# An Analysis of Crude Palm Oil Production in Malaysia

Ramli Abdullah*


## ABSTRACT

*Palm oil is a very important commodity in Malaysia, and as such, it has become one of the 12 economic sectors under the National Key Economic Areas (NKEA) to realise the country's vision towards attaining a high income nation status in 2020. However, land is a limited resource for future oil palm expansion, thus, land productivity is pivotal in achieving the target of the NKEA. This can also affect future production of palm oil. Thus, it is the objective of this article to understand its behaviour in the past in order to determine its trend in the future. Based on historical data, palm oil production behaviour can be characterised by four components, namely trend, cyclical, seasonal and irregular components. The cyclical component is less obvious due to the nature of the data which is on monthly basis. However, this monthly data is suitable for exhibiting the seasonal and trend components. The seasonal component produces significant monthly indices which show performance of monthly production in a year. The trend component shows that production of palm oil is generally on the uptrend. The last irregular component indicates the production behaviour which is not described by the other three components and is considered a totally random error. Having understood the production pattern which consists of the four components, various key factors (mostly biological in nature) which affect and determine the movement of the palm oil production were also discussed in this article. These factors include rainfall (which affects more on the fresh fruit bunches yield), matured areas and fertiliser application. Coupled with the four components, they give a clearer picture of the production pattern of crude palm oil production in Malaysia.*


## INTRODUCTION

Much has been said about palm oil in the global oils and fats sector. From just a small production of oil that was traded in the seventies, it is now the largest produced and traded oil in the world. Its production and traded volumes undoubtedly plummeted to reach 52.81 and 40.76 million tonnes in 2012 respectively with Malaysia and Indonesia being the two largest producers and exporters. Both countries accounted for 24.27% and 57.70% of the world's total production and export of oils and fats in 2012 (Oil World Annual, 2012; MPOB, 2012).

Claire and Saijei (2006) stated that 'money literally grows on trees in Malaysia and the best-

* Malaysian Palm Oil Board,
P. O. Box 10620,
50720 Kuala Lumpur, Malaysia.

performing oil investment comes from trees in Malaysia'. As regards to barter trade, most of the things that the country has bought, from battle tanks to supersonic fighters, and signed contracts for major infrastructure projects, all were paid for with palm oil (Nuryushida, 2001). Thus, palm oil is an important commodity and has become the strength of the country's economy. It could also become a catalyst for the country's economic growth.

Recently, Malaysia introduced 12 National Key Economic Areas (NKEA) programme to boost its economy and achieve a high income status by 2020 (MPOB, 2010). The NKEA will be the drivers to stimulate the economy towards attaining high income, sustainability and inclusiveness of the nation. Malaysia's palm oil industry is one of the important industries of the nation and it is the fourth largest contributor to the national economy with a Gross National Income (GNI) of RM 53 billion in 2009. The palm oil NKEA is targeted to raise the total GNI contribution of RM 125 billion to reach RM 178 billion by 2020 (MPOB, 2010). As a major contributor to the economic growth, the palm oil NKEA programme plans to implement eight cores Entry Point Projects (EPP) in spanning the palm oil value chain.

In view of the limiting land availability, the EPP have focused on the upstream sector. Land is one of the components in this sector and will be a scarce item in the country which consequently can affect production. Understanding the production pattern is important as the Malaysian oil palm industry has of late been challenged by that of the Indonesian oil palm industry. The latter has more advantages, especially in terms of labour and land availability. With these constraints, it is important to analyse the production pattern in terms of its characteristics and the most likely factors that contribute to its growth. It is the purpose of this article to study such characteristics and its important factors.

## MALAYSIAN CRUDE PALM OIL PRODUCTION IS ON THE RISE

Malaysia is currently the second largest producer of palm oil in the world. The country's production surged by 5.56% per year from 6.09 million tonnes in 1990 to 18.78 million tonnes in 2012 (*Figure 1*). A long-term increasing trend can be seen while indicating that production was dipping or increasing along it. Significant dips occurred in 1994 (-2.47%), 1998 (-8.26%), and 2010 (-3.25%) while marginal increases were seen in 1993 (16.16%), 1997 (8.14%), 1999 (26.85%), 2003 (12.14%), 2008 (12.07%), and 2011 (11.29%). A shortfall of production occurred due to stress of the oil palm after prolific production in the previous years, usually in the range of three to five years. Each dip was usually followed by a recovery.

The production of Malaysian palm oil had declined for two consecutive years in 2009 and 2010. It showed a decline of 0.96% in 2009 from 2008 and of 3.25% in 2010 from 2009. The dip in production in 2009 was more or less expected, as the oil palm were stressed after high production in 2008. It was expected to rebound in 2010, but other external factors had caused it to decline for the second year, such as bad weather which can affect harvesting.

The monthly historical production of Malaysian palm oil from 1980 until 2011 is as shown in *Figure 2*. It is clear that it exhibits a unique pattern which repeats every year.

## CHARACTERISTICS OF THE CRUDE PALM OIL PRODUCTION IN MALAYSIA

Crude palm oil (CPO) production data can be considered as one of the time series data because it is a set of data collected in a sequence of order over a successive equal increment of time (Bowerman and O'Connell, 1993). Over time, it establishes a certain type of behaviour which can be described by certain unique attributes, generally grouped into four main component types, namely, the trend component, the cyclical component, the seasonal component and the irregular

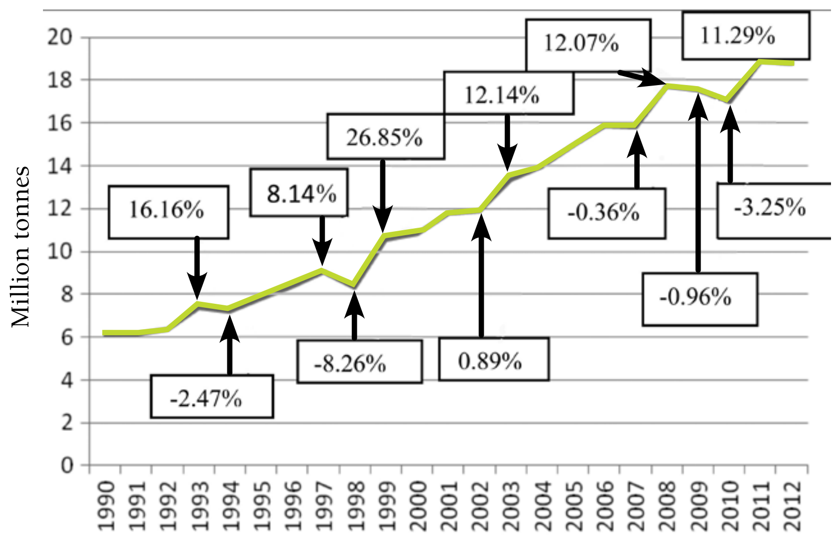


*Figure 1. The development of crude palm oil production in Malaysia since 1990.*

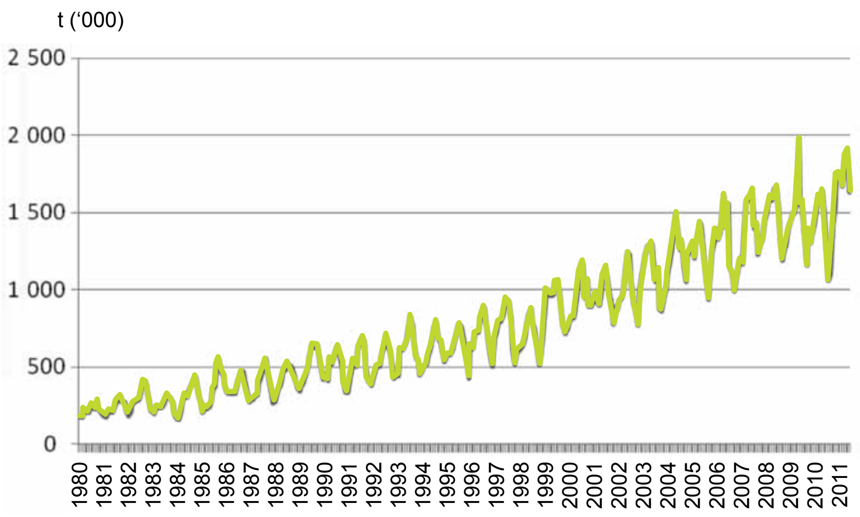


*Figure 2. Malaysian crude palm oil production.*

component (*Figure 3*). As such, it does not behave like a random sample. To understand well about CPO production in Malaysia, it is a usual practice to segregate the four components and analyse them in a systematic manner.

It is a good practice also to introduce common symbols to analyse such time series. The symbols represent the respective components of the time series. Let:

- $T_t$ represents the trend component in time period $t$;
- $C_t$ represents the cyclical component in time period $t$;
- $S_t$ represents the seasonal component in time period $t$; and
- $I_t$ represents the irregular component in time period $t$.

Note that the subscript '*t*' represents time related components for which $t = 1,2,3....n$ for $n$ time periods. For the analysis in this article, $t$ starts from January 1980 ($t$ = 1) until December 2011 ($t$ = 384).

The relationship of the four components is shown in *Figure 3* which is the hypothetical distribution of the palm oil production in Malaysia. These components are in a way related with one another in two basic relationships, these being either multiplicative or additive components models:

1) Additive components model: $Y_t = T_t + S_t + C_t + I_t$
2) Multiplicative components model: $Y_t = T_t \times S_t \times C_t \times I_t$ *for* $t = 1,2,3,.....n$

The components can be identified through an approach called decomposition. This article deals with only the multiplicative effect since the variability is not the same throughout the length of the series; otherwise, if it is the same, the additive components model is appropriate.

**The Trend Component**

The trend component of the CPO production illustrates the general movements of the production data, either up or down and allows us to understand the historical pattern existing in the production series. Only with a long set of data, the trend can be easily visualised by plotting a straight line or a smooth curve through the production data on the graph.

Excel software allows us to estimate several types of trends, namely linear, exponential, logarithmic, polynomial, power and moving average. Based on the original data of CPO production as illustrated in *Figure 2*, the best fitted trend line is the linear trend of the general form:

$$T_t = \alpha + \beta t + \Sigma_t \qquad (1)$$

where,

$T_t$ = the best fitted trend for CPO production in Malaysia in tonnes at time $t$,

$\alpha$ and $\beta$ are unknown intercept and slope parameter respectively to be estimated,

$t$ = time variable ($t$ = 1 refers to January 1980, $t$ = 2 refers to February 1980...) and

$\Sigma_t$ is the error term at time $t$.

Equation (1) had been estimated using palm oil production data ranging from January 1980 ($t$ = 1) until December 2011 ($t$ = 384). The estimated trend line is shown in *Figure 4* and its estimated equation is:

$$T_t = 60\,702 + 3703.5t \qquad (2)$$

It is quite a reliable equation as its coefficient of determination

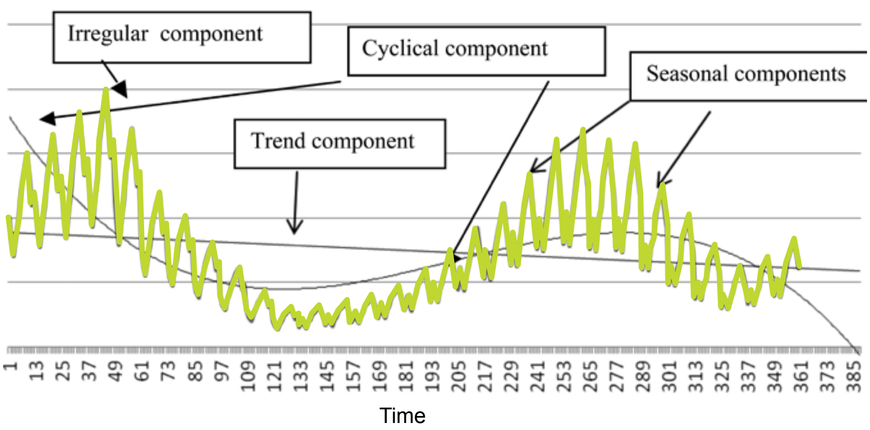


*Figure 3. The four components in a typical time series.*

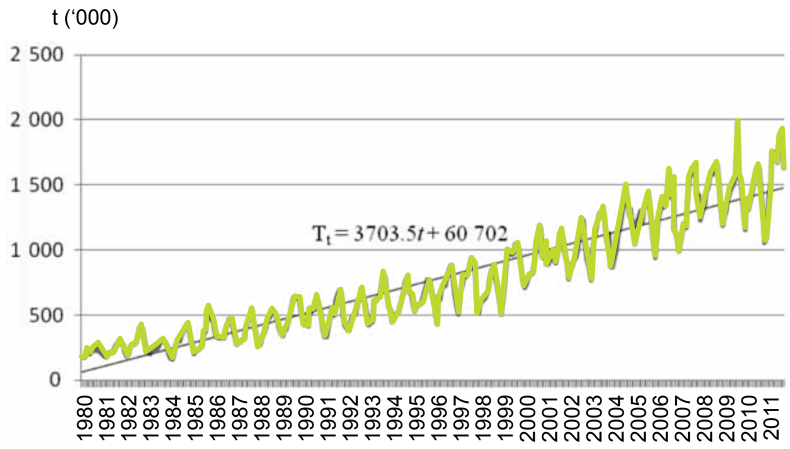


*Figure 4. Malaysian crude palm oil production and its estimated linear trend.*

($R^2$)[1] is considered high at 0.76. This means that 76% of the variable observed in production can be explained by time. It is progressing upwards over time.

### The Cyclical Component

The cyclical component refers to the ups and downs of the CPO production over unspecified periods of time, usually winding around a long-run trend as represented by the estimated trend above. In other words, it represents a long-term wave-like fluctuations or cycles of more than one year's duration. Since the CPO production data is on a monthly basis, it is quite difficult to identify the component compared to the annual data. Nevertheless, in the presence of this component, the Residual Method can be used to estimate it. The Residual Method is defined as:

Percentage of trend = ($Y_t/T_t$) X 100..(3)
where $Y_t$ is the actual CPO production in tonnes,
$T_t$ is the estimated trend obtained in Equation (2).

Due to the difficulty in identifying the cyclical component, it is not being illustrated graphically in this article.

### The Seasonal Component

In contrast to cyclical component, the seasonal component characterises regular fluctuations occurring within a specific period of time or more or a less stable pattern of change that appears like short-term regular wave-like patterns. In the following years, we can see that the fluctuations repeat with the same regulatory pattern. The seasonal component can be easily identified with monthly data, as in the case of data illustrated in *Figure 2*.

The identification of the seasonal component of the CPO production has been done using the ratio-to-moving average method, utilising data on monthly production of palm oil which spanned from January 1980 until December 2011. It involves calculating moving averages, calculating unadjusted seasonal indices, and adjusting the seasonal indices. It begins by removing the seasonal and irregular components leaving the trend and cyclical components. The adjusted seasonal indices for a year are shown in *Figure 5*. It is a regular pattern established every year.

The seasonal indices in *Figure 5* say that production at beginning of year is a bit higher than in February. It is 18% lower than the average production or 82% of the average production of that particular year. Meanwhile, February appears to be the month with lowest production (or the trough month) which is at about 76% of the average production or 24% lower than the average

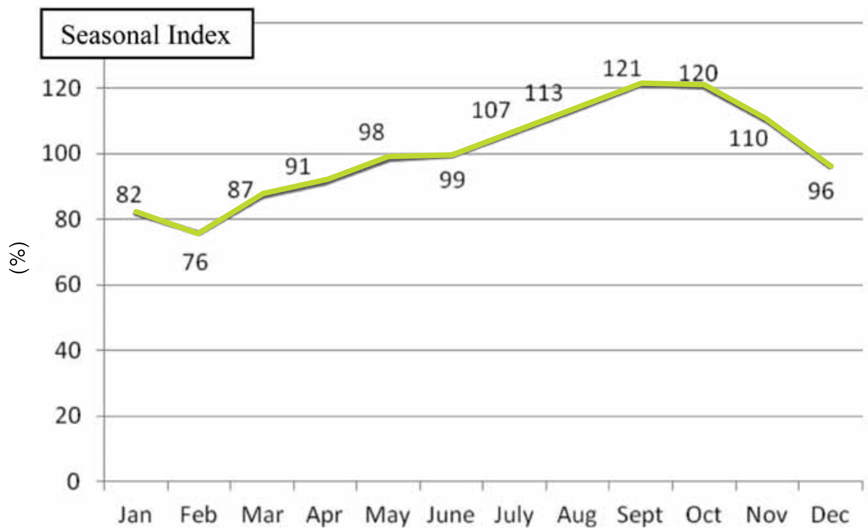


*Figure 5. Seasonal pattern of crude palm oil production.*

[1] $R^2$ is a measure of how well the least equation is. The higher the $R^2$ the more useful the model and it takes on values between 0 and 1.

production level. From then on, production is more or less gradually increasing until September or October to form peak month(s) in which their production is about 20%-21% higher than the average level. This pattern indicates that production gradually declines towards December starting from October every year. In total, there are about five months in a year where production is higher than the average level. This is the general pattern of CPO production based on its historical data.

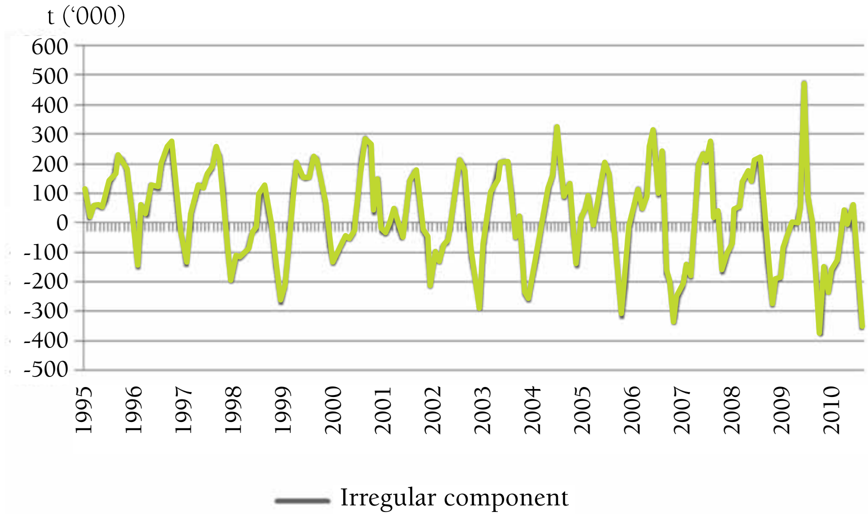


*Figure 6. The irregular component of Malaysian crude palm oil production.*

### The Irregular Component

This last component can be regarded as random error, unpredictable mainly due to random variations of nature and accidental or unusual events. The errors are considered random if they do not show any particular or systematic pattern and are assumed to be normally distributed with a mean zero and a variance $\sigma^2_\Sigma$. It appears that the errors are random as indicated by *Figure 6*.

## FACTORS AFFECTING CRUDE PALM OIL PRODUCTION

Apart from all the four components in the palm oil production series, the development of CPO production in Malaysia is affected by a number of other significant factors, including rainfall, increase in matured areas, fertiliser applications, replanting programmes, and others. This is explained as follows.

### Effect of Rainfall

Oil palm needs a certain amount of rainfall for a healthy growth. Lack of rainfall due to *El Niño* or too much of it due to *La Niña* or heavy monsoon can affect its productivity. *El Niño* occurs when rainfall in a month is below 100 mm (Mandeep, 2010) and its severity depends on the number of months it occurs (Haniff *et al.*, 2010). A continuous low rainfall (less than 100 mm) for more than two months will have significant effects on fresh fruit bunches (FFB) yield. The FFB yield potential will be reduced as the trees are exposed to stressful condition. Its effect on the yield can be observed after six months when fruits are about to set; after 18 months when inflorescence abortion is about to occur; and after 24 months when sex determination is about to begin (Haniff *et al.*, 2010). It was observed that since 2007, the country recorded below that level of rainfall only one month per year. In other words, no prolonged *El Niño* has happened recently. However, *El Niño* occurred in 1997 and 1998 and it resulted in low FFB yields and consequently low CPO production.

Although *El Niño* occurred very rarely in the past, *La Niña*, on the other hand, occurred quite frequently. The rainfall data shows that it is mostly above 100 mm (Phang and Mazlan, 2010). Severe rainfall causes *La Niña* or monsoons. An analysis on the relationship between rainfall and FFB yield was carried out on regional basis in Peninsular Malaysia, Sabah and Sarawak. The analysis on a regional basis is more appropriate than for Malaysia as a whole mainly due to the availability of regional rainfall and production data.

All the three regions show that the two variables, namely FFB yield lagged six months and rainfall, are negatively related. In Peninsular Malaysia, the correlation index between them is

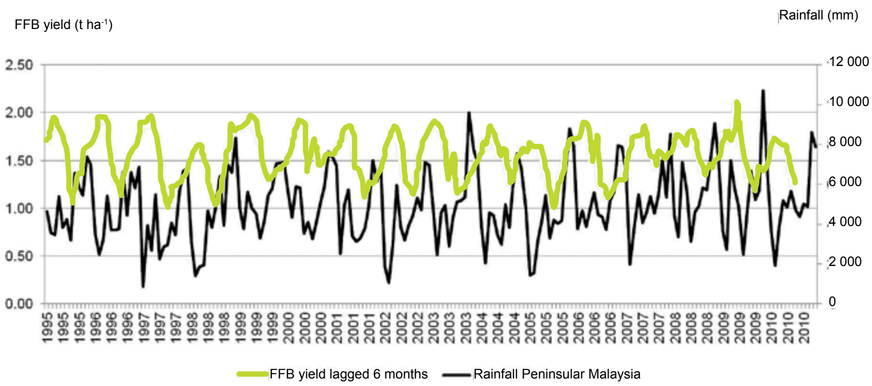


*Figure 7. Relationship between fresh fruit bunches (FFB) yield lagged six months and rainfall in Peninsular Malaysia.*

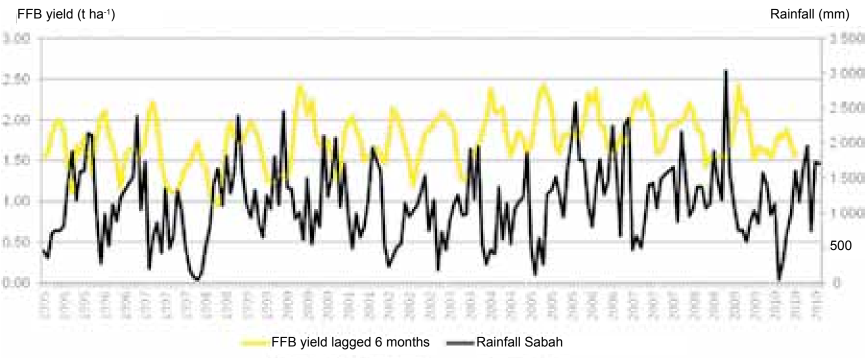


*Figure 8. Relationship between fresh fruit bunches (FFB) yield lagged six months and rainfall in Sabah.*

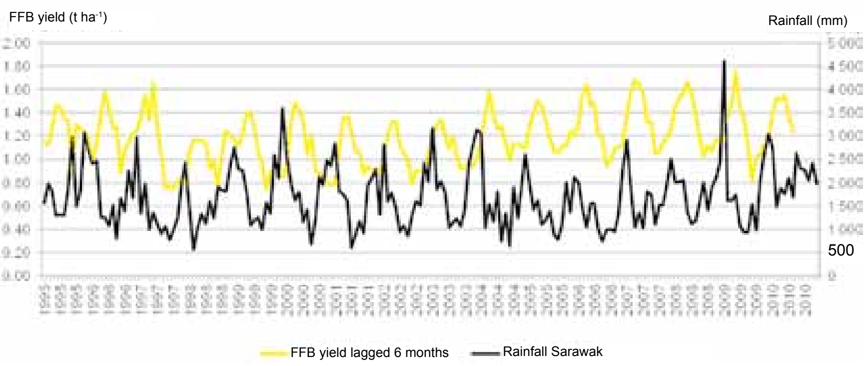


*Figure 9. Relationship between fresh fruit bunches (FFB) yield lagged six months and rainfall in Sarawak.*

-0.11 (*Figure 7*), whilst in Sabah and in Sarawak, the indices are -0.26 (*Figure 8*) and -0.13 (*Figure 9*). These indices indicate that when heavy rainfall happens, especially during monsoons, FFB yield will decline. The raining season will not only lower the yield, but it will also disrupt the transportation system. Hence, CPO production will decline.

As the FFB yield is lagged six months, this means that the yield in January 2013 was partly due to the effect of rainfall in June 2012. The intensity of rainfall from August 2012 until December 2012 will probably determine the performance of yield for the first six months of 2013. Of course, we should not forget about the effect of seasonal indices during this period which also play a role. Based on our projections, the expected FFB yield in Peninsular Malaysia is to be in the range of 1 to 1.5 t $ha^{-1}$ for the first six months of 2013, while for Sabah and Sarawak, the range will be from 1.5 to 2.00 and 1.2 to 1.4 t $ha^{-1}$ respectively.

**Increase in Matured Areas**

Oil palm areas in Malaysia have increased over the years. *Figure 10* shows that matured areas had moved almost in tandem with total planted areas and consequently with CPO production. The increase in the matured areas will result in the increase in CPO production, unless the yield is affected by vagaries of nature.

**Other Key Factors**

***Fertiliser applications.*** Data on fertiliser application in the Malaysian oil palm industry is not readily available but is estimated on the basis of its use in the total planted area.

The normal consumption of fertiliser in the oil palm matured area (based on industry practice) is 1.2 t $ha^{-1}$ $yr^{-1}$ (based on 8 kg $palm^{-1}$ $yr^{-1}$) while 0.74 t $ha^{-1}$ $yr^{-1}$ (based on 5 kg $palm^{-1}$ $yr^{-1}$) on immature area. Therefore, as an illustration, the estimated total consumption of fertiliser for 2010 with 4.85 million hectares of planted area was 5.04 million tonnes for mature and 0.48 million tonnes for immature areas, giving a total consumption of 5.52 million tonnes (*Table 1*). The total consumption of fertiliser in 2009 was 5.34 million tonnes, in 2008, 2007 and 2006 were 5.12, 4.91, and 4.78 million tonnes respectively. In 2011 and 2012, total fertiliser consumptions were estimated to increase further at about 5.67 and 5.75 million tonnes respectively. Thus, it is clear that the consumption of fertiliser increases as the area increases.

*Table 1* is based on the normal practice by the industry. However,

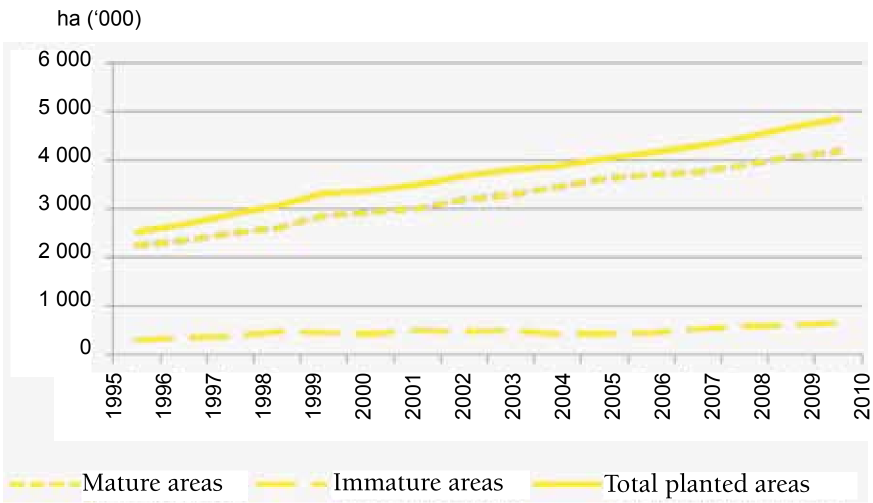


*Figure 10. Oil palm areas in Malaysia.*

**TABLE 1. ESTIMATED FERTILISER APPLICATION BY THE MALAYSIAN OIL PALM INDUSTRY**

| Year | Oil palm area (million hectares) | | Estimated fertiliser consumption (million tonnes)* |
|---|---|---|---|
| | Mature | Immature | |
| 2012 | 4.35 | 0.72 | 5.75 |
| 2011 | 4.28 | 0.72 | 5.67 |
| 2010 | 4.20 | 0.65 | 5.52 |
| 2009 | 4.07 | 0.62 | 5.34 |
| 2008 | 3.92 | 0.57 | 5.12 |
| 2007 | 3.76 | 0.54 | 4.91 |
| 2006 | 3.70 | 0.46 | 4.78 |

Note: * MPOB's estimate.

the price of palm oil can also play a role in influencing the industry to follow the above normal practice. During low prices of CPO, the industry is cost-squeezed and in effect, the frequency of fertiliser applications per month would be reduced. In contrast, high prices of CPO will give good returns to the industry which in return will apply more fertilisers to the oil palm trees. Hence, palm oil production is affected and fertiliser application can be regarded as an irregular component to the production level.

***Replanting programme.*** The replanting programme is another important factor. The purpose is to replant uneconomical oil palm aged 25 years and above. *Table 2* shows the data on replanted areas since 2000. A significant increase in the areas was recorded since 2008. This is due to the effect of the Oil Palm Replanting Incentive Scheme (OPRIS), introduced by the Malaysian government in 2008 with an allocation fund of RM 200 million targeting 200 000 ha of oil palm aged 25 years and above. Oil palm estates and smallholders including the government schemes FELDA, FELCRA, RISDA and state schemes were involved in this incentive. As a result, a total area of 129 567 hectares from 1285 estates had been felled off as at 31 December 2010 (*Table 3*). Another 19 553 ha from 5230 smallholders had also benefited. This gives a total of 149 120 ha being felled off, involving 6515 participants (estates and smallholders). Out of this, about 116 334 ha of oil palm have been replanted; 108 772 ha (93%) of the area replanted by the estates and 7562 ha (7%) by the smallholders. The replanted

**TABLE 2. MALAYSIAN OIL PALM REPLANTED AREAS (ha)**

| Region | 2000 | 2005 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| Pen. Malaysia | 34 774 | 37 739 | 41 137 | 74 339 | 91 447 | 64 567 | 65 078 |
| Sabah | 4 499 | 8 644 | 9 472 | 15 281 | 22 899 | 19 559 | 21 217 |
| Sarawak | 837 | 2 535 | 2 508 | 1 800 | 1 988 | 1 760 | 2 596 |
| Sabah/ S'wak | 5 336 | 11 179 | 11 980 | 17 081 | 24 887 | 21 319 | 23 813 |
| Malaysia | 40 110 | 48 917 | 53 117 | 91 420 | 116 334 | 85 895 | 88 891 |

Source: MPOB (2012).

**TABLE 3. MALAYSIAN OIL PALM REPLANTED AREAS IN 2010 AND IN 2012 (ha)**

| Region | 2010 | | | 2012 | | |
|---|---|---|---|---|---|---|
| | Fell off | | Replanted (ha) | Fell off | | Replanted (ha) |
| | No. | ha | | No. | ha | |
| Estates | 1 285 | 129 567 | 108 772 | n.a | n.a | 82 346 |
| Smallholders | 5 230 | 19 553 | 7 562 | n.a | n.a | 6 546 |
| Malaysia | 6 515 | 149 120 | 116 334 | - | - | 88 891 |

Note: n.a. – not available.
Source: MPOB (2012).

area, however, decreased in 2012, mainly due to the unavailability of OPRIS which expired in December 2010.

With such a development in the replanted area towards 2012, CPO production will be affected during the next three years. Oil palm planted and replanted in 2010 matured in 2012 and those replanted and planted in 2011 and 2012 will mature in 2013 and 2014 respectively.

## CONCLUSION

This article highlights the four components that characterise CPO production. Clearly, CPO production has exhibited an increasing trend and significant seasonal indices for the 12 months. However, the cyclical component and irregular component are less obvious due to the nature of the data which are on a monthly basis. In addition to the four components, the pattern of palm oil production is also determined by other factors such as rainfall, matured areas, fertiliser application and the replanting programmes.

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