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Impact of Increases in Fertilizer Prices on Long-term Economic Viability of Palm Oil Production

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ABSTRACT

Surges in fertilizer prices in recent years have led to a sudden increase in the production cost of fresh fruit bunches (FFB) of oil palm as the share of fertilizer cost in the overall field cost has escalated from 30%-35% in 2007 to as high as 50% in 2008. This phenomenon created concerns among industry members because net revenue from FFB production was cost-squeezed to payback the initial capital outlay and to finance field operations. Increases in fertilizer prices can affect investment viability and the economic attractiveness of oil palm planting and replanting. This article attempts to give an overview of and evaluate the impact of rising fertilizer prices on the long-term viability of palm oil production in Malaysia. Evaluation of various scenarios of fertilizer price increases on investment payback period and on production cost (per hectare and per tonne of FFB), as well as the determination of threshold crude palm oil (CPO) prices for viable cultivation and replanting of oil palm were undertaken using system dynamics – a programmable master schedule known as e-FA (e-Fertilizer Application).

ABSTRAK

Peningkatan harga baja secara mendadak sepanjang tempoh 2007-2008 telah menyebabkan peratus kos pembajaan dalam keseluruhan kos pengeluaran buah tandan segar (BTS) meningkat dari 30%-35% pada tahun 2007 kepada 60% pada tahun 2008. Fenomena ini telah menyebabkan industri sawit negara mengalami kemerosotan pulangan akibat pengeluaran BTS terjejas untuk membayar balik pelaburan awal dalam pembangunan ladang atau penanaman semula dan juga untuk membiayai kos operasi di ladang. Artikel ini bertujuan untuk memberi perspektif ekonomi kesan peningkatan harga baja ke atas daya saing pengeluaran minyak sawit untuk tempoh jangka panjang. Beberapa senario peningkatan harga baja dan kesannya terhadap pulangan pelaburan, kos pengeluaran BTS serta tahap harga minyak sawit mentah (MSM) yang berdaya maju telah dianalisis dengan menggunakan analisis kos faedah.

Keywords: fertilizer, investment viability, cost competitiveness.

INTRODUCTION

The high volatility of global fertilizer prices in the past two years has been described as 'perfect storms' by many (*e.g.* Goh and Ng, 2009). Prices began their sudden surge at the end of 2006 and remained high throughout 2007 prior to reaching historic record highs in 2008 (*Figure 1*). According to the Scottish Agricultural College (SAC, 2008), this worldwide phenomenon was attributed partly to:

- rising biofuel demand, *e.g.* ethanol demand in the US resulting in farmers switching production land from soyabean into maize which has higher nutrient requirements;
- strong commodity prices with the higher-than-normal prices for agricultural commodities that prompted a world food crisis. Higher output prices spearheaded efforts to boost agricultural production that demanded more use of chemical fertilizers; and
- increasing demand from emerging economies.

Increasing demand had stretched the capability of the fertilizer manufacturing industry to meet global needs. While huge capital investment was needed to sustain the existing global mining capacity and to develop new capacities, fertilizer manufacture (including mixing) which is an energy-intensive industry was cost-squeezed by the soaring price of natural gas (Fertilizer Institute, 2009). Prices of crude oil which surged to new heights during the period jump-started the coupling effects on related industries.

World Bank statistics (www.worldbank.com) show that global fertilizer prices had sky-rocketed,

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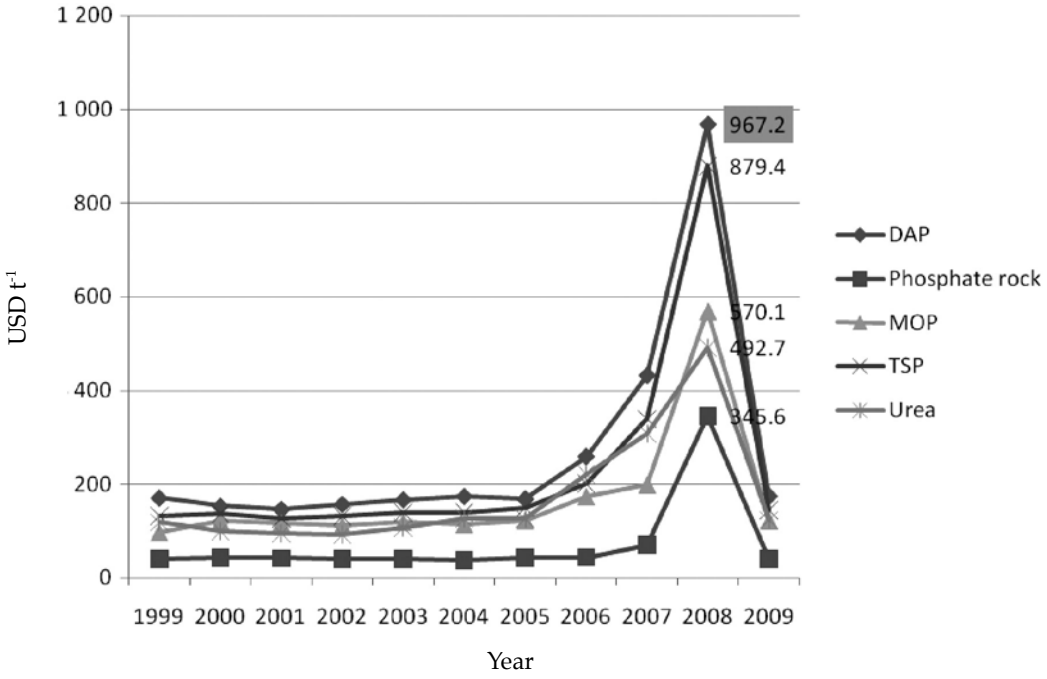


Note: 2009 (January – October).
Source: World Bank (www.worldbank.com).

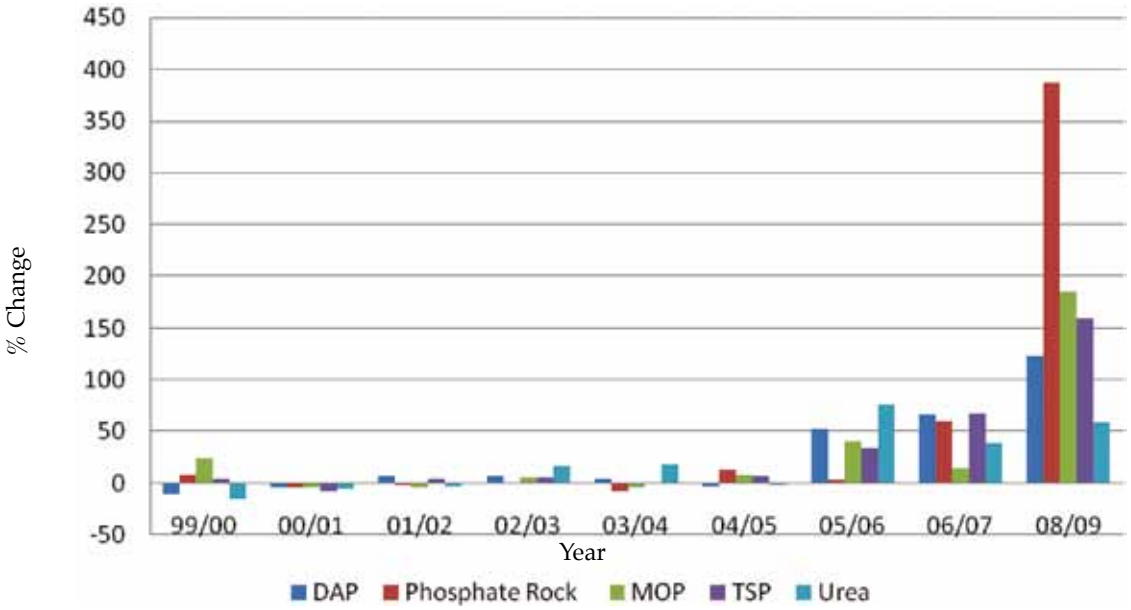
Figure 1. International prices of fertilizers (USD t^{-1}).

with the price of urea fetching USD 493 t^{-1} in 2008 compared to USD 309 t^{-1} in 2007 and USD 223 t^{-1} in 2006 (*Figure 1*). The price of diammonium phosphate (DAP) meanwhile increased by five times – to USD 967 t^{-1} in 2008 from USD 433 t^{-1} and USD 260 t^{-1} in 2007 and 2006, respectively. Standard grade muriate of potash (MOP) was traded at USD 570 t^{-1}, three times higher compared to USD 200 t^{-1} in 2007 and USD 175 t^{-1} in the previous year. Like any other internationally traded commodity, price volatility of fertilizer is a common phenomenon that indicates the dynamics of trading – due to supply and demand interactions – as in the period 2000-2005 in *Figure 2*. However, the recent volatility was exceptionally more pronounced and, if prolonged, it could jeopardize the world's agricultural industries because the demand for fertilizer in many countries is high. Price volatility for rock phosphate (RP) was the highest, soaring by almost 400% over the 2007/2008 year-on-year, followed by MOP (185%) and DAP (123%).

The volatile fertilizer price can have a staggering impact on an importing country like Malaysia whose agricultural sector depends heavily on imports to cater for its fertilizer needs. The country imported 4 million tonnes of fertilizers in 2007, valued at RM 3 billion, out of which more than 90% were consumed by the plantation industries, in particular, oil palm. Major imports comprised *inter alia* urea which was mainly sourced from Indonesia (263 000 t in 2007) and China (93 261 t) and super phosphates from Australia (51 350 t). NPK compounds were mainly sourced from South Korea (96 785 t), Belgium (70 000 t), China (65 128 t) and Russia (41 260 t) (Department of Statistics, 2008).

Figure 3 shows the local fertilizer price trend over 2006-2009 period. The price of Christmas Island rock phosphate (CIRP) surged by 225% in 2008 to RM 57 per 50-kg bag from RM 17.50 in the previous year whilst that of urea rose from RM 68 to RM 81 per 50-kg bag over the same period. The price of a 50-kg bag of MOP averaged at RM 94 and RM 68 in 2008 and 2007, respectively. In 2009, the world fertilizer prices declined sharply (*Figure 1*) however, the local retail prices remained stagnant (*Figure 3*). In view of our high dependency on these imported fertilizers, the high price level had cost-squeezed the industry as the share of fertilizer cost including application in the overall field production cost increased from 30%-35% in 2007 to as high as 50% in 2008 (*Figure 4*).

Initially, the profit margin was strong due to the high crude palm oil (CPO) price of RM 3477 t^{-1} in the first quarter of 2008 that offset the fertilizer price increase. However, the price bullishness declined by 54% to RM 1611.50 t^{-1} in the fourth quarter of the year prompting cost pressures as bearish FFB price did not generate enough of a margin. The industry



Source: World Bank (www.worldbank.com).

Figure 2. Yearly percentage change in world fertilizer prices.

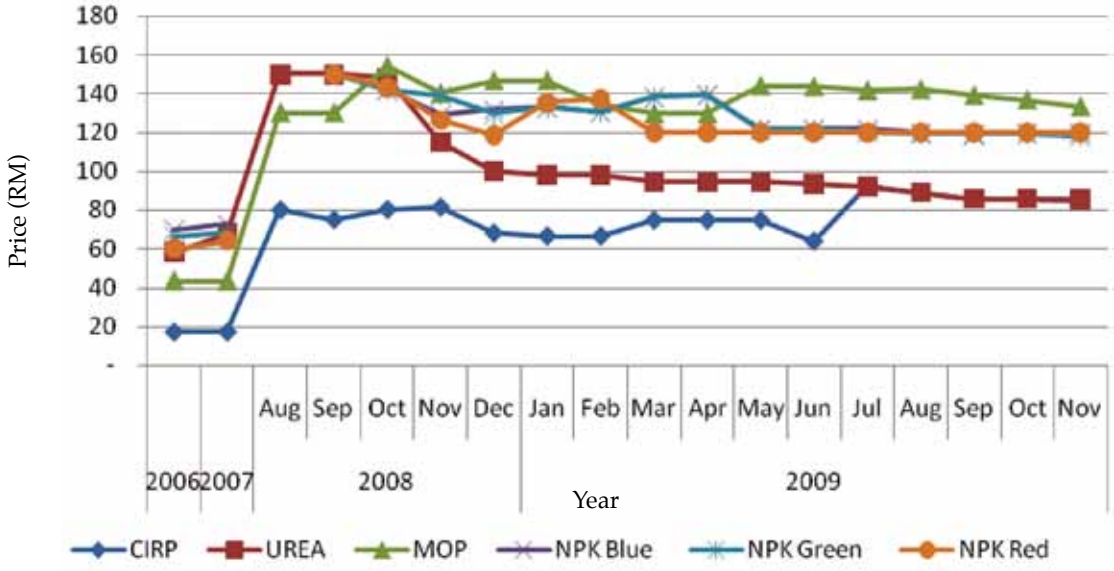


Figure 3. Price of selected local fertilizers.

had to spend more to get a RM 1.00 return. In the Peninsular, the gross margin as indicated by the cost:price ratio soared from 0.42 in the first quarter to 0.9 in the final quarter of the year (*Table 1*). The cost:price ratio in Sabah, at 0.38 in the first quarter, worsened to 0.83 in the fourth quarter while the scenario was even more detrimental in Sarawak with the ratio plummeting from 0.50 to 1.08.

The world fertilizer market had apparently faced 'demand destruction' as the agricultural industries were neither able nor willing to purchase fertilizers. Fertilizer dealers and estates could not agree on purchase deals as it was difficult to predict even near-term prices. Goh and Ng (2009) were right in describing the price trend as a 'perfect storm' because the world fertilizer market began to moderate in 2009 after the high volatility. By year end, prices of fertilizer were down to new low levels. Urea was traded at USD 124 t^{-1}, potash at USD 123 t^{-1} and RP at USD 42 t^{-1}. The two-year episode was captured in the domestic market for fertilizers.

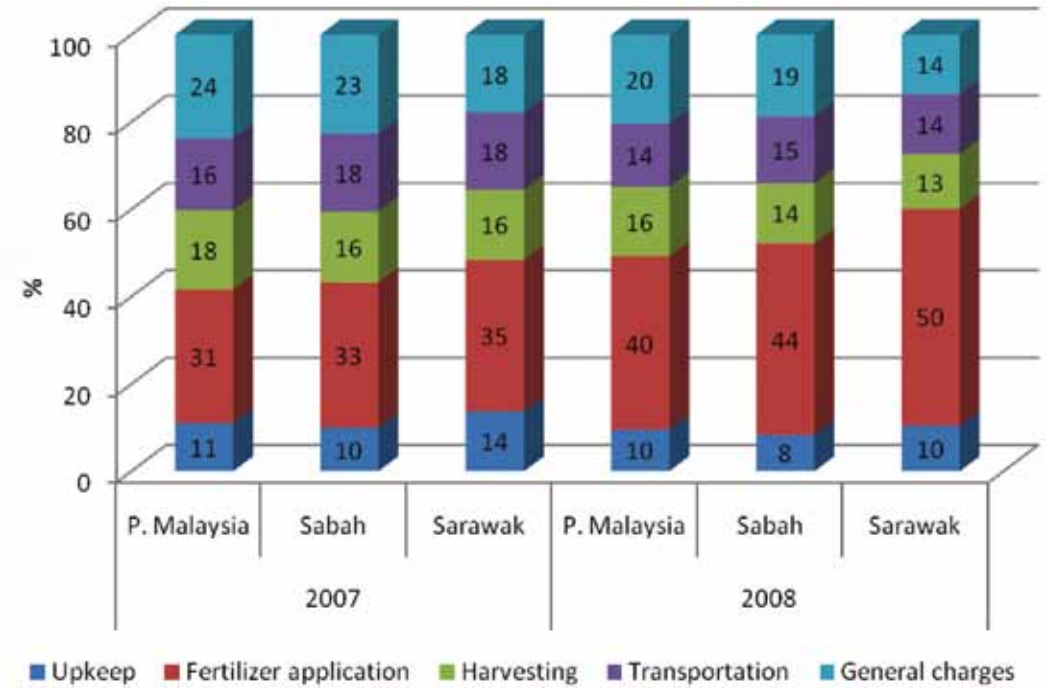


Figure 4. Share of fertilizer application cost in the overall production cost.

TABLE 1. ESTIMATED GROSS MARGIN – 2008 QUARTERLY (RM t^{-1} CPO)

CPO price	Peninsular Malaysia (RM)	Sabah (RM)	Sarawak (RM)
First quarter	3 477.00	3 388.00	3 388.00
Second quarter	3 510.00	3 543.17	3 543.17
Third quarter	2 825.83	2 834.50	2 834.50
Fourth quarter	1 611.50	1 566.00	1 566.00
Average CPO price	2 856.08	2 832.92	2 832.92
Cost RM t^{-1} CPO (2008)	1 451.66	1 292.61	1 688.90
Cost:price ratio			
First quarter	0.42	0.38	0.50
Second quarter	0.41	0.36	0.48
Third quarter	0.51	0.46	0.60
Fourth quarter	0.90	0.83	1.08
Average cost:price ratio	0.51	0.46	0.60

The price trend – surge, moderate and collapse – implies that various factors had converged and simultaneously caused fertilizer prices to behave in such a way. The 24-month episode was phenomenal as any development in the source countries could translate into higher production cost for FFB and reduced viability of new plantings (EMPA, 2009). As more replanting of oil palm will take place in the near future, the highly volatile fertilizer price regime can affect oil palm long-term cost competitiveness.

LITERATURE REVIEW/RATIONALE OF THE STUDY

Unlike the oilseed crops, the perennial oil palm has a 'gestation period' before it comes into the productive phase of its life cycle. The substantial investment incurred prior to maturity should be paid back by the stream of revenue generated during the productive years in order for the industry to remain viable. In the early 1980s, the cost to maturity was only RM 5000-6000 ha^{-1} (Mohd

Arif and Idris, 2000; Malek, 2002). Under such an investment scenario, a long-term CPO price of RM 1000 t^{-1} could generate a strong internal rate of return (IRR) of 23%-25%. However, in recent years, the cost structure has changed, resulting in an escalation of investment cost to RM 7761 ha^{-1} in 2005 and to RM 12 647 ha^{-1} in 2008 (MPOB, 2009). Oil palm on class 4 or 5 soils incurs a higher cost to maturity. For instance, Tayeb (2007) indicated that the investment cost of planting or replanting oil palm on peat soils could reach as high as RM 12 000 ha^{-1}, while Paimin (2009) recently reported that the cost had increased to RM 14 800 ha^{-1}. Under such situations, fertilizer price increases would surely impede the viability to remain in business.

Therefore, it would be a challenging task for the plantations to steer for growth in revenue during the productive cycle to cover operational costs and to recoup initial investment cost at times when the prices of fertilizers are on the uptrend, in particular when the CPO market is bearish. Thus, if fertilizer prices increase by a certain percentage, the question would arise: "At what CPO price will there be payback on the investment and will lead the plantation operation towards achieving an economically viable and worthwhile business?"

Simulations can be used to simplify the understanding of the impact of increases in fertilizer price on profit and long-term viability in oil palm cultivation. Mohd Nor *et al*. (2005) pointed out that once an investment to establish/replant an oil palm plantation has been made, there is little option for the entrepreneur to regulate production decisions. However, in this case, a programmable computer simulation system can be mobilized to optimize the fertilizer application regime in order to maximize profits.

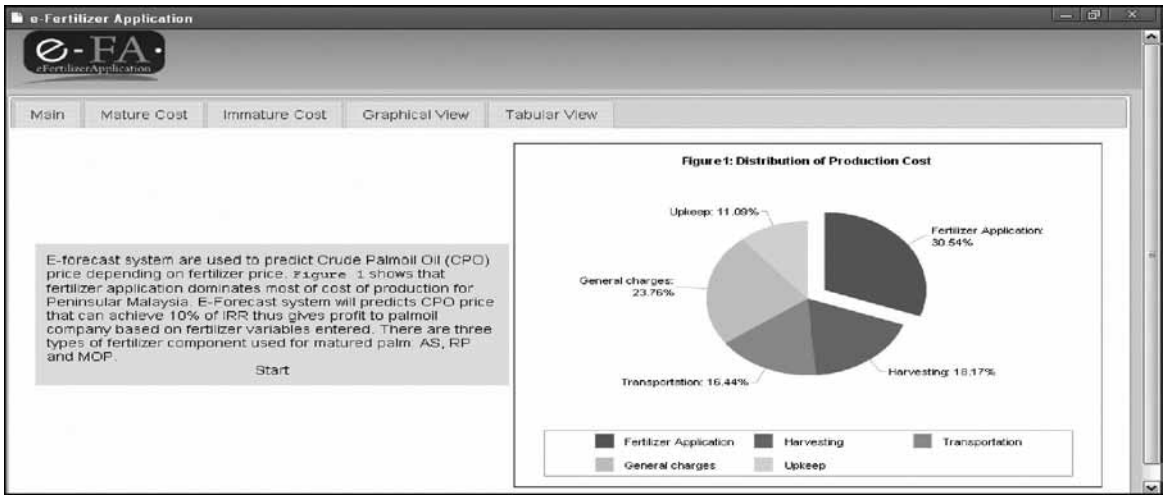
Under normal circumstances, the industry withdraws fertilizer application when its prices escalate to a certain threshold, or when CPO prices become uneconomical. Such a management philosophy can have near-term impact on FFB yield at a later date. A simulation system should be in place to help determine economically the reduced level of fertilizer rate that matches a positive margin during difficult times.

OBJECTIVES OF THE ARTICLE

The study is aimed at assessing the impacts of rising fertilizer prices on production cost and on the long-term economic viability of FFB production. It also attempts to determine the long-term CPO price level that can dictate investment viability at the various scenarios of fertilizer prices through the development of a computer programme; code-named e-FA (*e-Fertilizer Application*).

METHODOLOGY

A dynamics computer programme – *e-Fertilizer Application (e-FA)* – was developed as a programmable master schedule with built-in cost benefit analysis (CBA). As such *e-FA* can reveal key result areas (KRAs), such as payback period, production cost (per hectare and per tonne of FFB) together with the three conventional financial parameters, namely, the internal rate of return (IRR), net present value (NPV) and the benefit cost ratio (B:C), as well as the viable CPO price threshold at pre-determined prices of fertilizer mixes or NPK



compound. The *e-FA* utilizes viability criteria with rules of thumbs, *i.e*. when:

- IRR exceeds the opportunity cost of capital (which is presumed at 10%);
- net cash flows yield positive NPV, or;
- B:C is more than unity.

The *e-FA* was developed to simulate the viability scenarios for the three producing regions; *i.e.* Peninsular Malaysia, Sabah and Sarawak. The establishment of the cash in-flows and out-flows in *e-FA* involved several estimations and also assumptions. These are described as follows:

Cash in-flows (the revenue block)

Revenues generated throughout the productive cycle are constructed from the following estimation:

$Y = fn (yield_T, sales\ price)$

where, Y = revenue.
$yield_T$ = yield of FFB at corresponding years after planting.
sales price = selling price of FFB at corresponding CPO price.

FFB yields according to the three producing regions are as shown in *Figure 5*.

FFB prices are derived from CPO prices, taking into consideration a number of cost factors including transport cost, processing cost, oil extraction rate (OER), kernel extraction rate (KER) and kernel prices. Sales price would vary according to region due to the imposition of sales taxes in Sabah and Sarawak, at 7% and 5%, respectively. Therefore, lower FFB prices will be observed for the two states compared to Peninsular Malaysia (*Table 2*).

Cash Out-flows

The cash out-flows are represented by both the investment cost and the maintenance/operating cost of mature palms. To run a simulation on the impact of changing fertilizer prices on the above-mentioned KRAs, the following assumptions on investment cost and mature cost as well as price levels of fertilizers are made (*ceterus paribus*):

Investment cost – the immature phase. The immature costs that were built-in into *e-FA* are as shown in *Tables 3, 4* and *5*. Nevertheless, these cost frameworks can be adjusted accordingly based on the prevailing cost structures.

The mature phase. The *e-FA* uses mature cost as in *Table 6* to represent the cash out-flows for the mature oil palm. As in the previous case, this can also be adjusted according to situational needs.

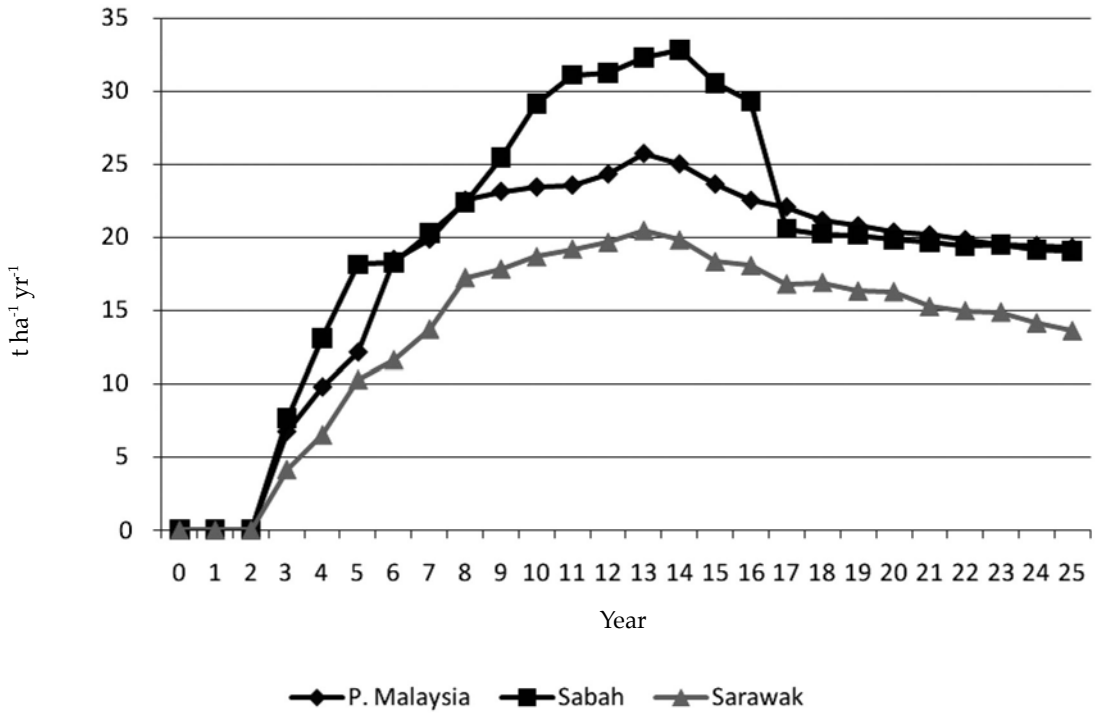


Figure 5. Fresh fruit bunches (FFB) yield profile by region.

TABLE 2. DERIVATION OF FRESH FRUIT BUNCHES (FFB) PRICES

CPO price (RM)	FFB price (RM t^{-1})		
	Peninsular Malaysia	Sabah	Sarawak
1 000	173.59	165.27	169.83
1 200	217.93	211.81	217.02
1 400	262.27	258.35	264.20
1 600	306.61	304.89	311.38
1 800	350.95	351.43	358.56
2 000	395.29	397.97	405.75

TABLE 3. OIL PALM IMMATURE COST, PENINSULAR MALAYSIA (RM ha^{-1})

	Peninsular Malaysia		
Cost item	Year 1	Year 2	Year 3
Non-recurrent costs	4 289.00	-	-
Felling and clearing	1 000.00	-	-
Terracing and platforming	450.00	-	-
Road construction	279.00	-	-
Drain construction	245.00	-	-
Lining	100.00	-	-
Holing and planting	345.00	-	-
Basal fertilizers	190.00	-	-
Planting material	1 480.00	-	-
Cover crops	200.00	-	-
Upkeep and cultivation	1 125.50	1 359.00	985.00
Weeding	250.00	405.00	330.00
Lallang control	139.00	110.00	79.00
Drains	125.00	85.00	56.00
Roads, bridges, paths, *etc.*	155.00	160.00	122.00
Soil/water conservation	60.00	92.00	31.00
Boundaries and survey	38.00	22.00	16.00
Cover crops	160.00	135.00	55.00
Survey and supply	28.00	65.00	32.00
Pruning	22.00	40.00	48.00
Pests and diseases	135.00	190.00	150.00
Castration	13.50	55.00	66.00
Fertilization	1 642.84	2 458.32	2 544.16
Fertilizers	1 588.04	2 403.52	2 489.36
Fertilizer application	51.80	51.80	51.80
Soil and foliar analyses	3.00	3.00	3.00
Total	7 057.34	3 817.32	3 529.16
Total immature cost	-	-	14 403.82

TABLE 4. OIL PALM IMMATURE COST, SABAH (RM ha^{-1})

Cost item	Sabah		
	Year 1	Year 2	Year 3
Non-recurrent costs	4 130.00	-	-
Felling and clearing	750.00	-	-
Terracing and platforming	500.00	-	-
Road construction	350.00	-	-
Drain construction	280.00	-	-
Lining	90.00	-	-
Holing and planting	200.00	-	-
Basal fertilizers	330.00	-	-
Planting material	1 480.00	-	-
Cover crops	150.00	-	-
Upkeep and cultivation	935.00	1 155.00	1 075.00
Weeding	250.00	300.00	290.00
Lallang control	90.00	100.00	80.00
Drains	70.00	140.00	130.00
Roads, bridges, paths, *etc.*	250.00	300.00	250.00
Soil/water conservation	40.00	50.00	70.00
Boundaries and survey	30.00	20.00	25.00
Cover crops	80.00	90.00	70.00
Survey and supply	30.00	40.00	60.00
Pruning	20.00	40.00	30.00
Pests and diseases	65.00	55.00	45.00
Castration	10.00	20.00	25.00
Fertilization	1 868.98	2 808.19	2 907.06
Fertilizers	1 828.98	2 768.19	2 867.06
Fertilizer application	37.00	37.00	37.00
Soil and foliar analyses	3.00	3.00	3.00
Total	6 933.98	3 963.19	3 982.06
Total immature cost	-	-	14 879.23

Quantity and cost of fertilizers. The *e-FA* takes into account the two types of fertilizers used, namely, the fertilizer mixes and compound fertilizers. For the former, the mixing ratios will depend on the agronomic recommendations (decided by the estates themselves or by the suppliers). The *e-FA* will automatically calculate the fertilizer cost based on the rates and prices of the fertilizer mixes or compounds; for example, a mix for the annual application of ammonium sulphate (AS), RP and MOP at pre-determined rates is auto-calculated at RM 8.08 per palm or RM 1195.84 ha^{-1}. In the case of an NPK compound, the cost is RM 14.50 palm^{-1} yr^{-1} or RM 2664 ha^{-1} yr^{-1}. The *e-FA* also takes into account that the planting density of oil palm in Sabah and Peninsular Malaysia is 148 plants ha^{-1} compared to 160 plants ha^{-1} in Sarawak.

For the purpose of this article, the price levels used are as given in *Table 9*. These levels are normal, and were subjected to a 50% price increase (Scenario 1) and a 100% price increase (Scenario 2). For the NPK fertilizers, Scenario 1 refers to a 30% price increase and Scenario 2, a 60% price increase.

TABLE 5. OIL PALM IMMATURE COST, SARAWAK (RM ha^{-1})

	Sarawak		
Cost item	**Year 1**	**Year 2**	**Year 3**
Non-recurrent costs	4 970.00	-	-
Felling and clearing	900.00	-	-
Terracing and platforming	700.00	-	-
Road construction	450.00	-	-
Drain construction	400.00	-	-
Lining	110.00	-	-
Holing and planting	300.00	-	-
Basal fertilizers	330.00	-	-
Planting material	1 600.00	-	-
Cover crops	180.00	-	-
Upkeep and cultivation	1 035.00	1 090.00	940.00
Weeding	280.00	300.00	250.00
Lallang control	95.00	60.00	40.00
Drains	80.00	200.00	150.00
Roads, bridges, paths, *etc.*	300.00	300.00	280.00
Soil/water conservation	60.00	40.00	20.00
Boundaries and survey	25.00	20.00	20.00
Cover crops	75.00	50.00	20.00
Survey and supply	10.00	25.00	40.00
Pruning	30.00	30.00	40.00
Pests and diseases	30.00	40.00	60.00
Castration	50.00	25.00	20.00
Fertilization	2 036.28	3 051.64	3 158.52
Fertilizers	1 977.28	2 992.64	3 099.52
Fertilizer application	56.00	56.00	56.00
Soil and foliar analyses	3.00	3.00	3.00
Total	8 041.28	4 141.64	4 098.52
Total immature cost	-	-	16 281.44

TABLE 6. MATURE COST (RM ha^{-1})

	Peninsular Malaysia	**Sabah**	**Sarawak**
Weeding	129.00	113.00	135.00
Lallang control	11.00	11.00	11.00
Cultivation/conservation	9.00	9.00	9.50
Upkeep of roads, bridges, paths, *etc.*	62.00	72.00	103.50
Upkeep of drains	14.00	13.00	15.50
Pests and diseases	16.00	14.50	13.00
Pruning and palm sanitation	52.00	31.00	36.00
Upkeep of bunds, boundaries and watergates	6.50	5.50	7.00
Mandore wages/direct field supervision	33.50	31.00	29.00
Survey of palms	5.00	5.00	6.00
Sundry expenses	12.00	14.50	15.00
Total upkeep	350.00	319.50	380.50
Fertilizer application	1 195.84	1 375.22	1 486.72
Harvesting	583.93	525.94	455.70
Transportation	528.48	581.00	496.72
General charges	750.00	720.00	500.00
Total cost of production	3 408.25	3 521.66	3 319.64

TABLE 7. EXAMPLES OF FERTILIZER APPLICATION COST (yearly)

Fertilizer type	Price (RM t^{-1})	Application rate (kg $palm^{-1}$ yr^{-1})	Cost per palm (RM $palm^{-1}$ yr^{-1})	Cost per ha (RM ha^{-1} yr^{-1})
AS	550	4.40	2.42	358.16
RP	500	3.00	1.50	222.00
MOP	1 600	2.60	4.16	615.68
Total	-	10.00	8.08	1 195.84
NPK	1 300	8.00	1.30	1 539.20

Note: AS – ammonium sulphate.
RP – rock phosphate.
MOP – muriate of potash.

TABLE 8. SCENARIO ASSUMPTIONS ON FERTILIZER PRICE INCREASE

Fertilizer type	Normal	Increase by	
		Scenario 1 (50%)	Scenario 2 (100%)
AS	550	825	1 100
RP	500	750	1 000
MOP	1 600	2 400	3 200
	Normal	**Increase by**	
		Scenario 1 (30%)	**Scenario 2 (60%)**
NPK	1 300	1 690	2 080

Note: AS – ammonium sulphate. MOP – muriate of potash.
RP – rock phosphate. NPK – compound fertilizer.

RESULT AND DISCUSSION

Fertilizer Price Increase and Cost of Production

Production cost. Field cost of mature oil palm was severely affected by increases in fertilizer prices. Under the normal scenario, the cost was estimated at RM 3048.25 ha^{-1} yr^{-1} in the case of Peninsular Malaysia, and RM 3521.66 ha^{-1} yr^{-1} and RM 3319.64 ha^{-1} yr^{-1} for Sabah and Sarawak, respectively (*Table 9*). However, if the fertilizer prices increased by 50% as in the case of Scenario 1, the field cost could increase to RM 4006.17 ha^{-1} for Peninsular Malaysia, and to RM 4209.27 ha^{-1} and RM 4063.00 ha^{-1}, respectively, for Sabah and Sarawak. Under Scenario 2, the field cost could escalate to RM 4604.09, RM 4896.87 and RM 4806.36 ha^{-1} yr^{-1}, respectively, for the three different regions.

From the FFB perspective, the production cost could increase from RM 173.01 t^{-1} to RM 203.36 t^{-1} for Scenario 1 and to RM 233.71 t^{-1} for Scenario 2 in the case of Peninsular Malaysia. In Sabah, FFB production cost could rise from RM 151.47 t^{-1} to RM 181.04 t^{-1} in Scenario 1 and to RM 210.62 t^{-1} in Scenario 2. The present high production cost in Sarawak (RM 205.17 t^{-1} FFB) would worsen further to RM 251.11 t^{-1} in case of Scenario 1 and to RM 297.06 t^{-1} in Scenario 2.

The impact of increases in NPK fertilizers is also the same. Despite moderate projected increases, the impacts on field cost and FFB production cost are slightly larger.

Table 10 shows *e-FA* simulations on gross margins from the production of 1 t of FFB. At a CPO price of RM 1500 t^{-1}, the gross margin shrank as prices of fertilizers rose in Scenarios 1 and 2. At that price, FFB production in Sarawak will not generate a positive margin in Scenario 2. The case worsened if the CPO price dropped to RM 1200 t^{-1} when Sarawak's gross margin will be negative if fertilizer price was as in Scenario 1. In Scenario 2, only Sabah registered a positive margin but the margin was very narrow.

TABLE 9. INCREASES IN FERTILIZER PRICES AND PRODUCTION COSTS

	Straight fertilizers			Compound fertilizers (NPK)		
	Peninsular Malaysia	**Sabah**	**Sarawak**	**Peninsular Malaysia**	**Sabah**	**Sarawak**
Cost per ha						
Normal	3 408.25	3 521.66	3 319.64	3 751.61	3 916.52	3 746.52
Scenario 1	4 006.17	4 209.27	4 063.00	4 213.37	4 447.55	4 320.60
Scenario 2	4 604.09	4 896.87	4 806.36	4 675.31	4 978.57	4 894.68
Cost per tonne FFB						
Normal	173.01	151.47	205.17	190.44	168.45	231.55
Scenario 1	203.36	181.04	251.11	213.88	191.29	267.03
Scenario 2	233.71	210.62	297.06	237.32	214.13	302.51

TABLE 10. PROFIT PER TONNE OF FRESH FRUIT BUNCHES (FFB)

	CPO price @ RM 1500			CPO price @ RM 1200		
	Peninsular Malaysia	**Sabah**	**Sarawak**	**Peninsular Malaysia**	**Sabah**	**Sarawak**
FFB price	284.44	281.62	289.79	217.93	211.81	217.02
Straight fertilizers						
Normal	111.43	130.15	84.62	44.92	60.34	11.85
Scenario 1	81.08	100.58	38.68	14.57	30.77	-34.09
Scenario 2	50.73	71.00	-7.27	-15.78	1.19	-80.04
Compound fertilizers (NPK)						
Normal	94.00	113.17	58.24	27.49	43.36	-14.53
Scenario 1	70.56	90.33	22.76	4.05	20.52	-50.01
Scenario 2	47.12	67.49	-12.72	-19.39	-2.32	-85.49

Note: CPO – crude palm oil.

Share of fertilizer cost in the overall production cost. *Table 11* shows the share of fertilizer cost in the overall production cost for the three producing regions. The cost share could increase from 35.09% (normal) to 44.72% in the case of Scenario 1 and to 51.95% in Scenario 2 for Peninsular Malaysia. In Sabah, the cost share could rise to 49.01% and 56.17% for Scenarios 1 and 2, respectively, compared to 39.05% under normal conditions. In the case of Sarawak, the cost share could also rise to 54.89% and 61.86% for Scenarios 1 and 2, respectively, compared to 44.79% under normal conditions. The trend is also the same if compound fertilizers were used.

Fertilizer Price Increase and the Long-term Viability

Fertilizer price increase and break-even CPO price. Break-even price is an important component of project viability (at 10% IRR, with a positive NPV and B:C exceeding unity). In order to remain viable, the long-term price of CPO should remain above certain economic thresholds. Under normal conditions, the suggested price is RM 1300, RM 1200 and RM 1800 t^{-1} for Peninsular Malaysia, Sabah and Sarawak, respectively. However, if the price of fertilizers escalated as in Scenario 1, the price threshold should remain at least at RM 1500 for Peninsular Malaysia and RM 1400 and RM 2000 t^{-1} for Sabah and Sarawak, respectively. At the higher price level of Scenario 2, the suggested CPO price should be at RM 1600, RM 1500 and RM 2300 t^{-1}, respectively, for the three regions (*Table 12*).

The economic parameters. It was found that increases in fertilizer price could affect the long-term viability of oil palm planting or replanting. The viability strengths of the three conventional parameters, *i.e.* IRR, NPV and B:C, were reduced when investments were subjected to the various fertilizer price levels (*Table 13*). Under normal conditions, investment in planting or replanting oil palm could generate an IRR of 10.09%, NPV of

TABLE 11. SHARE OF FERTILIZER COST IN THE OVERALL PRODUCTION COST

	Straight fertilizers			Compound fertilizers (NPK)		
	Peninsular Malaysia	Sabah	Sarawak	Peninsular Malaysia	Sabah	Sarawak
Normal	35.09	39.05	44.79	41.03	45.20	51.08
Scenario 1	44.72	49.01	54.89	47.49	51.74	57.58
Scenario 2	51.95	56.17	61.86	52.68	56.89	62.55

TABLE 12. BREAK-EVEN CRUDE PALM OIL (CPO) PRICE

	Straight fertilizers			Compound fertilizers (NPK)		
	Peninsular Malaysia	Sabah	Sarawak	Peninsular Malaysia	Sabah	Sarawak
Normal	1 300	1 200	1 800	1 400	1 300	1 900
Scenario 1	1 500	1 400	2 000	1 500	1 400	2 100
Scenario 2	1 600	1 500	2 300	1 700	1 500	2 300

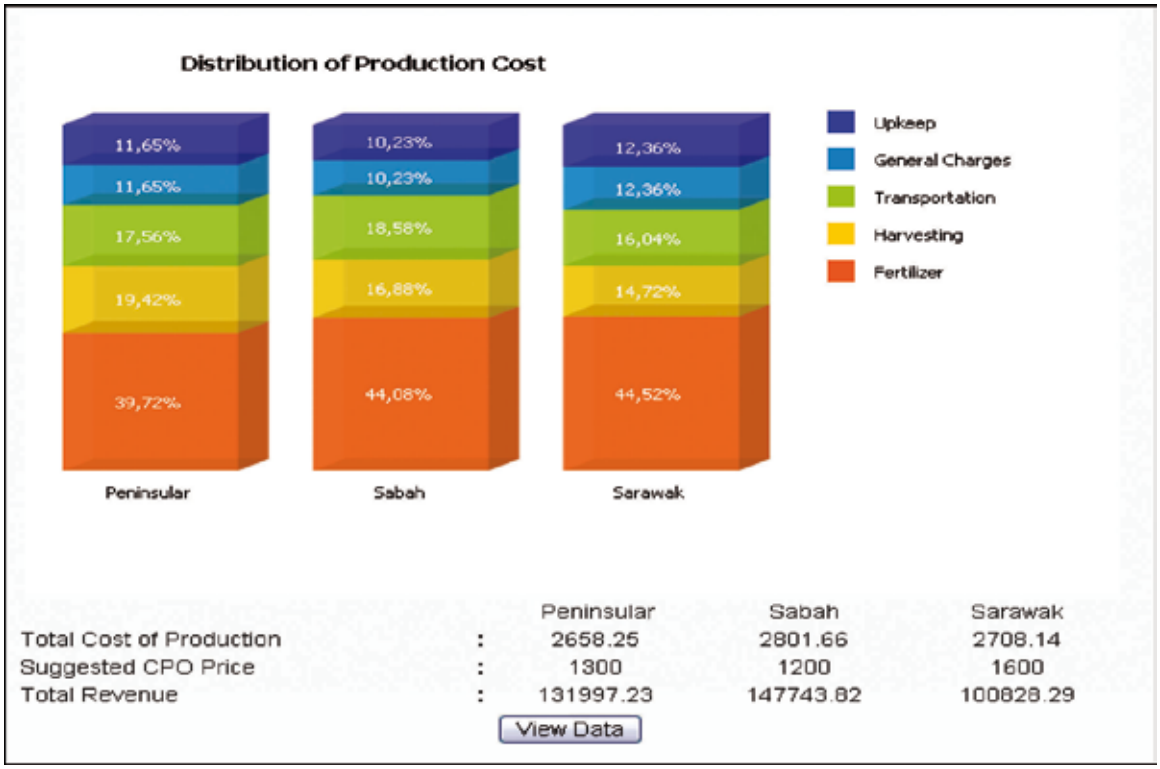
TABLE 13. THE ECONOMIC PARAMETERS

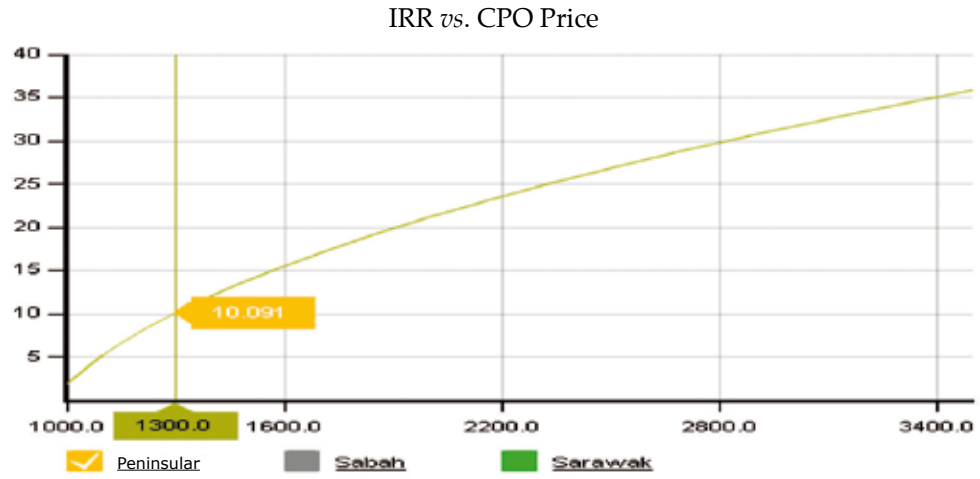
	Straight fertilizers			Compound fertilizers (NPK)		
	Peninsular Malaysia	Sabah	Sarawak	Peninsular Malaysia	Sabah	Sarawak
IRR (%)						
Normal	10.09	10.18	10.63	10.42	10.72	10.19
Scenario 1	6.80	6.31	7.24	8.02	7.94	7.61
Scenario 2	2.84	1.11	3.16	5.33	4.68	4.68
NPV						
Normal	117.29	238.04	974.22	561.06	961.56	292.46
Scenario 1	-3 873.28	-4 351.12	-3 987.04	-2 520.77	-2 582.54	-3 539.00
Scenario 2	-7 863.85	-8 940.28	-8 948.29	-5 602.59	-6 126.64	-7 370.47
B:C						
Normal	1.00	1.01	1.03	1.02	1.03	1.01
Scenario 1	0.97	0.88	0.89	0.93	0.93	0.91
Scenario 2	0.79	0.78	0.79	0.85	0.85	0.83

RM 117.29 and B:C of 1.00 for Peninsular Malaysia at a CPO price of RM 1300 t^{-1}, while in the case of Sabah, economic viability can be achieved at a slightly lower CPO price of RM 1200 t^{-1} that will generate an IRR of 10.18%, a positive NPV of RM 238.04 and B:C of 1.01. For Sarawak, the viability indicators are such that the IRR is 10.63%, NPV of RM 974.22 and B:C at 1.03, and this is achieved when CPO price is at RM 1800 t^{-1}.

The viability was reduced if the investment was subjected to the fertilizer prices of Scenarios 1 and 2. In Peninsular Malaysia, the IRR could be reduced to 6.80% and 2.84%, respectively, for Scenarios 1 and 2. Sabah would also experience reduced viability competitiveness as the IRR will erode to 6.31% under Scenario 1 and 1.11% under Scenario 2. In Sarawak, the IRR could reduce to 7.24% and 3.16% in the two respective scenarios if the oil palm investment were subjected to the fertilizer price increases of the scenarios in-hand (*Table 13*). Therefore, at the suggested CPO price, planting or replanting of oil palm would not be viable if fertilizer prices increased by 50% or 100%.

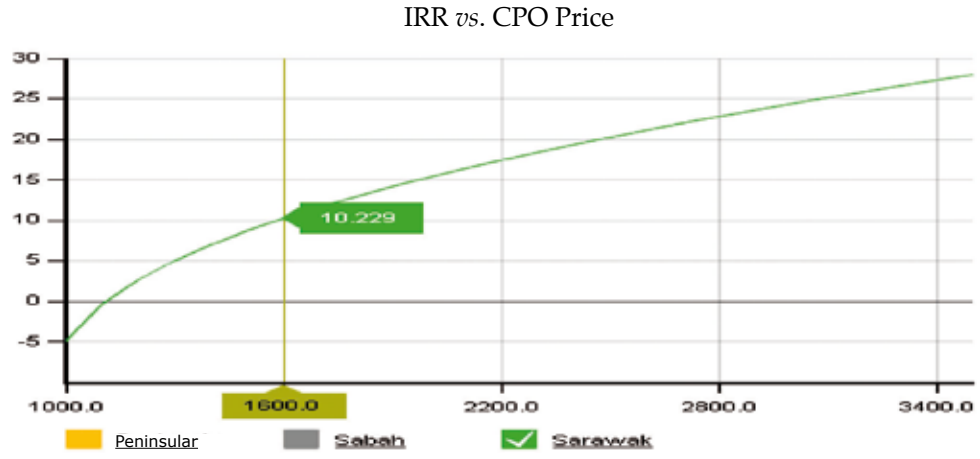
Displays by the *e-FA* System





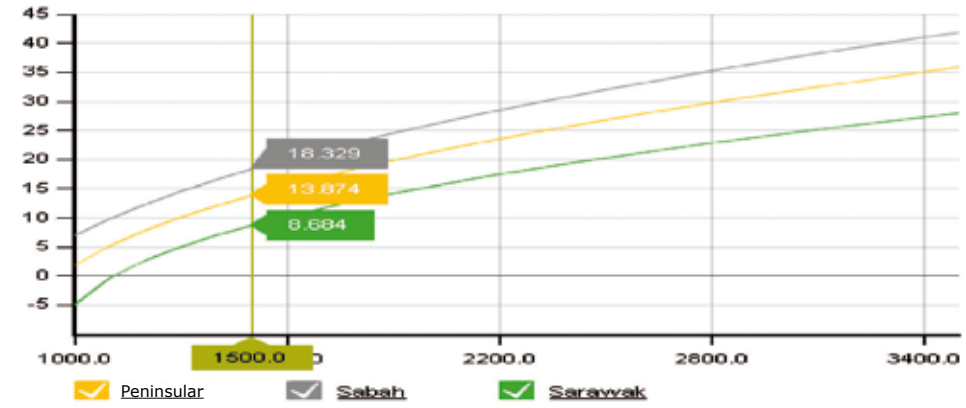
Peninsular Malaysia – crude palm oil (CPO) price @ RM 1300 t^{-1}.

Sabah – crude palm oil (CPO) price @ RM 1200 t^{-1}.



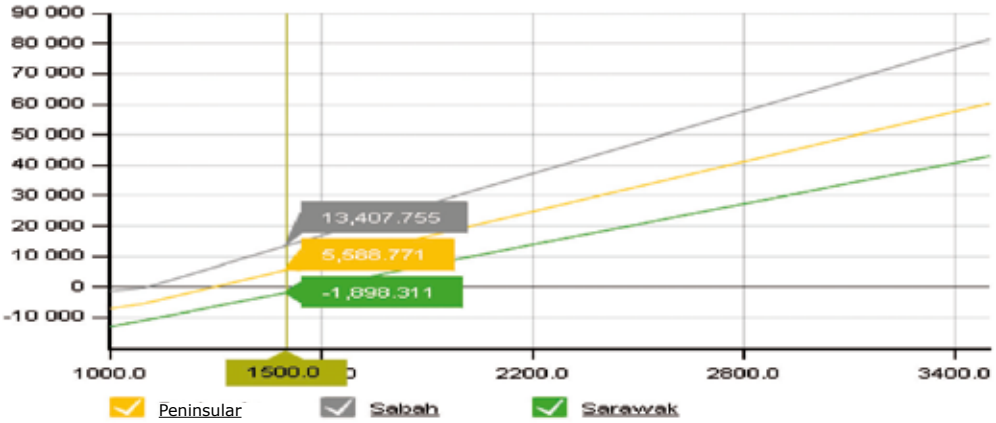
Sarawak – crude palm oil (CPO) price @ RM 1600 t^{-1}.

IRR *vs*. CPO Price



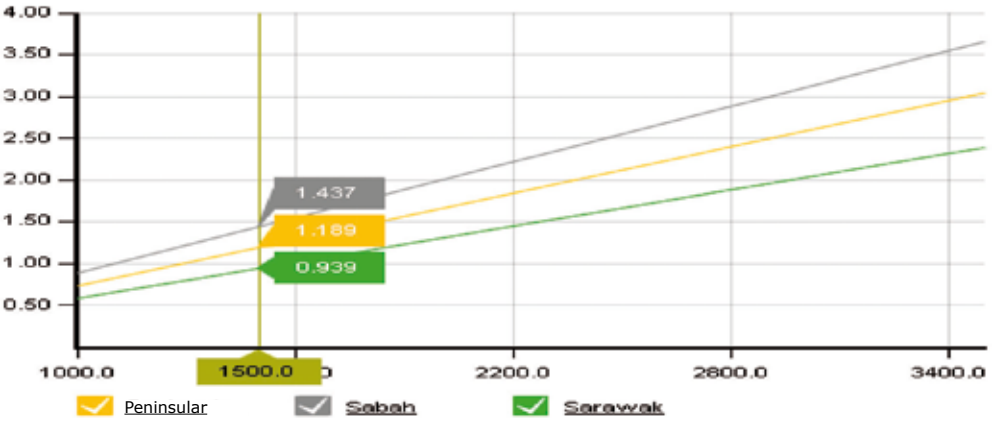
Internal rate of return (IRR) by region, crude palm oil (CPO) price @ RM 1500 t^{-1}.

NPV *vs*. CPO Price



Net present value (NPV) by region, crude palm oil (CPO) price @ RM 1500 t^{-1}.

BCR *vs*. CPO Price



Benefit cost ratio (BCR) by region, crude palm oil (CPO) price @ RM 1500 t^{-1}.

CONCLUSION

The cultivation of oil palm involves considerable capital expenditure. To remain cost-effective the stream of revenues generated during the productive phase of oil palm life cycle should be able to pay back the initial investment and to finance the overall year-on-year operations. Exogenous factors such as the case in hand – sudden surges in fertilizer price – could affect investment attractiveness and business profitability. The CBA method was used to evaluate the viability of investment under several fertilizer price scenarios, simulated through the development of a programmable master schedule, *e-FA*. The *e-FA* compares costs and benefits at a 10% discount rate.

Different cost profiles would in one way or another affect the long-term feasibility of oil palm planting in the country. As shown earlier, the level of financially acceptable profitability differs between Peninsular Malaysia and Sabah and Sarawak. In the Peninsular, financial feability only appears at a CPO price of RM 1300 t^{-1} when IRR crosses the 10% opportunity cost of the capital, NPV becomes positive and B:C is greater than 1. In Sabah, investment is feasible at a CPO price of RM 1200 t^{-1}, but in Sarawak, it would require a long-term price of RM 1800 t^{-1}. However, if fertilizer prices increased over the long-term, the feasible CPO prices will need to be sustained at RM 1500 t^{-1} in the case of the Peninsular, and at RM 1400 t^{-1} for Sabah. Sarawak requires the CPO price to be RM 2000 t^{-1} if prices of fertilizers increased by 50%. Therefore, in view of a rising cost regime, the plantation management should be geared towards increasing productivity to offset the increases in production cost.

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