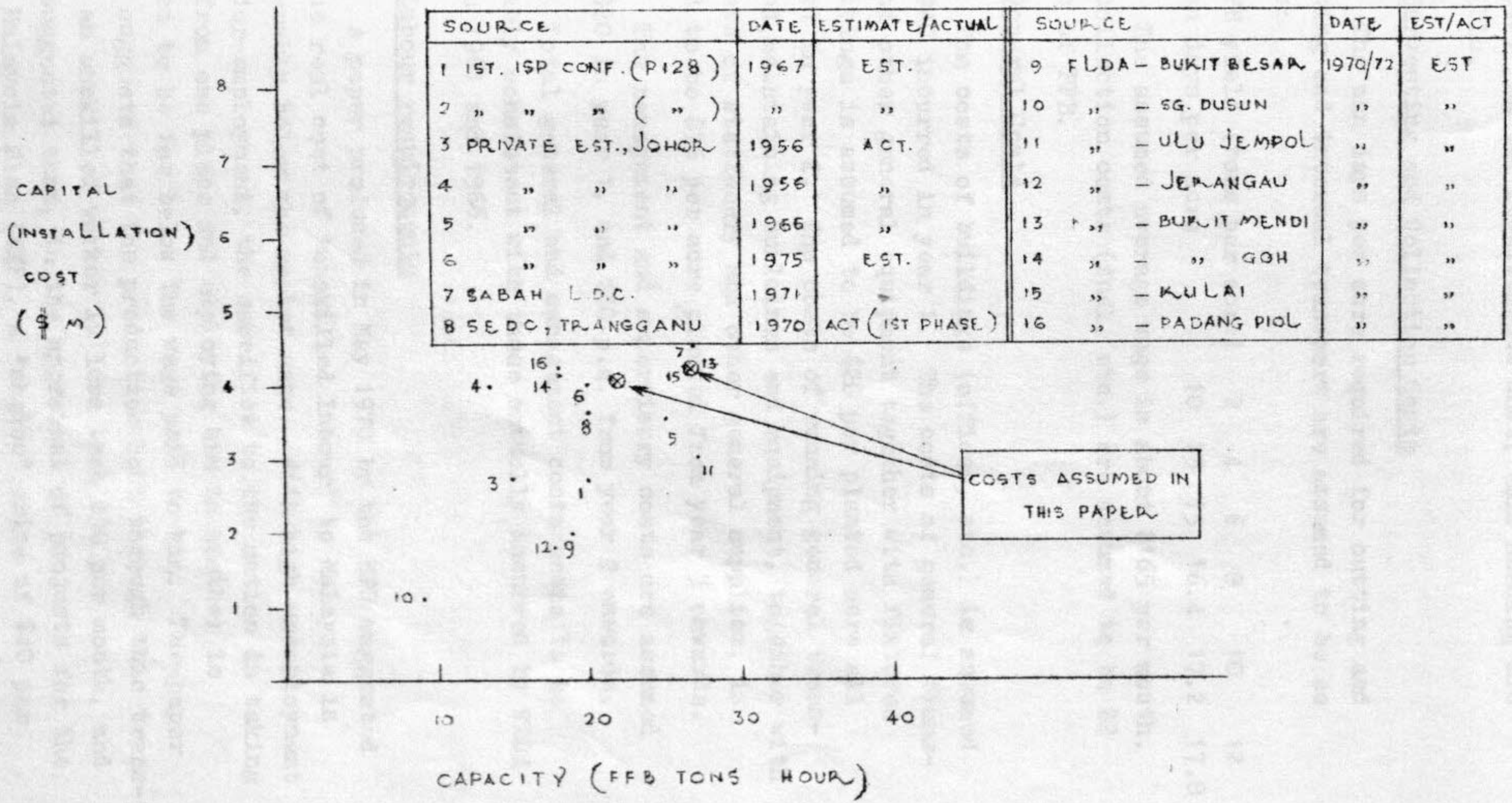
Year	2	3	4	5	6	7 onwards
Man days per acre	30	26	24	20	18	13

The average wage per worker is assumed to be $132 per month or $1,584 p.a. and the annual number of working days is assumed to be 300.

2.11 Fertiliser Cost

This is a large item in the total cost. Further costs comprise a fixed cost of $0.50 per planted tree ($30 per planted acre) and a variable cost of $6 per ton of FFB

FIGURE 7 : PALM OIL MILL CAPITAL COSTS



SOURCE	DATE	ESTIMATE/ACTUAL	SOURCE	DATE	EST/ACT
1 1ST. ISP CONF. (P128)	1967	EST.	9 FLDA – BUKIT BESAR	1970/72	EST
2 " " " (")	"	"	10 " – SG. DUSUN	"	"
3 PRIVATE EST., JOHOR	1956	ACT.	11 " – ULU JEMPOL	"	"
4 " " "	1956	"	12 " – JERANGAU	"	"
5 " " "	1966	"	13 " – BUKIT MENDI	"	"
6 " " "	1975	EST.	14 " – " GOH	"	"
7 SABAH L.D.C.	1971	"	15 " – KULAI	"	"
8 SEDC, TRANGGANU	1970	ACT (1ST PHASE)	16 " – PADANG PIOL	"	"

yield. The fixed cost is assumed to be incurred from year 2 onwards. Labour requirements under this heading are negligible.

2.12 Harvesting and Collection Costs

The man days per acre required for cutting and collecting and internal transport are assumed to be as follows:

FFB yield (tons per acre)	2	4	6	8	10	12
Man days per acre	10	13	15	16.4	17.2	17.8

The assumed average wage is about $165 per month. Other collection costs (fuel, etc.) are assumed to be $2 per ton of FFB.

2.13 General Costs

The costs of buildings (offices, etc.) is assumed to be $40 incurred in year 1. The costs of general transport and other general equipment together with fixtures and fittings is assumed to be $20 per planted acre all incurred in year 2. The costs of running general transport and maintaining buildings and equipment, together with the costs of stationery and other general supplies, is assumed to be $15 per acre planted from year 3 onwards.

The management and supervisory costs are assumed to be $20 in year 1, and $40 p.a. from year 2 onwards.

Total general and management costs seems to be reasonably consistent with those actually incurred by FLDA between 1961 and 1966.

2.14 Labour requirements

A paper produced in May 1970 by the EPU suggested that the real cost of 'unskilled labour' to Malaysia is considerably below the market wage. With high unemployment and under-employment, the sacrifice to the nation in taking a man from one place and employing him in another is believed to be far below the wage paid to him. The paper by EPU suggests that the production lost through this transfer of an unskilled worker is less than $50 per month, and it is suggested that, in the appraisal of projects for the Second Malaysia Plan (SMP), a "shadow" price of $40 per month is used for all labour being paid less than $180 per month.

the shadow cost is therefore about 25 percent of the total 'unskilled labour' wage bill.

Weeding and maintenance - The man days per acre required for this activity were set out in 2.10. The shadow cost is about 30 percent of the total cost.

Harvesting - The man days required for this activity were set out in 2.12. The shadow cost is about 35 percent of the total harvesting and collection cost (including the cost of transport - fuel and depreciation).

Others - The 'unskilled labour' and tax content in the fertiliser, buildings and equipment and management costs are assumed to be negligible.

Labour requirements through the life of the scheme - Table 8 summarises the 'unskilled labour' requirements through the life of the oil palm scheme. The overall average wage assumed for the financial calculations in this paper is $150 or about $6 per working day. Table 8 seems to indicate that for yields rising to a peak of about 10 or 12 FFB tons per acre, an oil palm scheme gives full time work to weeders and harvesters on the basis of about 10 acres per worker. If other activities, such as processing, are included this falls to about 9 acres per worker. These 'acres' are planted acres and the equivalent gross or cleared acres would be about 20 percent greater. The labour demand over the life of the scheme is fairly constant, although if all operations are included the labour requirement falls slightly as time goes on.

Seasonal labour requirements - More than 35 percent of the labour requirement in any one year is for weeding. This is unlikely to vary very much through the year. The only variation might possibly be a greater requirement during the wet season (October - January). As for as labour requirements for harvesting and processing are concerned, there is likely be a little peaking because of the peaking in yields (see figure 6 of this paper) but the variation from the average requirement is unlikely to be more than about 10 percent. When combined with the weeding requirements the total variation is not much more than ½ man day per acre per month on an average requirement of about 3 man days per acre. This does not affect the conclusion above, namely that a fulltime job in weeding and harvesting 'requires' about 10 planted acres.

TABLE 8 - 'UNSKILLED LABOUR' REQUIREMENTS ON AN OIL PALM SCHEME

ACTIVITY	MAN-DAYS PER ACRE IN YEAR:- 1	2	3	4	5	6	7	and onwards
DISTRIBUTION TO THE PORT	-	-	-	-	-	1		→
LAND CLEARING	25	-	-	-	-	-		
PLANTING	10	10	-	-	-	-		
CONSTRUCTION OF ROADS AND PATHS	-	-	2	-	-	-		
CONSTRUCTION OF OIL MILL	-	2	2	1	-	-		
MILL OPERATION	-	-	-	-	-	2.5		→
FIELD OPERATIONS								
WEEDING	-	30	26	24	20	18	13	→
HARVESTING (PEAK YIELD - 10 FFB TONS PER ACRE)	-	-	-	10	14	16	17	→
TOTAL MAN DAYS PER PLANTED ACRE	35	42	30	35	34	38	34	→
ACRES PER WORKER(1):-	ACRES PER WORKER(1):-							
ALL OPERATIONS	8.5	7	10	8.5	9	8	9	→
WEEDING AND HARVESTING ONLY	-	10	11.5	9	9	9	10	→

(1) ASSUMING 300 WORKING DAYS PER ANNUM. (25 days/month).

2.15 Optimum Life of Oil Palms - Some Considerations

2.15.1 Objective

The objective of this section is to consider the optimum life of oil palms on various assumptions. The profitability of oil palm is not very sensitive to changes of a few years in the life of oil palm - for example using an interest rate, or discount factor of 15 percent per annum, the value of $1 receivable in 1992 is only about 6 cents in 1972. But the optimum replanting period has been examined because it has implications for the repayment of capital by settlers (or smallholders), and it may give some guidance to FLDA on likely replanting dates.

2.15.2 The problems, the methods and the results.

The assumed objective when considering whether or not to replant is a maximisation of the present value of income. That is, its maximisation of the net present value of all oil palm schemes in the future using the discount rate equivalent to the return from the next best investment in the economy. If the EPU states that this next best return is 10 percent per annum, then this is the rate of interest or discount that should be used. In this analysis, a rate of discount of 15 percent per annum is assumed for evaluating projects at resource values. Therefore the replanting option that should be chosen is the one which gives the highest net present value now at the rate of discount selected (in this case 15 percent per annum). It is not a question of choosing the replanting option that merely gives a zero or positive net present value now. By postponing the replanting it may be possible to increase the net present value (in 1970) even though the net present value from replanting now is positive.

The optimum date of replanting will depend on the marginal year-by-year returns from the existing crop (or use of the land) and the likely future returns from new plantings (and replantings).

In a static situation, that is where future prices and costs are constant, and where yield improvements are not likely to take place, the optimum life for a scheme could be calculated using the method suggested in an article in the October 1969 issue of the Malayan Economic

Review. But where prices and yields are expected to be a function of time it is necessary to resort to a more dynamic approach (see Chapter 2 of Marglin's "Approaches to Dynamic Investment Planning"). In this situation, there is no simple formula for calculating when to replant.

But in order to simplify the problem and reduce the number of alternatives (without, a significant sacrifice in accuracy), the replanting problem could be considered in two stages.

The first stage consists of an attempt to find the optimum life for a plantation which is first planted now (1970). The second stage could, given this optimum replanting life, establish when existing land which is providing a particular income, should be replanted.

These 2 stages should theoretically be combined, but, if they are, the number of alternatives becomes very great, with, in <u>this case</u>, probably no significant improvement in accuracy. Only the first of these stages is discussed in this paper.

2.15.3 The optimum life for oil palms planted now.

The optimum replanting schedule will vary according to expectations of changes in prices, yields, costs, etc. The table below shows the effect of consistently rising (falling) prices, yields and costs on the optimum replanting date compared with the situation where these factors are kept constant. ("Constant" does not mean that the year-by-year yield is kept constant but that the yield profile from oil palms planted now will be the same as the yield profile from oil palm planted in 5 years from now).

The effects of rising or falling (through time) prices, yields, etc. on the optimum replanting date

	Earlier[1] replanting date	Later[1] replanting date
Prices of palm oil in real real terms	rising consistently	falling[2] consistently
FFB yields per acre	rising[2] consistently	falling consistently
Labour costs[3] in real terms	falling consistently	rising[2] consistently
Other costs[4] in real terms	falling[2] consistently	rising consistently

(1) compared to the optimum if all factors are kept 'constant'

(2) most probable future trend.

(3) labour costs are slightly higher in the earlier rather than later stages of the oil palm's life.

(4) seedling, fertiliser, housing, palm oil mill, and oil distribution costs will all probably fall in real terms. The net trend in 'other costs' in real terms is therefore likely to be slightly downward.

The cost trends are assumed to cancel each other out. (That is rising labour costs are assumed to be counteracted by falling "other costs".) The future trend in yields is more difficult to guess. The yield from Malaysian oil palms has been rising over the past decade. The Second ISP Conference Paper (p.138) suggested that "several major advances have occurred in techniques, ranging from clearing to oil production. Planting materials have steadily improved and growers now plant the higher-yielding dura x pisifera cross instead of dura x dura, with an increase in the oil-bunch extraction rate of about 5-6 percent and in yield of over 30 percent".

This presumably means that whereas the Bevan and Goering paper assumed a peak yield of 10 tons of FFB per acre and FLDA now use an extraction rate in the peak of 22 percent giving a peak oil yield per acre of 2.2 tons, the peak yield expected from 1960 plantings was about 7.7 tons of FFB per acre and the extraction rate was about 16 percent giving a peak oil yield per acre of about 1.2 tons. This implies that there has been an average yield increase of over 5 percent with each new year's planting. This agrees substantially with the 6 percent per annum increase in yield between the 1963 World Bank Report and the 1967 DTAM report.

The alternative yields estimated by Bevan imply the following increases:

Average Inland Soils (Moderately Suitable soils)

	Yield expected from plantings in 1970			Yields expected from plantings in 1975 or 1980		
Year after planting	FFB tons per acre	Extraction rate(%)(1)	Oil/kernels tons per acre(1)	FFB tons per acre	Extraction rate(%)(1)	Oil/kernels tons per acre(1)
3	0.5	20	0.1	2.0	24	0.5
4	3.6	22.4	0.8	5.5	26	1.4
5	6.3	23.5	1.5	8.0	28	2.2
6	8.5	25.8	2.2	9.5	30	2.9
10	10.0	27.0	2.7	11.0	32	3.5
25	7.0	27.0	1.9	9.7	32	3.1

(1) includes the extraction rate for both palm kernels and palm oil. (The 'most likely' price of palm kernels is close to that of palm oil, and combining the physical extraction rates is therefore more or less equivalent to combining the yields in value terms).

If the improved yields were obtained from plantings in the year 1975, the improvement (in terms of the percent per annum growth from the peak yield of one crop to the peak yield of the improved crop) would be between 5 percent per annum and 6 percent per annum. If the improved yield were obtained from palms planted in 1980, the improvement would be about 3 percent per annum.

This paper looks at the implications for the replanting date of a technical (yield) improvement of 3 percent per annum above the yield from 'moderately suitable' soils assumed in this paper. Future prices are assumed to be the same as the "most likely" prices taken earlier ( ).

Replanting capital costs were assumed to be as follows:

	$ per acre				% of cost for new plantings
Year	1	2	3	4	
Clearing and planting	296	179	-	-	100
Roads, paths & bridges	-	-	50	-	100
General buildings equipment	40	20	-	-	100
Total (exc. processing mill)	340	200	50	-	

Additional expenditure on the processing mill was assumed to vary with the extra capacity required. Every additional 10 tons FFB input per hour was assumed to result in an additional expenditure of $1.5 million, half of which was assumed to be needed in year 2 and half in year 3. For example this meant an expenditure of just over $300 per acre for replanting in 1990.

The fixed costs were assumed to be as follows:-

$ per acre	Year						
	1	2	3	4	5	6	7 and onwards
Rent	14	14	14	14	14	14	14
Weeding and maintenance	-	158	138	127	106	95	69
Fertiliser	-	30	30	30	30	30	30
Harvesting and collection(1)	-	-	-	100	100	100	100
Estate general and management	60	60	55	55	55	55	55
Processing general	-	12	12	12	20	20	20
	74	274	249	238	325	314	288

(1) Harvesting costs per acre were approximated by the function $100 + ($3.5 x FFB tons per acre)

Variable costs were assumed to be as follows:-

	$ per ton of oil	$ per ton of ffb
Distribution to port	20	-
Harvesting and collection		3.5
Processing - operating		5.6
Fertiliser		6.0
		15.1

The results of the calculations for the first stage are:-

(a) It does not pay to defer the planting of oil palm beyond the present year because although yields from plantings next year will be higher, prices are decreasing and the combined effect is insufficient to warrant the postponement of the investment;

(b) The optimum life for an oil palm scheme planted in 1970 is likely to be at least 25 years. With yields from new plantings being about 3 percent higher than the previous year's plantings and prices of around $344 per ton for oil and kernels in 1990, the optimum life will be 25 years or more at an interest rate of 15 percent per annum. A lower interest rate of say 10 percent per annum shortens the optimum life by about 1 year; a higher interest rate of say 20 percent per annum increases the optimum life by about 1 year. A faster rate of technical improvemhent (to say 5 percent or 6 percent per annum) shortens the life but not by more than 2 or 3 years.

(c) If a Government agency such as FIDA is considering when to replant, it may feel that it should exclude taxes, duties and other transfer payments from its calculations and it may feel that it wants to include only the opportunity cost of unskilled labour in its calculations. But the introduction of these factors into the calculations does not substantially alter the optimum lives. This is because the main tax or duty, (the export duty) is proportional to the value of the output and the unskilled labour input to an oil palm scheme is fairly constant over the life of the scheme.

(d) The optimum life of an oil palm scheme planted in 1970 is therefore likely to be at least 25 years. This does, of course, assume that the oil palm is replaced by oil palm. If gold were discovered on that land or a much better use were found for <u>that particular</u> 10,000 acres of land, then it would pay to pull up the oil palm at an earlier stage in its life.

2.15.4 Method of calculating when existing oil palms (or any other cost) should be replanted with oil palm.

If it is assumed that the life of oil palm if planted in 1970 or soon after is about 25 years, and the returns from it, are known these returns can be compared with the net income from existing schemes to say whether replanting is worthwhile. More precisely, since the benefits from replanted schemes will vary with the year in which they are planted (because of improvements in yields and falling prices), the following method must be used to decide whether an existing crop should be replanted:-

- Discount the costs and benefits from a scheme planted now (in 1970) back to a net present value in 1970, using the assumed optimum life of 25 years (i.e. using 1995 as the terminal year);

- Discount the costs and benefits from replanting in 1971 back to a NPV in 1970, taking the terminal year as 1995;

- Deduct the NPV from replanting in 1971 from the NPV of replanting in 1970, and call this the 'sacrifice' from postponing replanting;

- Compare this 'sacrifice' with the net cash flow in 1970 from the existing use of the land. If the 'sacrifice' is less than the marginal return (net cash flow) from the existing crop, then replanting should be postponed.

This procedure is then repeated year-by-year until replanting is found to be worthwhile.

References

Bevan, Fleming and Gray - "Planting Techniques for Oil Palms in Malaysia" ISP, Kuala Lumpur, 1966.

Bevan and Goering I - (See 1st ISP Conference)

Bevan and Goering II - "Another Look at Rates of Return from Oil Palm and Rubber Investments" - Internal Paper - EPU/FLDA, 1969.

CDC Study - "A Social Cost Benefit Analysis of the Kulai Oil Palm Estate, West Malaysia" Little and Tipping, Nuffield College, Oxford, July '70.

DTAM - "Interim Report of a Feasibility Study on the Oil Palm Scheme of the SEDC, Trengganu" - DTAM - October, 1967.

Economic Planning Unit - "Evaluation and Ranking of Road Investments - Technical Report on the Method Used and the Results Obtained for Projects to Improve the Federal Roads in W. Malaysia" - (Mrs. I. Thygesen - 1/7/70)

- SMP Memorandum "Integrating the Employment Objective - The Selection and Application of an Appropriate 'Shadow Wage'" - EPU 30/5/70

FLDA - "Size of Holdings and Settlers Farm Budget" - paper for RS Seminar, 1969 - see SEJP file 3/D29;

- "Cost Economics in FLDA Activities" - 1968 (?) - SEJP file 3/D26;
- "Land Settlement in Malaysia Under the FLDA" - March 1966 - SEJP file 3/D26;
- "A Review of the FLDA - Its Policies and Operations"- August 1969;
- "Proposed Management Levy" - 1970 (?) - SEJP file D26;
- "Estimates of Development Costs" - FLDA Planning Section, (July 1969) - SEJP file F/04;
- "Annual Reports" (1968, 1969 and 1970);
- "Development Estimates, 1971" - SEJP file D26
- "The Role of Land Settlement in the Economic Development of Malaysia" (undated) - SEJP file D.26
- Report of the Public Administration Report on FLDA - 1969 (for notes, see SEJP file D.26)

Incorporated Society of Planters (ISP) - Conferences -

1. "Oil Palm Developments in Malaysia" - 1st ISP Conference November 1967 - Contains Bevan and Goering 1 paper.
2. "Progress in Oil Palm" - 2nd ISP Conference - November 1968
3. "The Quality and Marketing of Oil Palm Products" 3rd ISP Conference (Symposium) - November 1969.

Jengka Triangle Report - "Resources and Development Planning" and "Appendices" - TAMS/HTS Ltd. - 1967.

Kajian Ekonomi Malaysia - "The Malayan Oil Palm Industry" Khoo Swee Joo - June 1964.

Malayan Economic Review - October 1969 - "Some Considerations Regarding Optimum Ages for Replanting Rubber Trees in Malaya" - A. Halim Ismail.

Marglin S.A. - "Approaches to Dynamic Investment Planning" - North Holland Publishing Company, 1963

MGTS - Malaysian General Transport Survey, Draft Report

S.D.F.C. - "A Study of the Distribution and Marketing of Palm Oil from the Lambir-Subis Area of the Fourth Division, Sarawak, Malaysia" - For the Sarawak Development Finance Corporation by C.B. Edwards, S.E. Johor Project, May 1970.

Sorca - "Oil Palm Products Marketing Study (Malaysia) - An Interim Report"; Sorca and Indacom, Brussels; - for FLDA and ADB, February '70.

South-East Johor Project - "Oil Palm and Rubber - A Comparison of Profitability and Income Opportunities" (forthcoming)

- "The Rate of Return from Forestry in Johor Tengah" (forthcoming)
- Rubber Paper
- Tourism Paper
- "Draft Project Report" and "Supporting Reports" - January '71.
- "Land Clearing - Mechanical or Manual?" - (forthcoming)
- Internal Memoranda and Notes on Interviews with Private Estates, FLDA, and Other Organisations.

World Bank (IBRD) - "Second Jengka Triangle Report, Malaysia" - IBRD - IDA (Agricultural Projects Department) 29-4-70: Report No.PA-31a restricted.

- "Current Economic Position and Prospects of Malaysia" - February '70.

APPENDIX A

1.1 The Market for Oil Palm Products

The oil palm is processed to produce two products. The pericarp of the fruit is pressed to produce palm oil and the kernel can be crushed to yield palm kernel oil, leaving a residual oil-cake which is used as a livestock feed. These two oil products are just two of about 20 types of oils and fats which are used throughout the world. As a result the oils and fats market is an important and highly complex part of the world agricultural economy. Trends in world trade in oils and fats are shown in Table A.1.

The total quantities entering world trade have risen from 9 million tons in 1960 to an estimated 13.25 million tons in 1970 or an increase of just under 4 percent per year. All oils have not expanded to the same extent, in fact there have been marked differences between them as can be seen from the table. The major expansion has been in edible vegetable oils, where exports have risen by 100 percent, and in particular soyabean, sunflower and rapeseed exported principally by United States, U.S.S.R. and Canada respectively. Exports of palm oils have remained virtually static over the decade and as a result have fallen as a proportion of total supplies from 26 percent in 1960 to about 19 percent in 1970. Palm oil itself has fallen from 7.1 percent to 6.4 percent over the same period and palm kernel oil from 4.9 percent to 2.8 percent. This trend is in fact even longer lived since, in the early nineteen-fifties palm oil made up over 15 percent of total world exports of fats and oils. During this same period however the price of palm oil has remained relatively stable relative to other oils and fats (see Table A.2). It is expected that production of palm oil will expand more rapidly in the near future. In order to discuss the effect of this on future prices it is necessary to review the nature of fats and oils.

Fats and oils are made up of compound fatty acids which vary in the extent of "saturation" of their carbon atoms. Generally speaking those with a greater degree of saturation melt at higher temperatures. Most vegetable oils such as soyabean, groundnuts, cottonseed and sunflower have a relatively high proportion of unsaturated fatty acids and have fairly low melting points being liquid at normal temperatures. Others (most of the tropical oils) have a lower proportion of unsaturated acids and higher melting points. Coconut oil for example melts in the temperature range 55°F to 75°F and palm oil in the range 75°F to 88°F. Animal fats similarly have relatively high melting points. Each of the individual oils with its particular combination of fatty acids has a result its own characteristic smell, colour, taste, etc.

TABLE A.1 Oilseeds, Oil and Fats (fat or oil equivalent) - World Exports ('000 short tons)

Commodity	Year 1960	1962	1964	1966	1968	1970
Edible Vegetable Oils						
Cottonseed	318	328	429	292	203	375
Groundnut	858	1,084	1,111	1,198	1,268	940
Soybean	1,577	1,654	1,895	1,940	2,233	3,475
Sunflower	268	399	427	836	1,321	1,150
Rapeseed	101	152	145	386	434	500
Sesame	87	98	98	95	101	100
Olive	76	96	125	76	90	100
Other[(1)]	49	65	77	80	57	50
TOTAL	3,334	3,876	4,307	4,903	5,707	6,690
Palm Oils						
Coconut	1,304	1,374	1,469	1,531	1,380	1,250
Palm kernel	443	401	407	415	348	375
Palm oil	645	560	629	691	736	850
TOTAL	2,392	2,345	2,505	2,643	2,474	2,480
Industrial Oils						
Linseed	468	496	492	491	390	500
Other[(2)]	251	242	281	247	305	290
TOTAL	719	738	773	738	695	790
Animal Fats						
Butter (fat content)	470	465	562	525	530	520
Lard	470	415	522	334	461	465
Tallow & Greases	1,100	1,133	1,549	1,505	1,569	1,475
TOTAL	2,040	2,013	2,633	2,364	2,560	2,460
Marine Oils						
Whale	350	262	220	189	140	135
Fish	251	404	395	559	796	700
TOTAL	601	666	615	748	936	835
GRAND TOTAL	9,086	9,638	10,833	11,396	12,372	13,255

(1) Corn, Safflower.

(2) Castor, Oiticia, Tung.

TABLE A.2 U.K. Import Prices of Selected Oils and Fats 1958 - 66 (£ per ton)

Vegetable Oils	1958	1960	1962	1964	1966
Soybean	105	91	85	89	104
Cottonseed	104	85	92	98	94
Groundnut	104	117	104	105	108
Coconut	106	117	85	105	108
Palm Oil	82	78	78	83	84
Marine Oils					
Whale	73	74	51	79	64
Fish	84	60	45	71	69
Lard	113	82	79	85	93

Fats and oils are used in the following ways:-

(a) In their natural state or after slight processing (e.g. purification or refining) without altering their nature. Thus coconut oil and other oils are used for cooking purposes, butter and animal fat as a spread and for cooking.

(b) After processing that changes their characteristics and structure (e.g. hydrogenation, dehydration, etc.) but which retains their basic nature. Thus oils are hydrogenated to produce products which are solid at normal temperature and can be used as spreads.

(c) As fatty acids produced by cracking the compound molecules in simple fatty acids. These are used for a wide variety of industrial purposes such as lubrication, coating materials, dressing of leather and skins, etc.

The degree to which individual fats and oils can be used for different purposes varies widely. Most fats and oils contain approximately the same fatty acids but in varying proportions. As raw materials for the preparation of fatty acids, the nature of which can be altered through hydrogenation, there is almost no limit to their interchangeability, at least as far as the demand for saturated fatty acids is concerned.

The major uses of fats and oils in salad oils, spreads, frying and cooking fats and oils and manufacture of soaps are considered in mere detail;

(a) Salad oils. These oils must be fluid. Thus palm oil as it stands cannot be used for this purpose. It can be cracked to produce a fluid salad oil which is used in some countries. However, interchangeability among oils here is greatly influenced by customary preferences with regard to taste, colour smell, etc. Some oils such as olive oil are widely used for this purpose. Others, e.g. corn oil and sunflower can be readily used to form emulsions as the basis for salad dressings.

(b) Spreads. The most widely used spread is that commonly referred to as margarine which is made up from a variety of vegetable and animal fats and oils, essentially as a substitute for butter (but which can also be used for cooking). There are a wide variety of margarines but all must resemble and spread like butter and not become rancid when stored. There is a very wide range of possibilities for creating such a product using different fatty substances, mainly hydrogenated oils. A major use of palm oil has been for this purpose, together with oils (e.g. soybean) which have been hydrogenated. However, in order to obtain specific properties (e.g. spreadability) even when stored under refrigeration and to include poly-unsaturated fatty acids for nutritional reasons, there has been a tendency towards the use of certain non-hydrogenated oils (e.g. sunflower and corn oils). This limits interchangeability since, while oils can be readily hydrogenated, those such as palm oil with relatively high proportions of saturated fatty acids cannot yet be satisfactorily "dehydrogenated" on an industrial scale. This case of substitution by other oils has been a prime reason for the relative stability of the palm oil price while its relative scarcity has been increasing. However, because of the dehydrogenation problem, it will probably be much more difficult for palm oil to be substituted for the other oils.

(c) Frying and cooking fats and oils. For frying purposes liquid or solid forms can be used. The major factors are stability under heat and taste and smell imparted to food. Taste and smell are similarly important for use in making dough products with flour e.g. bread, biscuits, pastries etc. For these uses similar considerations apply as for manufacture of spreads with regard to interchangeability of fats and oils.

(d) Soaps. Soaps are made either by combining fats and oils with a base or alkali (a process known as saponification) or by direct combination of individual fatty acids with a base. The degree of interchangeability is again fairly wide subject to the required characteristics of an individual product.

In terms of specificity of use, fats and oils may be conveniently divided into four groups:-

(a) Linseed and Castor oil which have highly specific industrial uses.

(b) Liquid edible oils, e.g. groundnut, soyabean etc. These have fairly highly "specific" demands and can also be hydrogenated etc. to produce a wide variety of end-products.

(c) Lauric acid oils - coconut and palm kernel. Specific demand for these is relatively strong, both in industrial uses, (manufacture of soap and of lauric acid), and in food consumption as an all purpose oil popular in warm countries and as a high grade vegetable fat in temperate countries and for use in special margarines.

(d) Among the remaining fats and oils, tallow and palm oil have similar characteristics, as do marine oils. This group has the least specific demand of all.

The position of the oil palm products may therefore be summarized as follows:-

(1) Palm oil has a low specificity of demand. Other oils and fats can easily be substituted for it should price trends make such a move profitable. On the other hand technical constraints greatly restrict its ability to replace other oils.

(2) Palm kernel oil has much greater specificity in use, and its end-uses as a cooking oil and in soaps and margarines are in products which tend towards the "high-quality" end of their respective ranges.

1.2 Prospects for Palm Oil

Table A.3 shows recent trends in the production as well as exports of fats and oils. Table A.4 shows projections prepared by F.A.O., of world output to 1975 and the comparison of these to outputs in 1961-63. Overall output was seen as increasing from 33 to 46 million tons. The major increase was expected to come from soft oils, (edible vegetable oils), which were expected to increase by 50 percent from 13 to 20 million tons per year. Data in Table A.3 indicate that production of these oils has already reached this level. Palm oil output was expected by the F.A.O. to rise from 1.2 million to 1.8 million tons per annum. As was seen in Table A.3 of palm oil had hardly grown grown at all by 1968. However during the period since 1980 considerable planting of oil palm has taken place particularly in Malaysia and Ivory Coast. Increasing production in these two countries has been partly offset by declining production in Nigeria and Congo (Kinshasa). However output from the latter two countries is expected to stabilise and as a result overall quantities of palm oil moving onto export markets will expand rapidly and are likely to reach 1.8 million tons by 1975.

At the present time prices for oils and fats are at a high level attained initially in 1969 when supplies of groundnut, sunflower, coconut and marine oils were all down over the previous year reducing total world exports from 12.4 million tons in 1968 to 11.8 million tons in 1969. They have stayed at high levels despite markedly higher shipments of cottonseed, soybean and rapeseed during 1970 raising total supplies to an estimated 13.3 million tons. A similar increase in 1971 would almost certainly result in a general reduction of prices. For reasons discussed above the position of palm oil in the overall market is somewhat weak and given the projected increase in its supply it must be expected to be in the forefront of any decline. In 1968 supplies of all fats and oils increased by just over four percent, while palm oil exports rose by over 20 percent. While the prices of all oils fell, palm oil showed a particularly marked decline, and differentials between it and other oils widened, (see Table A.5).

It is expected that the export price of palm oil (FOB Malaysia) will have fallen to $420 by 1975 as output of palm oil is expected to expand more rapidly than most other fats and oils. Output of palm oil in 1975 is virtually determined by the acreage of the crop planted at present. Changes made now or in the immediate future will have their impact upon supplies in the years after 1975. Longer term demand trends will depand upon the strength of

Item	1968 (est) Million short tons	Percent
Production		
Palm oils:		
Palm Kernel.....	.39	1.0
Palm............	1.40	3.5
Other...........	2.22	5.5
Total......	4.01	10.0
Edible vegetable oils	19.62	48.9
Industrial oils......	1.41	3.5
Animal fats..........	13.82	34.4
Marine oils..........	1.30	3.2
Total......	40.16	100.0
Exports		
Palm oils:		
Palm Kernel.....	.32	2.7
Palm............	.60	5.0
Other...........	[illegible]	9.9
Total......	2.11	17.6
Edible vegetable oils	5.53	46.1
Industrial oils......	.66	5.5
Animal fats..........	2.75	22.9
Marine oils..........	.95	7.9
Total......	12.00	100.0
Exports as a percentage		
Palm oils:		
Palm Kernel.....	82	
Palm............	43	
Other...........	54	
Total......	53	
Edible vegetable oils	28	
Industrial oils.....	47	
Animal fats.........	20	
Marine oils.........	73	
Total	30	

TABLE A.3

Estimated production and exports of palm and other major categories of vegetable, animal and marine fats and oils with proportions of total total average 1960-64 and 1966-68 annual

Item	1960-64 average		1966		1967		1968 (est)	
	Million short tons	Percent	Million short tons	Percent	Million short tons	Percent	Million short tons	Percent
Production								
Palm oils:								
Palm Kernel....................	.46	1.3	.44	1.1	.38	1.0	.39	1.0
Palm...........................	1.32	3.9	1.38	3.6	1.24	3.2	1.40	3.5
Other..........................	2.42	7.0	2.58	6.7	2.34	5.9	2.22	5.5
Total..........................	4.20	12.2	4.40	11.4	3.96	10.1	4.01	10.0
Edible vegetable oils...............	15.14	44.1	18.02	46.5	18.68	47.7	19.62	48.9
Industrial oils.....................	1.59	4.6	1.80	4.6	1.60	4.1	1.41	3.5
Animal fats.........................	12.28	35.7	13.22	34.2	13.61	34.7	13.82	34.4
Marine oils.........................	1.18	3.4	1.26	3.3	1.35	3.4	1.30	3.2
Total..........................	34.39	100.0	38.70	100.0	39.20	100.0	40.16	100.0
Exports								
Palm oils:								
Palm Kernel....................	.41	4.1	.41	3.6	.30	2.6	.32	2.7
Palm...........................	.61	6.1	.68	6.0	.55	4.7	.60	5.0
Other..........................	1.42	14.3	1.53	13.6	1.30	11.1	1.19	9.9
Total..........................	2.44	24.5	2.62	23.2	2.15	18.4	2.11	17.6
Edible vegetable oils...............	3.63	36.5	4.78	42.5	5.25	44.9	5.53	46.1
Industrial oils.....................	.74	7.4	.74	6.6	.73	6.2	.66	5.5
Animal fats.........................	2.31	23.2	2.37	21.1	2.65	22.6	2.75	22.9
Marine oils.........................	.84	8.4	.74	6.6	.92	7.9	.95	7.9
Total..........................	9.96	100.0	11.25	100.0	11.70	100.0	12.00	100.0
Exports as a percentage of production	Percent							
Palm oils:								
Palm Kernel....................	89		93		79		82	
Palm...........................	46		49		44		43	
Other..........................	59		59		56		54	
Total..........................	58		60		54		53	
Edible vegetable oils...............	24		27		28		28	
Industrial oils.....................	47		41		46		47	
Animal fats.........................	19		18		19		20	
Marine oils.........................	71		59		68		73	
Total	29		29		30		30	

Compiled from data in Foreign Agricultural Circular FFO-1-69, January 1969.

TABLE A.4

Fats and Oils: World Production by Type, Average 1961-63 and Projections for 1975, Low Assumption

Oil or Fat	Average 1961-63				1975			
	World	Developed Countries	Centrally planned Countries	Developing 1/ Countries	World	Developed Countries	Centrally planned Countries	Developing 1/
	Million tons							
Butter	4.51	2.55	1.09	0.88	5.95	3.36	1.54	1.05
Lard	4.94	2.26	2.34	0.34	6.42	2.74	3.18	0.49
SOFT OILS								
Groundnut oil	2.56	0.10	0.35	2.11	4.02	0.15	0.51	3.36
Soybean oil	3.83	2.99	0.81	0.04	6.51	5.14	1.11	0.27
Cottonseed oil	2.21	0.95	0.54	0.71	2.91	1.10	0.80	1.01
Rapeseed oil	1.29	0.27	0.48	0.54	1.88	0.53	0.63	0.72
Sunflowerseed oil	1.98	0.05	1.74	0.19	3.29	0.09	2.97	0.23
Olive oil	1.30	1.13	0.01	0.16	1.49	1.25	0.01	0.23
Total	13.17	5.49	3.93	3.75	20.10	8.25	6.02	5.83
LAURIC ACID OILS								
Coconut oil	2.08	0.18	-	1.90	2.62	0.22	-	2.40
Palm kernel oil	0.48	-	-	0.48	0.61	-	-	0.61
Total	2.56	0.18	-	2.38	3.23	0.22	-	3.01
HARD OILS								
Marine oils	1.02	0.53	0.04	0.45	0.81	0.48	0.05	0.28
Palm oil	1.17	-	-	1.17	1.78	-	-	1.78
Tallow	3.55	2.73	0.35	0.47	4.80	3.73	0.48	0.60
Total	5.74	3.26	0.39	2.09	7.39	4.21	0.53	2.66
INDUSTRIAL OILS 2/	1.29	0.43	0.19	0.67	1.44	0.35	0.23	0.86
OTHER FATS AND OILS 3/	0.83	0.23	0.15	0.44	1.13	0.34	0.18	0.62
GRAND TOTAL	33.04	14.40	8.09	10.55	45.65	19.46	11.63	14.51

1/ Including Antarctic
2/ Linseed, Castorseed and Tung oils
3/ Includes all oils of minor importance not shown separately above

F.A.O. Agricultural Projections 1975 - 1985 the following factors:-

(a) <u>Those acting to weaken the position of palm oil</u>:

(1) Trends in consumer preference towards those products for which palm oil is not specifically required and cannot easily be used.

(2) The relative ease of expanding production of oil bearing annual crops such as sunflower and soybeans.

(3) The fact that, for several of the major vegetable oils, oil is to some degree a by-product. For example, soybean and sunflower are crushed to provide a meal fed to livestock as well as oil. Increases in demand for livestock products have resulted in a considerable growth in this market and have been a major influence on the increase in output of soybeans in particular. Thus the impact on producers of a fall in oil price is reduced.

(4) Actions by governments to protect producers from world market fluctuations, particularly in North America, Europe and U.S.S.R. These have taken the form of concessional sales of products in third markets e.g. P.L. 480 sales of soybean oil to India, Pakistan and countries in the Middle East and North Africa. Furthermore although the income elasticity of demand for fats and oils by developing countries is high, these markets are often restricted by exchange controls as well as concessional sales.

(b) <u>Those acting to strengthen the position of palm oil</u>:

(1) The oil palm is by far the greatest oil producer of all vegetative plants in terms of output per acre. Technological improvement will obviously improve its output further and reduce production costs.

(2) Possible developments in processing to widen the end-uses of the products e.g. improvements in cracking the oil into specific fractions and possibly the development of a technique for "dehydrogenating" the oil.

It is within this demand framework that supply decisions must now be made. The F.A.O. Indicative World Plan has suggested that Malaysia will plant 30,000 acres of oil palms per annum in the 1970-75 period and 35-50,000 acres p.a. in 1975-1985, to achieve total acreages of more than ½ million by 1975 and about a million by 1985. This

TABLE A.5

Prices for palm oil and selected oils and fats with price spread comparisons, annual 1960-67 monthly January-June 1968

Period	Palm oil 1/	Soybean oil 2/ price	Soybean oil 2/ spread	Sunflower oil 2/ price	Sunflower oil 2/ spread	Rapeseed oil 2/ price	Rapeseed oil 2/ spread	Tallow 3/ price	Tallow 3/ spread	Lard 4/ price	Lard 4/ spread	Fish oil 5/ price	Fish oil 5/ spread
						U.S. cents per pound							
1960	10.2	9.9	-.3	10.9	+.7	10.3	+.1	6.5	-3.7	11.5	+1.3	6/	—
1961	10.4	12.6	+2.2	14.2	+3.8	12.7	+2.3	7.3	-3.1	11.0	+.6	6/	—
1962	9.9	10.1	+.2	10.6	+.7	10.2	+.3	6.3	-3.6	9.9	0	6/	—
1963	10.5	9.8	-.7	10.7	+.2	9.8	-.7	6.5	-4.0	9.6	-.9	6/	—
1964	10.9	10.4	-.5	11.6	+.7	11.5	+.6	7.9	-3.0	11.4	+.5		
1965	12.4	12.3	-.1	13.2	+.8	11.9	-.5	9.2	-3.2	13.3	+.9	9.2	-.7
1966	10.7	11.8	+1.1	11.7	+1.0	11.1	+.4	8.3	-2.4	12.8	+2.1	9.8	-2.6
1967	10.2	9.8	-.4	9.6	-.6	9.4	-.8	6.4	-3.8	9.3	-.9	8.9	-1.8
Average 1960-67	10.6	10.8	+.2	11.6	+1.0	10.9	+.3	7.3	-3.3	11.1	+.5	5.8	-4.4
1968												8.4	-2.2
Jan	8.7	8.9	+.2	8.3	-.4	8.3	+.4	6.0	-2.7	8.3	-.4	4.8	-3.9
Feb	8.7	8.8	+.1	8.2	-.5	8.1	-.6	5.9	-2.8	7.9	-.8	4.6	-4.1
Mar	8.7	8.6	-.1	7.6	-1.1	7.9	-.8	5.9	-2.8	8.2	-.5	4.1	-4.6
Apr	8.6	8.6	0	7.2	-1.4	7.4	-1.2	5.8	-2.8	7.8	-.8	4.4	-4.2
May	8.5	8.6	+.1	7.2	-1.3	6.9	-1.6	5.8	-2.7	7.5	-1.2	4.8	-3.7
June	8.0	8.1	+.1	7.3	-.7	6.8	+1.2	5.7	-2.3	6.8	-1.2	4.5	-3.5
July	7.8	7.3	-.5	6.9	-.9	6.5	-1.3	5.6	-2.2	7.5	-.3	4.2	-3.6
Aug.	6.8	7.1	+.3	7.5	+.7	6.6	-.2	5.7	-1.1	6.9	+.1	4.0	-2.8
Sept	6.4	7.3	+.9	8.0	+1.6	7.0	+.6	5.6	-.8	6.8	+.4	4.2	-2.2
Oct	6.4	7.5	+1.1	7.7	+1.3	7.0	+.6	5.6	-.8	7.5	+1.1	4.5	-1.9

1/ 1960-64 5% bulk c.i.f. European ports; 1965 and subsequent Malaya 5% bulk c.i.f. European ports.
2/ Any origin, crude, ex-tank Rotterdam.
3/ North American bleachable, c.i.f. European ports.
4/ American, bulk U.K. ports.
5/ Peruvian, semi-refined, c.i.f. European ports.
6/ Not available.

Source: London Public Ledger, Saturday edition (Via Foreign Agriculture Circular 1-69) development would yield an output of at least 1.5 million tons in 1985, (not 0.8 million tons as specified in the Plan). This would amount to approximately 40 percent of world production of palm oil of about 3.7 - 4.0 million tons (about 3.6 million tons in study countries, plus 200,000 tons or more in others, particularly Indonesia). This would mean a growth in world production of about 5.5 percent per annum over the 1970-85 period. In the absence of a technological breakthrough, which could dramatically increase the potential market for oil palm, (this cannot be predicted with any accuracy) it is anticipated that the price trend of palm oil will be downward in the long-term as follows:-

		Min. Brit.
1975	$420 (FOB Singapore 5% F.F.A)	410
1980	$380	370
1985	$360	350
1990	$344	334
1995		330.

The S.E.J. Project proposals in terms of oil palm acreages planted are based essentially upon a planting programme of the above order of magnitude.

Various possible marketing problems for palm oil are however examined in more detail in the paper headed "Oil palm and rubber - a comparison of profitability and income opportunities".

Prospects for palm kernels

It was noted earlier that palm kernel oil has a much greater specificity of demand than palm oil, and that it and coconut oil are favoured for a number of uses particularly as a cooking oil in tropical Asia. As seen in Tables A.1 and A.3 output and exports of coconut oil have been virtually unchanged over the past decade due partly to increasing age of palms in most producing areas, and partly to adverse weather conditions in the Philippines, the largest single producer, which has resulted in considerable damage to that country's crop.

A steady growth in demand for palm kernel oil is anticipated, and the price of both kernels and oil is expected to be less severely affected by any general fall in prices than palm oil. The price of palm kernels over the 20 year period under review is expected to be as follows:-

		Min. British.
1975	$370/ton F.O.B. Singapore	360
1980	$360/ton	350
1985	$350/ton	340
1990	$344/ton	335
1995		330