

Rainfall Impact on Oil Palm Production and OER at FELDA Triang 2

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ABSTRACT

FELDA is an organization that is responsible in the development of new agricultural land. Its achievement is mostly based on agricultural business in oil palm. A study on the relation of rainfall distribution and oil palm yield and Oil Extraction Rate (OER) was carried out in FELDA Triang 2. Based on 10 years' data recorded in this area, rainfall at sex determination or 18 months before harvesting was found to affect the yield significantly. OER, however, was not affected by the rainfall distribution in this area, probably due to the absence of distinct dry spell.

INTRODUCTION

Malaysia is currently the world's largest producer and exporter of palm oil. During the last 50 years, plantation development was accelerated through large-scale investments in the cultivation of oil palm. Areas cultivated with oil palm increased from 54,000 hectares in 1960 to 4.05 million hectares in 2006, reflecting a compound annual growth of 10.06%. Oil palm production also increased from 94,000 tonnes in 1960 to 15 million tonnes in 2006, or by almost 160 times within 45 years, representing a compound annual growth of 11.93% per year. These figures speak eloquently not only for the industry's success, but also for the tremendous contribution that Malaysian palm oil has made to the world food sources.

Oil palm growth and yield depend very large extent on the physical and climatic characteristic of the environment in which the palm is established. Oil palm fruit production is generally determined by five main factors, frond production, sex ratio, the extent of floral abortion, the degree of survival of floral after anthesis and bunch weight. Oil palm yield potential is reduced when trees are exposed to stressful conditions. Low moisture is the most common stressful condition that oil palm faces. Therefore, monitoring rainfall is useful in predicting palm oil yield levels. The ideal requirements for oil palm according to Hartley (1988) and Goh *et al.* (1994) are:

- a) Annual rainfall of 2000mm or greater, evenly distributed without a marked dry season, and preferably at least 100mm each month.
- b) A mean maximum temperature of about 29-30°C and a mean minimum temperature of about 22-24°C.
- c) Sunshine of 5-7h/day in all months and solar radiation of 15 MJ/m² per day.

The oil palm thrives under Malaysia's tropical climate which is marked by all-year-round temperatures ranging from 25 to 30°C and evenly distributed rainfall of 2000 mm per year. Tropical countries that experience several months of drought experience drastically reduced yield.

The time span between initiation of leaves and inflorescences at the apical meristem is both long and varies between locations because of environmental influences. Table 1 shows the stages which determine the final inflorescence and bunch characteristics.

Table 1: Developmental stages of fruit components in mature palms

Ordinal leaf no., L	Approximate months before harvest	Developmental stage
L 46	38	Floral initial formed
L 17	24	Spikelet no. determined
L 12	22	No of flower per spikelet
L 11	18	Sex determination
L + 6	12	Rapid expansion of female inflorescences
L +7	12	Rapid expansion of male inflorescences
L + 8	11	Abortion
L + 15	8	Frame weight (stalk plus spikelets)
L + 17	6	Anthesis and fruit set
L + 18	5	Single fruit weight
L + 31	0	Harvest

Source: Breure and Menendez (1990)

The seasonal wind flow patterns coupled with the local topographic features determine the rainfall distribution patterns over Malaysia. During the northeast monsoon season, the exposed areas like the East Coast of Peninsular Malaysia, Western Sarawak and the Northeast Coast of Sabah experience heavy rain spells. On the other hand, inland areas or areas which are sheltered by mountain ranges are relatively free from its influence.

Intermittent water stress was reported to reduce fresh fruit bunches (FFB) yield by 88.46% as compared with the non-stressed or irrigated condition (Gawankar *et al.*, 2003). Leaf production was reduced by 30% in the early growth phase and by 12.5% in the later growth phase due to water stress. Stem growth was reduced by 49.1% due to water stress. Production of male inflorescences was least affected, but female inflorescences were reduced by 86% under intermittent water stress. This resulted in more than 91% reduction in the number of FFBs and ultimately caused 88.46% reduction in FFBs yield.

Goh *et al.* (1994) compared data on rainfall and FFB yield from a number of countries (Table 2). The relationship between them was only moderately good, as is to be expected, but overall FFB yield were relatively poor with rainfalls of less than 2000mm/year or several dry months.

Oil Extraction Rate (OER), on the other hand, is used to evaluate the performance of the oil palm processing centres. Rainfall was reported to affect OER (Table 3). Agronomical and harvesting practices, introduction of new clones and the discipline in the mill operation also affect the OER. OER achieved in Malaysia on an average is below 20%.

Table 2: Typical FFB yield in various countries and the local rainfall

Country	Site	Rainfall (mm/year)	FFB yield (tonne/ha per year)
Malaysia	Teluk Intan, Perak	2420	37.9
	Paloh, Johore	2010	35.0
	Tampin, Malacca	1580	30.9
	Bintulu, Sarawak	3400	28.9
Indonesia	West Sumatra	-	30.0
	North Sumatra	2890	35.1
Papua New Guinea	Kimbe	3870	30.8
	Popondetta	2640	31.5
	Bialla	5400	21.4
Costa Rica	Quepos (SE)	3920	29.5
	Quepos (NW)	2800	23.0
	Coto	4040	26.0
Honduras	San Alejo	2740	29.6
Benin	Pobe	1100	13.2
	Akpadanou	1010	9.7
Columbia	Unipalma	2500	26.7

Source: Goh *et al* (1994)

Table 3: Effect of rainfall on seasonal OER pattern

Effect	OER Pattern
Primary effect	Low rainfall for two or more months in succession will depress OER about 11 (range 9-11) months later. Conversely, high rainfall will enhance OER about 11 months later.
Secondary effect	Very low rainfall can depress OER about two months later. Conversely, very high rainfall can boost OER about two months later.
Direct effect	Exceptionally high rainfall will depress OER in the same month because of excessive moisture in the fruit bunches and in recovering loose fruits.

Source: Ho (1993)

The current study was a case study that aimed to evaluate the effects of rainfall on the oil palm production and OER in FELDA Triang 2, Bera, Pahang, Malaysia. FELDA is formed under the Land Development Act 1956 on 1st July 1956. This project is based on the fund provided by the government to form agricultural area and new settlement area for the rural citizens and to increase the status of rural citizens. The settlers are placed in the new village called scheme or *Rancangan* with some basic requirements for pursuing their life. The outcome of this study is important to the management personnel to forecast the yield, expenses and profit for future implementation. It is also important for the management team to revamp the water management system to achieve optimum oil palm yield.

METHODOLOGY

The rainfall and oil palm mill data (OER) from 1998 to 2007 obtained from FELDA Triang 2 were used in this study. This estate is assigned as Division 84A, 84B and 85C. Table 4 shows the basic information of Division 84A, 84B and 85C, FELDA Triang 2. The data on the monthly rainfall from the year 1998 to 2007 and yield at 6, 12 and 18 months later in this estate were subjected to correlation analysis. The data on monthly rainfall and OER at 3 and 6 months later for the same period as mentioned were also subjected to correlation analysis.

Table 4 : Information of FELDA Triang 2

Div.	Year Planted	Total Area (Ha)		Stand palm/ha	Soil Series	Road	Topography (%)**				Year Harvest
		Planted	Harvest				S	F	M	H	
PM84B	01 / 81	345.8	345.77	123	DURIAN HARIMAU MELAKA	43810	-	60	30	10	01 / 84
PM84A	02 / 82	626.8	626.75	126	DURIAN HARIMAU MELAKA	66810	-	70	25	5	09 / 84
PM85C	09 / 82	408	408	129	BUNGOR MELAKA	55870	-	75	20	5	07 / 85

** S - swamp F - Flat & Undulating (<10°) M - hilly (5-20°) H - Very Hilly (>21°)

Source: FELDA Plantation Sdn. Bhd.

RESULTS AND DISCUSSION

The rainfall pattern in FELDA Triang 2 area changed every year (Figure 1, Table 5). However maximum rainfall was observed from September to January. The average rainfall was 1944 mm per year based on the past 10 years data of 1998 to 2007, fulfilling the requirement for planting oil palm according to Hartley (1988) and Goh *et al.* (1994). Year 2007 recorded the lowest total rainfall of only 1619 mm. The highest record was in 1999 with 2472 mm.

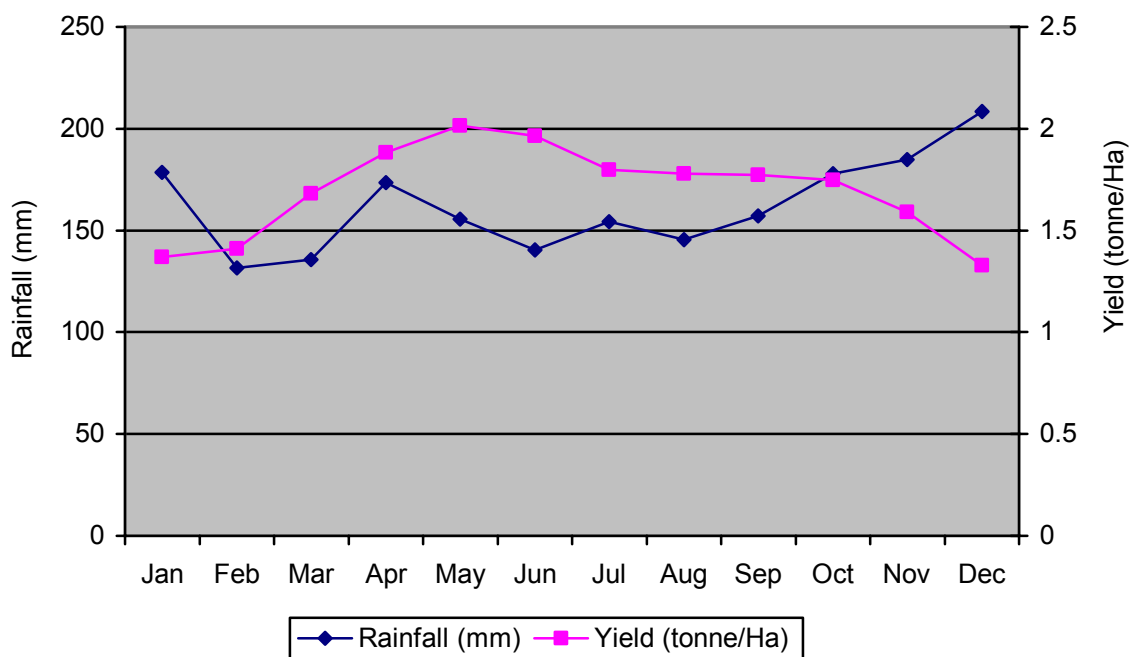


Figure 1: Average rainfall and yield for 1998-2007 in FELDA Triang 2

The yield of oil palm in FELDA Triang 2 was generally low with an average monthly production of only 1.69 tonnes per ha (Figure 1, Table 5). The yield was generally relatively lower in the period of November to February the following year.

Correlation analysis in this study indicated that rainfall at 18 months before harvesting was significantly correlated to oil palm production (Table 6). Higher rainfall was related to development of female inflorescence and hence, would bring to higher yield (Figure 2). Moisture stress at this critical time was presumed to result in fewer female flowers, which will reduce fruit development. Rainfall at 12 months before harvesting that determine floral abortion and rainfall at 6 months before harvesting, i.e. anthesis, however, was not significantly correlated to oil palm yield.

Table 5: Rainfall, yield and OER pattern for 1998-2007 in FELDA Triang 2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)												
Mean	178.6	131.5	135.7	173.5	155.5	140.5	154.3	145.4	157.3	178.0	184.8	208.6
Standard Error	19.3	13.3	16.2	14.9	16.6	10.1	17.8	18.6	17.5	19.2	25.6	26.8
Standard Deviation	61.0	42.1	51.2	47.2	52.6	32.0	56.2	58.7	55.2	60.7	81.1	84.7
Minimum	85	71.2	69.2	97	54	98	50	61	88	111.15	55.08	65.2
Maximum	273	188.6	243.5	242.2	227.2	209.8	221.6	243	254.4	267.82	281.2	311.9
Yield (tonnes/Ha)												
Mean	1.39	1.42	1.70	1.90	2.03	1.96	1.77	1.75	1.75	1.74	1.58	1.33
Standard Error	0.12	0.11	0.14	0.14	0.16	0.12	0.11	0.16	0.17	0.15	0.07	0.15
Standard Deviation	0.39	0.35	0.45	0.44	0.52	0.36	0.34	0.49	0.55	0.46	0.22	0.46
Minimum	0.75	0.73	0.93	1.21	1.38	1.5	1.25	1.11	0.96	0.9	1.23	0.56
Maximum	1.92	1.88	2.7	2.77	2.76	2.53	2.39	2.76	2.6	2.35	1.85	2.05
OER (%)												
Mean	18.34	18.63	18.56	18.53	18.48	18.50	18.21	18.31	18.42	18.63	18.80	18.63
Standard Error	0.20	0.19	0.11	0.23	0.24	0.23	0.21	0.23	0.23	0.38	0.15	0.12
Standard Deviation	0.62	0.61	0.35	0.72	0.74	0.74	0.68	0.73	0.74	1.19	0.46	0.36
Minimum	17.45	17.71	17.92	17.68	17.7	17.72	17.14	17.01	17.51	16.52	18.02	18.1
Maximum	19.34	19.69	19.12	19.72	19.65	20.01	19.22	19.34	19.56	20.1	19.61	19.2

Table 6: Correlation analysis of yield and rainfall in FELDA Triang 2

	Rainfall at x months before harvesting		
	18	12	6
Yield (tonnes/Ha)	0.257 (0.005)	0.094 0.308	0.010 0.913

(the number in parenthesis is the P value at 5% level of significance)

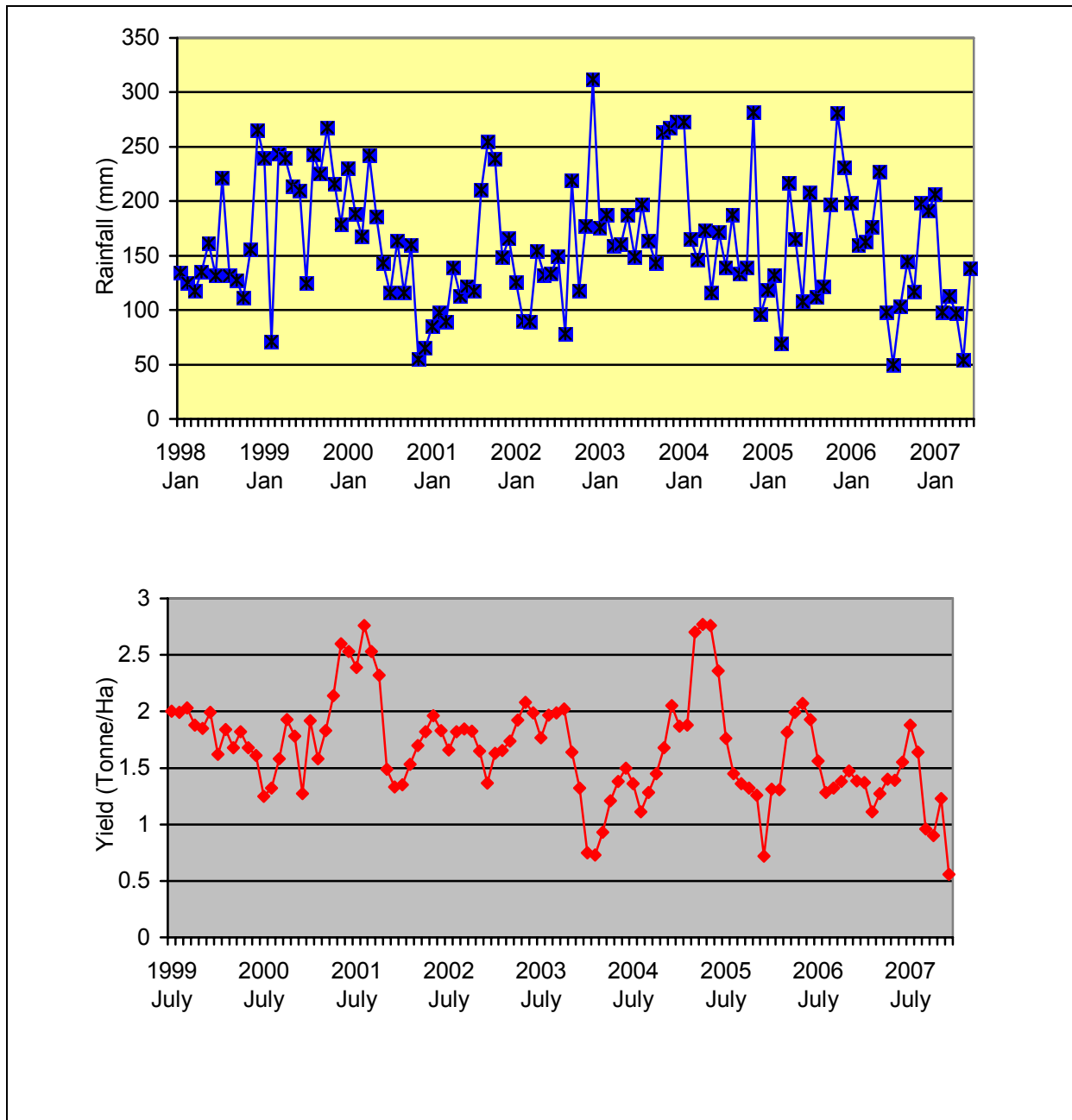


Figure 2: Matching rainfall and yield of oil palm at 18 months later in FELDA Triang 2

Based on the results, the impact of rainfall on oil palm yield could be summarized as:

1. rainfall between 200-300 mm/month gave production of 2.0-3.0 tonnes/Ha
2. rainfall between 100-199 mm/month allowed production of 1.5-2.0 tonnes/Ha
3. rainfall between 0-99 mm/month only gave production of 0.5-1.5 tonnes/Ha

OER of the oil palm in FELDA Triang 2 was not correlated to both rainfall at 3 or 6 months before harvesting (Table 7). These results were different from that indicated by Ho (1993) on the effects of rainfall on seasonal OER pattern, probably due to the absence of obvious dry spell in FELDA Triang 2. There was rainfall in almost every month even with low volume of only 50 mm. Ho (1993) reported that very low rainfall can depress OER about two months later. On the contrary, high rainfall can boost OER about two months later. The average OER of FELDA Triang 2 was 18.5 % (Table 5).

Table 7: Correlation analysis of OER and rainfall in FELDA Triang 2

	Rainfall at x months before harvesting	
	6	3
OER (%)	0.059 (0.260)	0.044 (0.317)

(the number in parenthesis is the P value at 5% level of significance)

CONCLUSION AND RECOMMENDATION

Rainfall at 18 months before harvesting or more commonly known as sex determination period showed significant correlation to oil palm yield. The shortage of rainfall will affect the production at 18 months later as it can reduce the development of female flowers. Rainfall, however, was not correlated to OER at 3 or 6 months later.

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