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AAR - NEWS

EDITORIAL

Yield Improvement - The Way To Higher Profit

Over the past few years, AAR has devoted much efforts to develop and fine-tune our SYP (site yield potential) model and the related expertise to set and achieve yield targets through site-specific agromanagement practices (SSAP). The SYP is the yield realised when all agronomic and management inputs and practices are perfect. Among other things, the SYP and SSAP require a thorough and detailed study of each site to identify the yield limiting factors and provide solutions to rectify them. A multi-disciplinary approach entailing the use of AAR's AeGIS database, INFERS (integrated site-specific fertilizer recommendation system), economic analysis, best month for fertilizer application model and the state-of-the-art GPS/GIS (Global Positioning System/ Geographical Information System) technology was pursued by AAR for use in oil palm plantations.

It is now feasible to implement the above package in commercial scale plantings as illustrated in this special article on **Yield Improvement Project** prepared by our Kok, T.F.; Tey, S.H. and Chew, P.S.

The importance of achieving SYP cannot be over-emphasised. The level of yield obtained by an estate has a direct effect on the cost of production as well as profit. This may be simply illustrated in the following three equations :-

1) $\text{Production Cost} = \dfrac{\text{Fixed Cost}}{\text{Yield}} + \text{Variable Cost}$

2) Revenue = Yield x Price

3) Profit = Revenue - Production Cost

Equation 1 indicates that as yield goes up, production cost per unit product comes down. The second and third equations show that the higher the yield, the higher will be the revenue and hence profit. To put it simply, higher yield means lower production cost and higher profit.

We have devoted this entire issue of our Newsletter to this very important subject on **Yield Improvement** and hope it will be of interest to you.

Please do not hesitate to write to us and let us have your views.

OOI, L.H.

YIELD IMPROVEMENT PROJECT

By Kok, T.F. ; Tey, S.H. and Chew, P.S.

1. Introduction

AAR has embarked on a programme to identify poor performing oil palm areas and estates with agronomic constraints to improve their yields and profitabilities.

This new AAR Yield Improvement Project (YIP) utilises the site-specific and site-yield potential (SYP) approaches. The SYP is the yield realised when all agronomic and management inputs and practices are perfect.In the site-specific approach, the palm, site and management constraints at each site are identified and rectified.

In order to achieve these site-specific practices and SYP, more site data e.g. soil series and slopes, and use of new agronomic and information technologies e.g. Global Positioning System (GPS), Geographical Information System (GIS), database, site-yield prediction models and systems for recommending fertiliser requirements are required.

The necessary technologies to implement site-specific practices on extensive scale are now available at AAR. The YIP has been drawn up to improve the results and profitabilities of its client estates.

An estate has been selected to test and develop the methodologies and the reporting system for the YIP. Monitoring of the progress and results of the YIP for the next 3 years will be implemented after commencement.

1.1. Objectives of AAR Yield Improvement Project (YIP)

I) To identify under performing fields

II) To identify and quantify the growth and yield limiting factors

III) To provide site-specific corrective measures to improve growth and achieve SYP for the fields within the shortest time possible and

IV) To assess economics of the practices and inputs implemented.

1.2. Methodology

The method used for the study comprised :-

I) Desktop study to gather available information and preliminary computation of SYP. With the available information from AAR's AeGIS database, computation of SYP was carried out using AAR's model (ASYP ver 2.8) which takes into account factors such as palm age, type of planting materials, light interception, soil and climatic factors. Study of the differences in yield and SYP was made.

II) An initial field visit to verify the initial data and collect additional information for re-computation of SYP.

III) A second visit to discuss and verify the identified growth and yield limiting factors in the field.

IV) A third visit was made to collect leaf, rachis and soil samples of the selected fields as nutrients were identified to be limiting.

V) Finally, the limiting factors are reported and inputs recommended in this report.

VI) Further monitoring programmes will be conducted throughout this project. This monitoring programme will include periodic leaf and soil samplings and monthly progress report from the estate to ensure that the objectives are achieved within the shortest time frame.

2. Physical Factors of the Estate/Fields

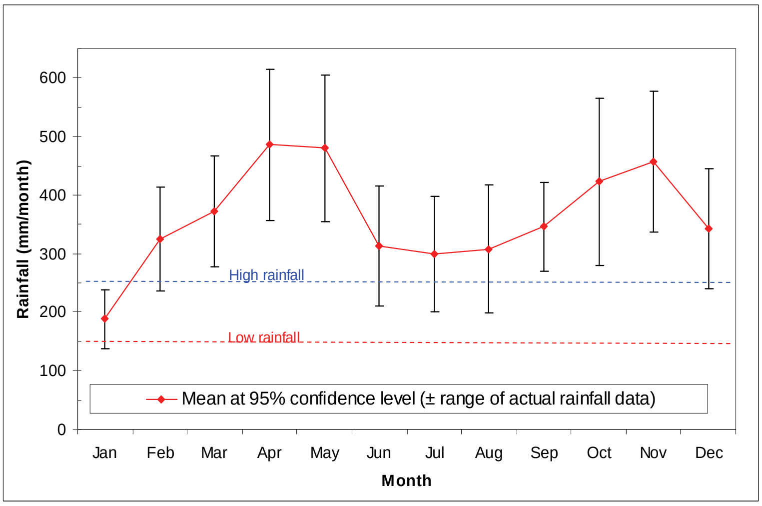
2.1. Location

The three fields selected (one manuring block per field) for the YIP were :- PM90A1, PM94A1 and PM93A1.

2.2. Rainfall

The estate received high rainfall with annual rainfall of 3200 mm (1988 to 1998). Figure 1 shows the monthly rainfall probability using 1978-1998 rainfall records at 95% confidence level. The rainfall peaks in April and November.

Figure 1 : Monthly Rainfall Probability (1978-1998 rainfall records)



2.3 Hectarages

The GPS hectarages differed from those declared by the estate by 3.4% to 9.4% :-

Manuring Blocks	Estate (ha)	GPS surveyed (ha)	Difference (%)
PM94A1	66	68.3	3.4
PM93A1	48	52.5	9.4
PM90A1	66	68.5	3.6

Map 1 shows the block boundaries before and after GPS survey. The recomputed SPH (stand per ha) and yield based on GPS ha are tabulated in Table 1:

Map 1 : GPS surveyed vs. Desktop Mapped

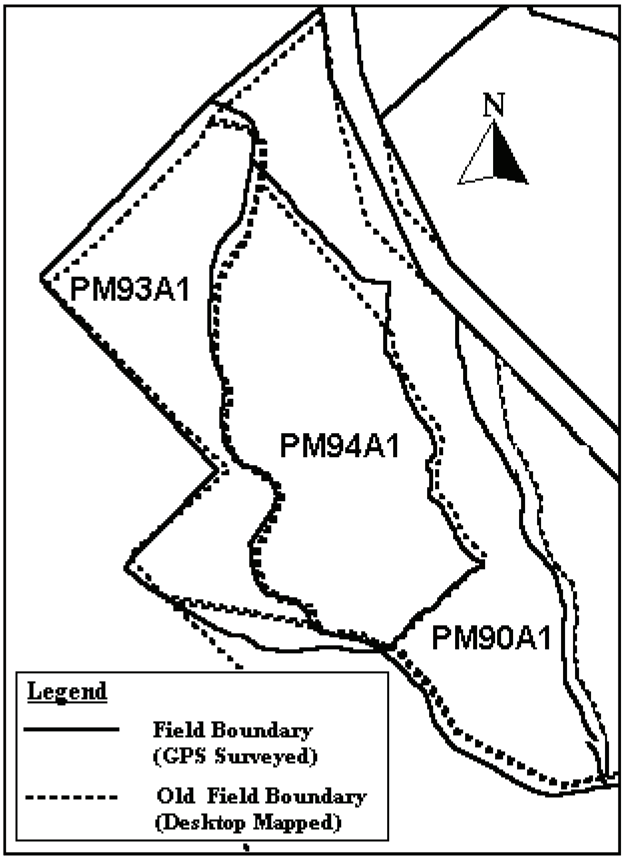


Table 1 : Recomputed SPH and yield based on GPS ha

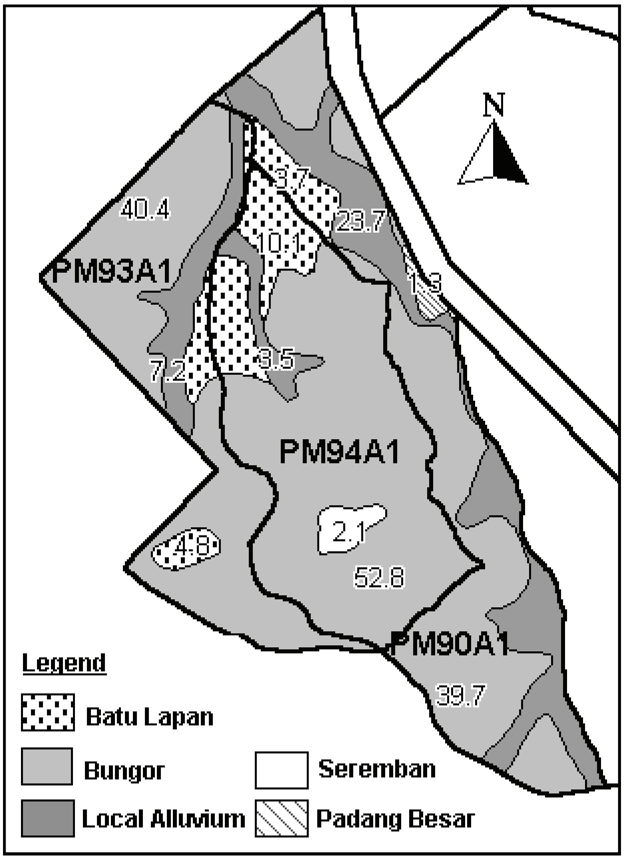
Manuring Blocks	Estate SPH (1998)	Corrected SPH * (1998)	1998 Estate Yield (t/ha)	1998 Corrected Yield (t/ha) #
PM94A1	136	131	14.3	13.8
PM93A1	164	150	19.4	17.7
PM90A1	136	131	20.1	19.4

*Computation using GPS surveyed hectarage and total number of palms as reported
Computation using the GPS surveyed hectarage

2.4. Soil

A detailed soil survey (grid system 300m x 300m at an intensity of ± 9 ha/check point) was completed. The preliminary soil map for the three fields is shown in Map 2.

Map 2 : Soil Map of YIP Blocks



1) Soil Types

Distribution of soils in the selected fields is as tabulated in Table 2.

Table 2 : Distribution of Soil Series

Soil Series	Manuring Blocks (GPS-ha) - % of area			
	PM94A1 (68.5ha)	PM93A1 (52.5ha)	PM94A1 (68.3ha)	Mean
Bungor	77.1	77.0	58.1	70.2
Local Alluvium	5.1	13.7	34.7	18.2
Batu Lapan	14.7	9.1	5.4	9.8
Seremban	3.1	-	-	1.1
Padang Besar	-	-	1.9	0.7

II) Soil Nutrient Status

The soil nutrient status is summarized in Table 3.

Organic C and N contents ranged from very low to extremely low. Hence N mineralization is likely to be very limited. However, P results showed high levels in the palm circles.

K content was low to very low generally while Mg had built up in two fields but not in PM90A1.

Responses to N and K can be expected for all fields and Mg in PM90A1. Nutrients were concentrated in the palm circles for PM93A1 and PM94A1. In future, fertilisers should be broadcast over the palm inter-rows.

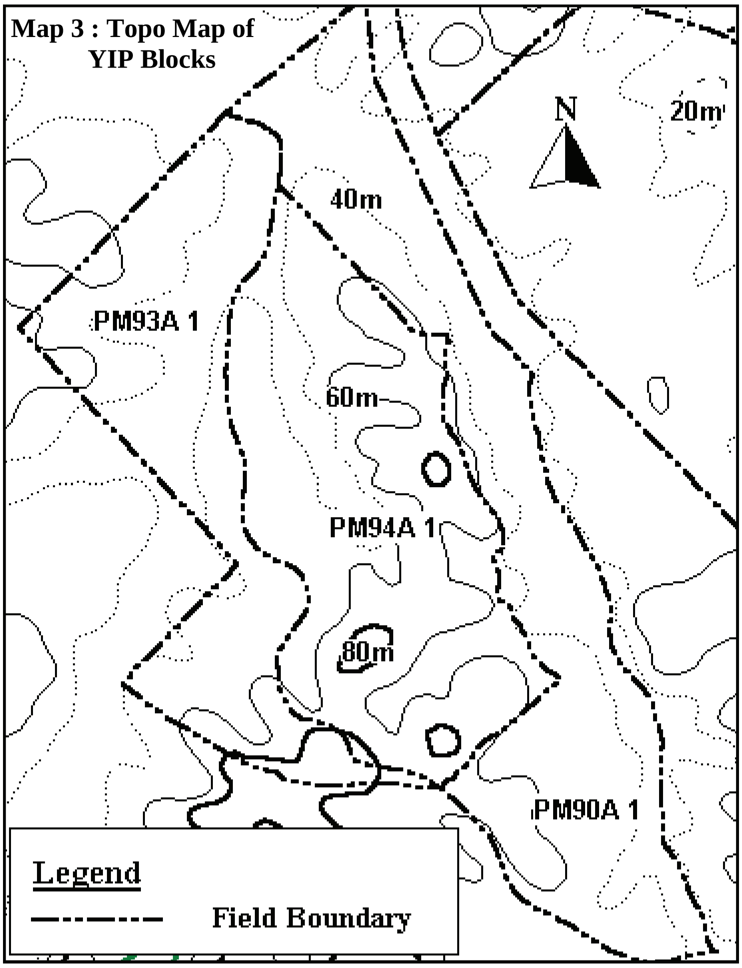


Table 3 : Summary of Soil Nutrient Status (1998)

Manuring Block	Area	Depth (cm)	pH	Org. C (%)	Total N (%)	P (ppm)		Exch. Cations (m.e.%)		CEC (m.e.%)
						Total	Avail.	K	Mg	
PM94A1	I.R.	0-15	M	XL	XL	ML	M	L	ML	VL
		15-45	M	XL	VL	L	L	VL	L	VL
	P.C.	0-15	M			H	H	L	H	
		15-45	M			H	H	L	H	
PM93A1	I.R.	0-15	M	VL	VL	ML	M	VL	VL	XL
		15-45	M	XL	XL	ML	H	L	L	XL
	P.C.	0-15	H			H	H	ML	H	
		15-45	M			M	H	L	M	
PM90A1	I.R.	0-15	M	L	VL	ML	H	VL	XL	VL
		15-45	M	XL	XL	VL	ML	VL	XL	XL
	P.C.	0-15	M			H	H	H	VL	
		15-45	M			ML	H	L	XL	

Reference: H : High M : Medium ML : Marginal L : Low
VL : Very Low XL : Extremely Low

III) Terrain

Terrain was generally undulating to rolling in PM90A1 but PM94A1 was hilly. South of PM93A1 was hilly while major parts of PM93A1 were undulating to flat in the north (Map 3 : Topo Map).

IV) Soil conservation measures

Palms on the hilly terrain were planted on terraces. Stops along terraces were noted and correct placement of fronds along the terraces was practised.

Thick vegetation was also noted in blocks PM93A1 and PM94A1 but the ground vegetation was mainly *Asystasia sp.* and grasses.

Good soil conservation measures should be maintained due to the highly erodible soils, hilly terrain and high rainfall.

V) *Soil moisture deficit*

Rainfall in the estate was high. Moisture deficit is unlikely to pose any serious problem even on the most shallow soil type and is expected to be less than 30mm/year.

3. Biological Factors of Fields

3.1. Yield Potential

I) *Cultivar*

All the selected manuring blocks were planted with DxP AA materials.

II) *Age*

The selected blocks were 4 (PM94A1), 5 (PM93A1) and 8 (PM90A1) years old.

III) Planting distance, pattern and uniformity

PM93A1

A mixture of contour planting on the hills and straight line planting on the undulating to flat areas. Palm uniformity was fair to poor with small to very small canopies on the hills. Palm count for this field need to be re-checked as very high density was recorded.

PM94A1

Mainly hilly areas and palms were planted on terraces with poor uniformity. Planting distance also varied from one place to another resulting in pockets of sparse and dense palms over the field.

This uneven spacing is inefficient in light utilization and will pose more problems when the palms get older.

PM90A1

Planting pattern was poor. In the low-lying areas, slight etiolation was noted. Palm uniformity was very poor probably due to poor nutritional history. Many factors could have contributed to the latter but were difficult to identify at the time of visit.

IV) Yield Gaps

Table 4 summarizes the SYP computation against corrected actual yields for the last 3 years.

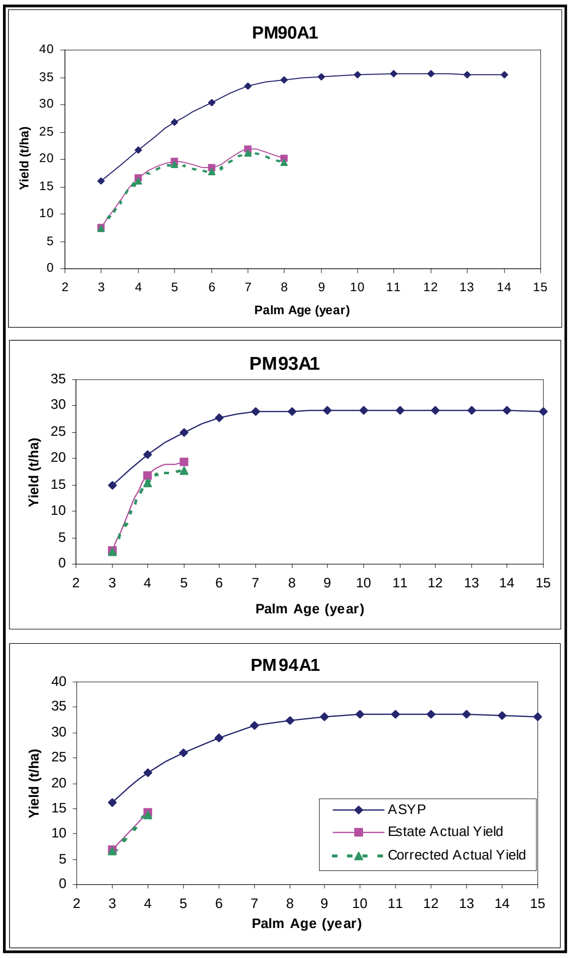
Figure 1 shows the SYP trend, actual yields reported and the corrected actual yields against age of palm.

Table 4 : Yield Gaps (1996- 1998)

Manuring Blocks	1996 SYP (t/ha)	1996 Actual Yield (t/ha)	1996 Yield Gap (%)	1997 SYP (t/ha)	1997 Actual Yield (t/ha)	1997 Yield Gap (%)	1998 SYP (t/ha)	1998 Actual Yield (t/ha)	1998 Yield Gap (%)
PM94A1	na	na	na	16.1	6.5	-60	22.0	13.8	-37
PM93A1	15.0	2.3	-85	21.0	15.4	-27	26.0	17.7	-32
PM90A1	30.4	17.8	-41	33.4	21.2	-37	34.5	19.4	-44

na = not available

Figure 1 : SYP trend, actual and current yields vs palm age



3.2. Palm growth and nutritional status

I) Canopy Growth and Size

Frond 17 dry weights in each block from 1997 to 1999 are shown in Table 5. Distribution of canopy sizes are shown in Table 6.

The distribution of different canopy size is shown in Map 4. Very poor palms were mainly on the hill tops in PM94A1 and PM93A1.

In PM90A1, very poor to poor palms were in the more sandy areas of the Local Alluvium and the transition of Bungor to Local Alluvial soils.

II) Nutrition

Leaf N concentration appeared adequate but total canopy N content was low due to the small canopies. However K concentration was low. The low levels of K were confirmed by rachis-K results.

3.3. Field condition and quality

Thick ground vegetation mainly a mixture of competitive weeds such as *Asystasia sp.* and light grasses was noted in PM94A1 and PM93A1. In PM90A1, sparse ground vegetation was noted in the low-lying sandy areas.

4. Recommendations

The results and analyses confirmed that the poor growth and yields in the selected fields were primarily due to poor nutritional

Map 4 : Canopy Size Assessment

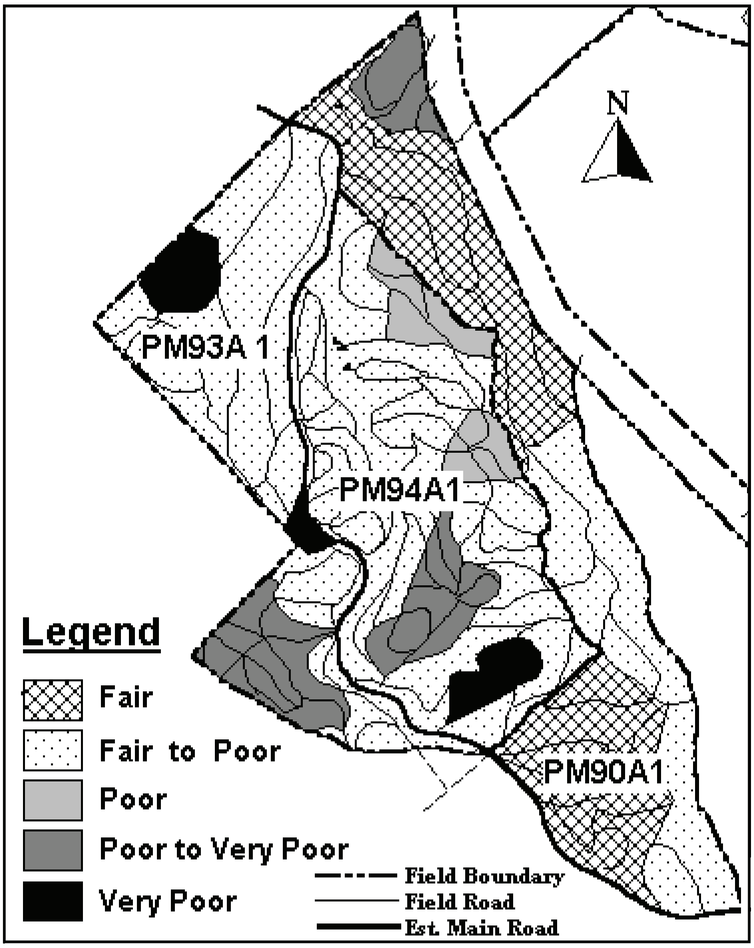


Table 5 : Frond 17 dry weight (1997-1999)

Manuring Block	Frond Dry Wt. (kg)		
	1997	1998	1999
PM94A1	1.37 (62 %)	1.66 (55 %)	2.45 (66 %)
PM93A1	1.98 (66%)	2.66 (71%)	2.85 (65%)
PM90A1	3.39 (70 %)	4.16 (81 %)	4.36 (82 %)

( ) = % of optimum as computed with AAR's INFERS model

Table 6 : % distribution of canopy sizes

Manuring Block	Fair	Fair to Poor	Poor	Poor to Very Poor	Very Poor
PM94A1	-	75	11	10	4
PM93A1	-	76	-	16	8
PM90A1	60	33	-	7	-

Canopy size classes : Percentage of optimum
Fair : 71-75%; Fair to poor : 66-70% ; Poor : 61-65% ; Poor to very poor : 56-60% ; Very poor : < 55 %

status of the palms. Hence, the recommendations are:

- ***to improve the canopy size and vigour to optimum levels within three years by correcting N and K status of the palms immediately***
- ***to improve the yields while correcting the palm growth in the next three years before reaching the SYP***

The yields in the intermediate years prior to achievement of SYP are termed as 'expected yields'.

4.1. Fertilization

I) The old manuring schedule (for PM93A1, PM94A1, PM90A1) is tabulated in Table 7.

II) The revised manuring schedule for the remaining three-quarters of 1999 and for year 2000 and 2001 is tabulated in Table 8.

Table 7 : 1999 (Old) manuring schedule for the selected fields

Manuring Block	Units	1'1999	2'1999	3'1999	4'1999	5'1999	6'1999	7'1999	8'1999	9'1999	Total (kg/palm) MOP	AC	KS	GML
PM94A1		AC	MOP	KS		AC			MOP	AC				
	kg/palm	1.50	1.75	1.50		1.50			1.75	1.50	3.50	4.50	1.50	
PM93A1		AC	MOP	KS		AC			MOP	AC				
	kg/palm	1.75	2.00	1.50		1.75			1.75	1.75	3.75	5.25	1.50	
PM90A1		AC	MOP	GML		AC			MOP	AC				
	kg/palm	1.50	2.00	3.50		1.50			1.75	1.50	3.75	4.50		3.50

Table 8 : Revised Oil Palm Fertilizer Programme for the last three quaters of 1999 to 2001

Manuring Block	Current Ha	Density	Application Mth/Yr	Fert.	kg/palm	kg/ha	Total tonnes	Fertilizer Bags	Cost/ha*
PM90A1	68.5	131	1/99	AC	1.50	197	13.46	269	61
			2/99	MOP	2.00	262	17.95	359	149
			3/99	GML	3.50	459	31.41	628	36
			5/99	AC	1.50	197	13.46	269	61
			7/99	AC	2.00	262	17.95	359	81
			8/99	MOP	2.50	328	22.43	449	186
			9/99	AC	1.50	197	13.46	269	61
			10/99	JRP	2.00	262	17.95	359	80
			11/99	GML	2.50	328	22.43	449	26
			12/99	MOP	2.50	328	22.43	449	186
1999 total					**21.50**	**2,817**	**192.93**	**3,859**	**926**
			1/00	AC	2.25	295	20.19	404	91
			2/00	HGFB48	0.10	13	0.90	18	24
			5/00	AC	2.00	262	17.95	359	81
			7/00	MOP	2.25	295	20.19	404	167
			9/00	AC	2.00	262	17.95	359	81
			12/00	MOP	2.75	360	24.68	494	204
2000 total					**11.35**	**1,487**	**101.85**	**2,038**	**649**
			1/01	GML	4.00	524	35.89	718	41
			2/01	AC	2.00	262	17.95	359	81
			5/01	HGFB48	0.10	13	0.90	18	24
			7/01	MOP	2.25	295	20.19	404	167
			9/01	AC	2.00	262	17.95	359	81
			12/01	AC	2.25	295	20.19	404	91
2001 total					**12.60**	**1,651**	**113.07**	**2,262**	**486**
PM93A1	52.5	150	1/99	AC	1.75	263	13.78	276	81
			2/99	MOP	2.00	300	15.75	315	170
			3/99	KS	1.50	225	11.81	236	95
			5/99	AC	1.75	263	13.78	276	81
			7/99	AC	1.50	225	11.81	236	70
			8/99	MOP	2.50	375	19.69	394	213
			9/99	AC	1.50	225	11.81	236	70
			10/99	JRP	3.00	450	23.63	473	138
			11/99	GML	3.00	450	23.63	473	36
			12/99	MOP	2.50	375	19.69	394	213
1999 total					**21.00**	**3,150**	**165.38**	**3,309**	**1166**

Manuring Block	Current Ha	Den-sity	Application Mth/Yr	Fert.	kg/palm	kg/ha	Total tonnes	Fertilizer Bags	Cost/ha*
PM93A1	52.5	150	1/00	AC	2.25	338	17.72	354	105
			2/00	HGFB48	0.10	15	0.79	16	27
			5/00	AC	2.25	338	17.72	354	105
			7/00	MOP	2.50	375	19.69	394	213
			12/00	AC	2.25	338	17.72	354	105
2000 total					**9.35**	**1,403**	**73.63**	**1,472**	**553**
			1/01	MOP	3.00	450	23.63	473	255
			3/01	AC	2.00	300	15.75	315	93
			7/01	MOP	2.25	338	17.72	354	191
			8/01	AC	2.00	300	15.75	315	93
			9/01	HGFB48	0.10	15	0.79	16	27
			12/01	AC	2.25	338	17.72	354	105
2001 total					**11.60**	**1,740**	**91.35**	**1,827**	**764**
PM94A 1	68.3	131	1/99	AC	1.50	197	13.42	268	61
			2/99	MOP	1.75	229	15.66	313	130
			3/99	KS	1.50	197	13.42	268	83
			5/99	AC	1.50	197	13.42	268	61
			6/99	MOP	1.75	229	15.66	313	130
			7/99	AC	1.50	197	13.42	268	61
			8/99	MOP	1.75	229	15.66	313	130
			9/99	AC	2.00	262	17.89	358	81
			10/99	JRP	2.00	262	17.89	358	80
			11/99	GML	3.00	393	26.84	537	31
			12/99	MOP	2.00	262	17.89	358	149
1999 total					**20.25**	**2,653**	**181.18**	**3,622**	**996**
			1/00	AC	2.50	328	22.37	447	102
			2/00	HGFB48	0.10	13	0.89	18	24
			3/00	MOP	1.25	164	11.18	224	93
			5/00	AC	2.50	328	22.37	447	102
			8/00	MOP	2.00	262	17.89	358	149
			9/00	AC	2.50	328	22.37	447	102
			12/00	MOP	3.00	393	26.84	537	223
2000 total					**13.85**	**1,814**	**123.92**	**2,478**	**792**
			2/01	AC	2.00	262	17.89	358	81
			5/01	AC	1.75	229	15.66	313	71
			7/01	MOP	2.25	295	20.13	403	167
			8/01	AC	1.75	229	15.66	313	71
			9/01	HGFB48	0.10	13	0.89	18	24
			12/01	AC	2.00	262	17.89	358	81
2001 total					**9.85**	**1,290**	**88.13**	**1,763**	**495**

*Dec 1998's prices

This recommendation includes additional inputs of fertilisers for:-

a) Correction of canopies to the desired size as shown in Table 9 in three years.

b) Achieving expected yields

The expected yields (Table 10) were estimated using AAR's ASYP model and actual Yield Trend in Figure 1 and AAR's INFERS programme which has an accuracy of ± 10%.

Table 9 : Projected canopy improvements for the next three years

Manuring block	Frond 17 dry weight (kg)		
	2000	2001	2002
PM94A1	3.3 (76 %)	4.5 (92 %)	5.1 (99 %)
PM93A1	3.7 (78 %)	4.8 (94 %)	5.2 (98 %)
PM90A1	4.8 (88 %)	5.1 (93 %)	5.3 (96 %)

( ) = % of optimum for the year concerned as computed using

Table 10 : Expected yields for 1999-2001

Manuring blocks	Expected yields (t/ha)			
	1999	2000	2001	Mean
PM94A1	16	20	25	20
PM93A1	23	29	32	28
PM90A1	22	28	29	26

The total fertiliser required for the three years is tabulated in Table 11.

Table 11 : Total fertiliser requirement for three years (1999 to 2000)

Manuring	Total (kg/palm)					
	AC	MOP	RP	GML	HGFB	KS
PM94A1	21.50	15.75	2.00	3.00	0.20	1.50
PM93A1	19.50	14.75	3.00	3.00	0.20	1.50
PM90A1	19.00	14.25	2.00	10.00	0.20	-

Timing of Fertiliser Application

The timing of fertiliser application in Table 8 was adjusted using AAR's Best Month for Fertiliser Application Model. This schedule adjusts the fertiliser rate applied according to the climatic condition and terrain to reduce nutrient losses. If necessary due to inadequate speed of improvement, this schedule will be modified.

Fertiliser application for the first quarter of 1999 should have been completed as per the old manuring schedule. Subsequent applications should follow the new schedule in Table 8.

EFB Mulching

Application of EFB in the areas indicated on Map 5 are recommended.

The rates and priority order of application are given in Table 12.

EFB mulches should be spread out in the inter-rows in PM90A1 and in between palms on terraces for PM94A1 and PM93A1.

Magnesium correction

As noted during the visits, palms showing severe symptoms of Mg deficiency were corrected with 2 kg of kieserite per palm. Further correction will be required if the palms still show symptom of deficiency. This will be followed up by the agronomist visiting the estate.

Map 5 : EFB Application Area

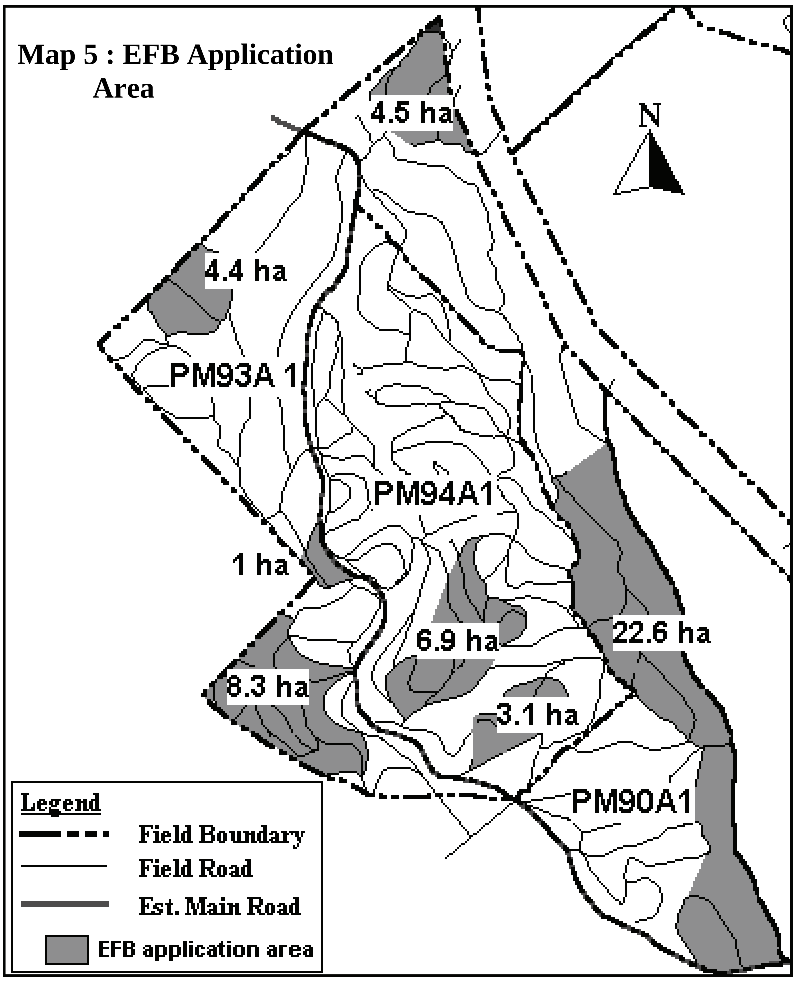


Table 12 : EFB application schedule 1999-2001

Manuring Blocks	EFB Rate (t/ha/yr)	Preferred Months	Priority
PM94A1	60	July - August	2
PM93A1	40	Sept. - Oct.	3
PM90A1	40	May - June	1

Table 13 : YIP Monthly Report for the month of ....year ....

Field		PM90A1	PM93A1	PM94A1
Manuring	Date Applied			
	Type of Fertilzer			
	Rate (kg/p)			
	No. of supervisors			
	No. of workers			
	No. of bags			
	AAR assistance (Y/N)			
	Weather Condition			
Harvestin g	Date			
	No. of rounds			
	Total yield (kg)			
Prunning	Date			
	Ha completed			
Field Upkeep - Weeding	Date			
	Chemical Used			
	Rate (kg/p)/Ha completed			
	Weather Condition			
Pest and Disease Control	Date			
	Chemical Used			
	Rate (kg/p)/Ha completed			
	Weather Condition			
Remarks				

Date : ....….....
Manager

4.2. Field upkeep

Strongly competitive weeds especially *Asystasia sp*. in PM94A1 and PM93A1 need to be eradicated as soon as possible to minimize competition for nutrients. Circle and inter-row spraying with 0.17ml/ liter metsulfuron-metyl or 0.3ml/liter 2,4-D Amine when there is no significant spray drift, was recommended for areas with *Asystasia sp.* in PM94A1 and PM93A1 at a maximum spraying interval of 50 days until the weed has been eradicated.

4.3. Soil and moisture conservation practices

Current soil and moisture conservation practices should be maintained e.g. correct placement of fronds should be continued to minimize surface runoff and erosion on the hilly terrain. Light grasses and Nephrolepis should be maintained as ground covers and complemented by EFB mulching as recommended earlier.

5. Monitoring programme

To achieve the objectives and targets set for the YIP, fertiliser applications need to be on time and well supervised. AAR will monitor the progress of these areas and will assist in supervising manuring if necessary.

5.1. Feedback

A monthly progress report (Table 13) is requested from the estate to enable AAR to monitor and review the inputs and practices carried out. Co-operation is requested from the Estate Manager to complete it and return to AAR by the 6th of every month.

5.2. Palm status assessment

The next leaf and soil sampling will be carried out in August 1999 to assess the improvement of the fields. A sampling unit for each group of palm sizes as per Map 4 will be allocated to monitor the palm improvements. Details of the subsequent samplings are given in Table 14.

6. Economics

Table 14 : YIP Monitoring Programme

Month / Year	Programme	No. of leaf samples	No. of soil samples
August 1999	Leaf Sampling	11	-
September 1999	Agronomist Visit and Recommendations for yr. 2000	-	-
February 2000	Leaf and Soil Sampling	11	3
August 2000	Leaf Sampling	11	-
September 2000	Agronomist Visit and Recommendations for yr. 2001	-	-
February 2001	Leaf and Soil Sampling	11	3
August 2001	Leaf Sampling	11	-
September 2001	Agronomist Visit and Recommendations for yr. 2002 and overall assessment of YIP	-	-

6. Economics

Table 16 shows the break even price of FFB for the recommended fertiliser applications (Table 15) and the benefit to cost ratio at different FFB prices.

The break even price of FFB for the additional fertilizer inputs is less than RM150 per ton. At RM175 per ton FFB, the average additional benefit to cost ratio would improve to a range of 2.2 to 2.8. Details of the computations are given in Appendix 1.

7. Conclusion

The YIP project on the 3 low yielding blocks of the estate identified poor palm growth probably arising from poor palm nutrition as the main yield-limiting factor. Immediate correction of N and K nutrition is the principal requirement. Further measures to carry out EFB mulching, maintain good soil and moisture conservation, and improve fertiliser uptake in the high rainfall and steep terrain will be important.

Yields are expected to increase to 25t/ha/yr from 14t/ha/yr for PM94A1, 32t/ha/yr from 18t/ha/yr for PM93A1 and 29t/ha/yr from 19t/ha/yr for PM90A1 within 3 years from the improvements carried out. With these improvements, the costs of additional fertilizers should be economical.

Table 15 : Average fertiliser requirement (over 3 years)

Manuring Block	Total (kg/palm/yr)					
	AC	MOP	RP	GML	HGFB	KS
PM94A1	7.17	5.25	0.67	1.00	0.07	0.50
PM93A1	6.50	4.92	1.00	1.00	0.07	0.50
PM90A1	6.33	4.75	0.67	3.33	0.07	-

Table 16 : Benefit - Cost Ratio and Break Even Price

Manuring Block	Average expected FFB yield t/ha/yr (over 3 years)	Benefit / Cost Ratio at expected FFB yield for different FFB prices (RM/t)					Break Even FFB Price (RM/t)
		FFB price	125	175	275	375	
PM94A1	20		2.0	2.8	4.4	6.0	143
PM93A1	28		2.0	2.8	4.5	6.1	117
PM90A1	26		1.6	2.2	3.5	4.8	124

Appendix 1 : Summary of Results of Benefit- Cost Computation

Manuring Block	PM94A1				PM93A1				PM90A1			
Total hectarage for area studied	68.5				52.5				68.3			
Palm/ha	131				150				131			
Yield (t/ha)	Y0 13.8		Y1 20.0		Y0 17.7		Y1 28.0		Y0 19.4		Y1 26.0	
Cost	At	Y0	At	Y1	At	Y0	At	Y1	At	Y0	At	Y1
	RM/t	RM/ha	RM/t	RM/ha	RM/t	RM/ha	RM/t	RM/ha	RM/t	RM/ha	RM/t	RM/ha
Fixed Cost												
a) Indirect cost	60	831	42	831	47	831	30	831	43	831	32	831
b) Mature area upkeep cost	78	1077	54	1077	61	1077	38	1077	56	1077	41	1077
Additional cost of fertilizer input			7	134			8	211			10	247
Variable Cost												
c) Harvesting and collection	41	567	41	822	41	727	41	1150	41	797	41	1068
Ex-estate cost	179	2475	143	2864	149	2635	117	3269	139	2705	124	3223

Y0 = base yield Y1= average improved yield (mean over 3 years)

Appendix 1 (cont'd) : Summary of Results of Benefit- Cost Computation

Table for PM94A1 : Benefit Cost-Ratio and Break Even Yield at Various FFB Prices

Selling Price of the FFB (RM/t)	125	175	275	375
Additional Benefit (RM/ha)	775	1085	1705	2325
Additional Cost (RM/ha)	389	389	389	389
Benefit/Cost ratio for the additional input	2.0	2.8	4.4	6.0
Break even increase in yield for the additional input (t ffb/ha)	1.6	1.0	0.6	0.4
Break even yield at new cost (t ffb/ha) :	24.3	15.2	8.7	6.1
Break even FFB Price (RM/t) (average over 3 years) :		**143**		

Table for PM93A1 : Benefit Cost-Ratio and Break Even Yield at Various FFB Prices

Selling Price of the FFB (RM/t)	125	175	275	375
Additional Benefit (RM/ha)	1288	1803	2833	3863
Additional Cost (RM/ha)	634	634	634	634
Benefit/Cost ratio for the additional input	2.0	2.8	4.5	6.1
Break even increase in yield for the additional input (t ffb/ha)	2.5	1.6	0.9	0.6
Break even yield at new cost (t ffb/ha) :	25.3	14.2	9.2	6.3
Break even FFB Price (RM/t) (average over 3 years) :		**117**		

Table for PM90A1 : Benefit Cost-Ratio and Break Even Yield at Various FFB Prices

Selling Price of the FFB (RM/t)	125	175	275	375
Additional Benefit (RM/ha)	825	1155	1815	2475
Additional Cost (RM/ha)	518	518	518	518
Benefit/Cost ratio for the additional input	1.6	2.2	3.5	4.8
Break even increase in yield for the additional input (t ffb/ha)	2.9	1.8	1.1	0.7
Break even yield at new cost (t ffb/ha) :	25.7	16.1	9.2	6.5
Break even FFB Price (RM/t) (average over 3 years) :		**124**		

Summary

AAR has embarked on a Yield Improvement Project (YIP) to identify poor performing oil palm areas with agronomic constraints to improve yields and profitabilities. An estate was selected to test and develop the methodologies and reporting system.

The objectives of the YIP were :- (1) to identify and quantify the yield and growth limiting factors in each block, (2) to draw up site-specific corrective measures to achieve the site yield potential (SYP) within the shortest time possible and (3) to assess economics of the practices and inputs implemented.

The YIP commenced with a desktop study using available information at AAR to compute preliminary SYP and identify yield gaps. Visits to the estate to verify the initial data , collect additional information for re-computation of SYP and to discuss and verify the identified growth and yield limiting factors were made. Leaf, rachis and soil samples were also collected for nutrient analysis.

Monitoring of the progress and results of the YIP for the next three years will be implemented with the co-operation from the Estate Manager.

This paper reports the results of a study carried out in three blocks of an estate i.e. PM94A1 (68.3ha), PM93A1 (52.5ha) and PM90A1(68.5ha) which yielded 13.8t/ha, 17.7t/ha and 19.4t/ha respectively in 1998. Their respective computed SYP were 22t/ha, 26t/ha and 35t/ha. The average yield gap was 37%.

Measured frond dry weight in 1998 showed that PM94A1 was 45% below the optimum dry weight as computed with AAR's INFERS model. The respective figures for PM93A1 and PM90A1 were 29% and 19%. The low yields were most likely related to the poor canopy sizes.

The GPS survey carried out showed that the hectarages were under-declared by 8.6% for PM93A1 and 3.5% for the other two blocks. The detailed soil survey carried out showed that the soil comprised 70.2% Bungor, 18.2% Local Alluvium, 9.8% Batu Lapan, 1.1% Seremban and 0.7% Padang Besar. 59% of the shallow soils (Batu Lapan and Seremban series) were located in PM94A1 and 69% of the Local Alluvium in PM90A1.

All the blocks were planted with DxP AAR and

planting pattern was a mixture of straight line and terraced plantings. Vegetative measurement showed that 82% and 18% of the area had frond weight of 28% and 40 -50% below optimum respectively. Overall leaf-N concentration was adequate but total canopy N was low. Leaf-K concentrations were low and confirmed by low rachis-K results.

N-mineralization was expected to be limited due to low Organic C and N contents in the soil. P status had built up in the palm circles. Soil K content was low to very low generally and Mg content in PM90A1 was extremely low.

Thick ground vegetation comprising mainly a mixture of *Asystasia sp.* and light grasses was noted for PM94A1 and PM93A1. In PM90A1, sparse ground vegetation was noted in the low-lying sandy areas.

The results confirmed that the poor growth and yields were primarily due to poor nutritional status of the palms. Hence, our recommendations were to improve the canopy size and vigour to optimum levels by immediately correcting N and K status of the palms and to achieve improved yields in the next three years before reaching the SYP.

On average, a total of 14.9kg/palm of muriate of potash (MOP), 20.0kg/palm of ammonium chloride (AC), 1.0 kg/palm of kieserite (KS) and 5.3kg/palm of ground magnesium limestone (GML) were recommended for application in 3 years.

Canopy sizes were projected to improve to 97% of the optimum levels and yield improved to 25t/ha/yr by 2002.

Empty fruit bunch (EFB) mulch was recommended as an additional input for the 18% of the areas where palms were 40-50% below optimum size and in the sandy areas in PM90A1. Priority was given to the sandy areas in PM90A1 at application rate of 40t/ha/yr. Palms that were poor to very poor at hill caps in PM94A1 and PM93A1 were to be mulched next at a rate of 60t/ha/yr and 40t/ha/yr respectively.

Palms showing severe symptoms of Mg deficiency in PM94A1 were corrected with 2kg kieserite per palm. Further corrections would be made if the palms continued to show symptoms of deficiencies.

Circle and inter-row spraying with 0.17ml/liter metsulfuron-metyl or 0.3ml/liter 2,4-D Amine when there is no significant spray drift, was recommended for areas with *Asystasia sp.* in PM94A1 and PM93A1 at a maximum spraying interval of 50 days until the weed has been eradicated.

Current soil and moisture conservation practices would be maintained with correct placement of fronds and maintenance of light grasses and Nephrolepis as ground covers.

The break even price of FFB for the additional fertilizer inputs is less than RM150 per ton. At RM175 per ton FFB, the average additional benefit to cost ratio would improve to a range of 2.2 to 2.8. Yields are expected to increase to 25t/ha from 14t/ha for PM94A1, 32t/ha from 18t/ha for PM93A1 and 29t/ha from 19t/ha for PM90A1 by 2002.

The estate was required to provide a monthly progress report by the 6th of every month for AAR to monitor and review the inputs and practices carried out.

To achieve the targets of YIP, the fertilizer applications need to be on time and well supervised. AAR will monitor the progress of these areas and will assist in supervising manuring if necessary.

SOCIAL AND PERSONAL

CONGRATULATIONS:

Marriage: En. Fabli Bin Salleh and Cik Hanifah Bt. Kolian on 16/4/99.

Births:

- Mdm. Desiyarani on the birth of her daughter Keerthana d/o Krishnan on 26/2/99.
- Pn. Noraimi Bt. Minka and En. Isnine Bin Norhasan on the birth of their son Mohd Aidil bin Isnine on 10/3/99.
- Mr. Heng Yong Choon on the birth of his son Heng Zhe Yen on 22/3/99.

Chen, K.C.

A sign post in a park goes : "Grass grows by inches, dies by feet"

Thanks to automatic teller machines, we no longer have to tell the children money dosen't grow on trees. They now think it comes out of a wall.

"I'm sorry you don't like my gift," the aunt said to her nephew, "but I asked if you preferred a large check or a small check."
"I know, " he replied, " but I didn't think you meant neckties!"