# Prospects of Elevating National Oil Palm Productivity: a Malaysian Perspective

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ABSTRACT

*The expansion of oil palm plantings has been phenomenal: from 60 000 ha in 1960 to 3.50 million hectares in 2001 and an expected 5.10 million hectares in 2020. The increase in palm oil production has accordingly reflected the pattern of the planted area,* i.e. *91 793 t in 1960 to 11.80 million tonnes in 2001 and an expected 18.81 million tonnes in 2020.*

*The national oil yield average does not seem to increase in step with the advances made in science and technology. The national oil yield average was 3.63 t/ha from 1975 to 2001, while the last 10-year average (1992-2001) was only 3.50 t/ha. This is very low indeed with no significant difference from other competing countries.*

*Oil palm breeding has improved the planting materials. The oil yield of* duras *has improved from 2.8 to 4.5 t/ha after four selections. The oil yield of* teneras *from subsequent* dura *selections and introgression with selected* pisiferas *has improved from 6.3 to 11.2 t/ha in the last four decades.*

*Why then is the national oil yield average still low? There can be many macro-reasons. Some reasons can be that with the rapid expansion of oil palm area, the limited areas of Class 1 and 2 soils have been used up and plantings have extended to Class 3 (marginal) and 4 (unsuitable) soils. Some other reasons may be inadequate agronomic inputs (especially fertilizer, field maintenance,* etc.*), shortage of skilled labour, ineffective and inadequate estate management, low replanting rate, and imbalance of extension service capability vis-à-vis increases in oil palm plantings. These factors can lead to a combination of low fresh fruit bunch (FFB) yield and oil extraction rate (OER) which will eventually lead to low oil yield.*

*There is a need to have strategies and a plan of action to overcome these constraints in order to increase the national oil yield average to the target of 8.8 t/ha by 2020. Implementation of short-term strategies can lead to an immediate increment in oil yield. However, it would need the implementation of medium- and long-term strategies to eventually lead to achieving the target. The incentive for the industry to follow these strategies will be an increase in yield with a sustained cost of production, thus making the industry more profitable and competitive.*

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## INTRODUCTION

The first oil palm plantation in Malaysia was established in 1917. However, the pace of expansion was slow until after independence in 1957. In 1960, oil palm plantings covered 60 000 ha and reached 1.07 and 3.38 million hectares in 1980 and 2000 respectively. In 2001, oil palm covered 3.5 million hectares and is expected to increase to 4.72 and 5.10 million hectares in 2010 and 2020, respectively (*Table 1*).

With the expansion of the oil palm area, palm oil production rose from 91 793 t in 1960 to 11.80 million tonnes in 2001 and is expected to reach 18.81 million tonnes in 2020 (*Table 1*).

Although there has been an increase in production with the expansion of planted areas, the national yield of oil per hectare does not reflect the technological and scientific advances made, especially in breeding, agronomy and other estate management practices, in the oil palm industry. For example, the yearly national oil yield average from 1975 to 2001 was only 3.63 t/ha (ranging from 2.95 t/ha for the year 1978 to 4.41 t/ha in 1986) and had not improved from the early years. This has been a great concern to the industry as it reflects a low level of productivity while the cost of production has increased significantly. Eventually, these factors can make the oil palm industry less competitive and sustainable than it is today.

The objective of this paper is, therefore, to examine the main reasons for the low national oil yield average and to develop strategies and plans of action for improvement. Many of the points raised here are a summary of the lengthy work done by the National Task Force on Productivity (NTFP) set up by MPOB and the industry.

**TABLE 1. AREA OF OIL PALM AND PALM OIL PRODUCTION**

| Year | Area (million ha) | CPO (million t) | Oil yield (t/ha) |
|---|---|---|---|
| 1960 | 0.06 | 0.09 | 3.75* |
| 1965 | 0.10 | 0.15 | 3.75* |
| 1970 | 0.30 | 0.43 | 3.58* |
| 1975 | 0.64 | 1.26 | 3.66 |
| 1980 | 1.07 | 2.57 | 3.78 |
| 1985 | 1.48 | 4.13 | 4.33 |
| 1990 | 2.03 | 6.09 | 3.64 |
| 1995 | 2.54 | 7.81 | 3.51 |
| 2000 | 3.38 | 10.84 | 3.46 |
| 2001 | 3.50 | 11.80 | 3.66 |
| 2002 * | 3.65 | 11.64 | 3.70 |
| 2003 * | 3.37 | 12.40 | 3.74 |
| 2005 * | 4.04 | 13.86 | 3.86 |
| 2010 * | 4.72 | 16.47 | 3.83 |
| 2015 * | 5.05 | 18.58 | 3.75 |
| 2020 * | 5.10 | 18.81 | 3.78 |

Note: * Estimates.
Source: MPOB.

## PROGRESS IN OIL PALM BREEDING

Most of the oil palm planting materials in Malaysia are descendents of the four Bogor palms. Breeding and selection have improved the oil yield through an increase in the FFB yield and oil to bunch (O/B) ratio. The oil yield of *dura* in breeding trials has improved from 2.8 to 4.5 t/ha (*Table 2*) after four cycles of selection.

Further *dura* selection and introgression with selected *pisiferas* have improved the *tenera* oil yield significantly from 6.3 to 11.8 t/ha over the last four decades (*Table 2*).

The on-going breeding programmes, both by MPOB and industry, would lead to further selection of newer elite *duras* and *pisiferas* derived from selected germplasm materials and they can further improve the *teneras* in the future (Jalani, 1999; Jalani *et al*., 2001; Soh and Goh, 2002).

**TABLE 2. PERFORMANCE OF UNSELECTED AND SELECTED *DURAS* AND *TENERAS* IN BREEDING TRIALS**

| Progeny | Year | FFB (t/ha) | O/B (%) | Oil yield (t/ha) |
|---|---|---|---|---|
| *Duras* | | | | |
| F1 Bogor | 1878 | 16.5 | 17.6 | 2.8 |
| Tg Morawa | 1885 | 16.0 | 17.4 | 2.7 |
| Elmina | 1933 | 20.1 | 17.0 | 3.4 |
| OPRS | 1969 | 24.8 | 18.3 | 4.5 |
| *Teneras* | | | | |
| DD x CI/UAC/SP/Avros | 1960's | 28.2 | 22.5 | 6.3 |
| DD x Avros/Dy Avros | 1970's | 33.1 | 25.3 | 8.4 |
| DD x Yangambi | 1980's | 35.1 | 26.0 | 9.5 |

Sources: Adapted from Hardon *et al.* (1987 ); Lee and Toh (1991); Sharma and Tan (1996);

## HISTORICAL FRESH FRUIT BUNCH (FFB), OIL EXTRACTION RATE (OER) AND OIL YIELD

The historical national oil yields from 1975 to 2001 averaged 3.63 t/ha (*Table 1*). However, looking closer at the 10-year (1992-2001) national oil yield, the average was 3.5 t/ha (ranging from 3.37 to 3.78 t/ha) with an average FFB yield of 18.62 t/ha (ranging from 15.98 to 20.26 t/ha) and OER of 18.84% (ranging from 18.51% to 19.22%) as shown in *Table 3*.

This yield is still low despite advances made in agronomic practices, plant breeding, plant protection measures, estate management, and other innovations which have overcome many constraints. It is our considered opinion that there is strong evidence of the failure in the implementation of these technologies.

The Malaysian national oil yield average at 3.5 t/ha is not much different from other competing palm oil producing countries, especially Indonesia. As shown in *Table 4*, the oil palm planting material is capable of achieving higher yield potential.

**TABLE 3. RECENT HISTORICAL YIELD OF OIL PALM IN MALAYSIA**

| Year | FFB (t/ha) | OER (%) | Oil yield (t/ha) | Production (million t) |
|---|---|---|---|---|
| 1992 | 17.83 | 19.21 | 3.37 | 6.37 |
| 1993 | 20.26 | 18.67 | 3.78 | 7.40 |
| 1994 | 18.42 | 18.63 | 3.43 | 7.22 |
| 1995 | 18.93 | 18.51 | 3.51 | 7.81 |
| 1996 | 18.95 | 18.71 | 3.55 | 8.39 |
| 1997 | 19.10 | 19.03 | 3.63 | 9.07 |
| 1998 | 15.98 | 18.91 | 3.02 | 8.32 |
| 1999 | 19.26 | 18.86 | 3.58 | 10.55 |
| 2000 | 18.33 | 18.66 | 3.46 | 10.84 |
| 2001 | 19.14 | 19.22 | 3.66 | 11.80 |
| Average | 18.62 | 18.84 | 3.50 | - |

Source: MPOB (2001).

**TABLE 4. YIELD OF OIL PALM**

| Yield class | Oil yield (t/ha/yr) | Source |
|---|---|---|
| Wild groves | 0.2 | Ejemba (1989) |
| Average national yields | | |
| Nigeria | 2.1 | MPOB, Oil World (2002) |
| Indonesia | 3.4 | MPOB, Oil World (2002) |
| Malaysia | 3.7 | MPOB, Oil World (2002) |
| Colombia | 3.9 | MPOB, Oil World (2002) |
| Papua New Guinea | 4.2 | MPOB, Oil World (2002) |
| Good commercial yield: Malaysia | 5.5 | MPOB |
| Best experimental yields | | |
| Best plots | 8.6 | Corley *et al.* (1976) |
| Best progenies | 11.5 | Jalani (1999) |
| Best individual palms | 14.9 | MPOB |
| Theoretical yield | 18.6 | Corley (1996) |

## REASONS FOR LOW FRESH FRUIT BUNCH (FFB), OIL EXTRACTION RATE (OER) AND OIL YIELD-

Many reasons have been given for the low national average yield, namely,

### Expansion into Marginal Areas

During the initial phase of expansion, Class 1 and other good soils were readily available for oil palm development. However, due to very rapid expansion, very little Class 1 and 2 soils are left for planting and many plantations have gone into Class 3 and 4 which are marginal and unsuitable soils, respectively. For example, at least 40% of the oil palm areas in Felda are on poor to marginal soils and the productivity would be dependent on the agronomic inputs (Felda, 2002). However despite such inputs, the productivity may not increase commensurately because of the limitations of edaphic conditions (*Table 5*).

### Inadequate Agronomic Inputs

There could be inadequate agronomic inputs to maintain yields, especially during low palm oil prices. When the plantations, owned by the organizations are very large, they have different classes of soils and with wide distribution. The effects of fertilizer reduction on yield at six different situations (*Tables 6* and *7*) have been elucidated by MPOB (Mohd Tayeb and Tarmizi, 2001).

Despite low oil prices, plantations should continue with adequate agronomic inputs to ensure higher yields by using appropriate technologies, such as eco-specific, site-specific or precision agriculture (combination of GPS, GIS, RS and VRT or geographical positioning system, geographical information system, remote sensing and variable rate

**TABLE 5. EXPECTED FRESH FRUIT BUNCH YIELD (t/ha) FROM OIL PALM GROWN IN DIFFERENT CLASSES OF SOILS**

| Year of planting | Coastal soils | | | Inland soils | | |
|---|---|---|---|---|---|---|
| | Good | Average | < Average | Good | Average | < Average |
| 3 | 14 | 12 | 10 | 9 | 8 | 6 |
| 4 | 24 | 21 | 18 | 17 | 15 | 12 |
| 5 | 30 | 27 | 23 | 21 | 19 | 16 |
| 6 | 32 | 28 | 24 | 24 | 22 | 19 |
| 7 | 32 | 27 | 24 | 26 | 23 | 20 |
| 8 | 31 | 27 | 23 | 26 | 23 | 21 |
| 9 | 31 | 27 | 23 | 24 | 22 | 21 |
| 10 | 31 | 27 | 23 | 24 | 22 | 20 |
| 11 - 15 | 30 | 26 | 22 | 23 | 21 | 18 |
| 16 - 20 | 27 | 23 | 20 | 21 | 20 | 17 |
| 21 - 25 | 22 | 20 | 18 | 18 | 16 | 14 |
| Average | 27.6 | 24.2 | 20.7 | 21.2 | 19.6 | 16.7 |

Source: Mohd Tayeb (1994).

**TABLE 6. GOOD INLAND SOIL (*e.g.* Munchong Series – Typic Kandiudult): EXPECTED FRESH FRUIT BUNCH (t/ha/yr) AND PERCENTAGE YIELD DECLINE (in parenthesis) AFTER FERTILIZER REDUCTION**

| Period | Fertilizer reduction | | | |
|---|---|---|---|---|
| | 25% | 50% | 75% | 100% |
| Age 8 years:current year | 28.3 | 28.3 | 28.3 | 28.3 |
| 1st year | 28.2 (-0.4%) | 28.1 (-1%) | 27.9 (-1%) | 27.4 (-3%) |
| 2nd year | 28.1 (-1%) | 27.8 (-2%) | 27.2 (-4%) | 25.6 (-10%) |
| 3rd year | 28.0 (-1%) | 27.4 (-3%) | 26.5 (-6%) | 23.8 (-16%) |
| 4th year | 28.0 (-1%) | 27.2 (-4%) | 26.1 (-8%) | 22.9 (-19%) |
| Age 12 years:current year | 26.4 | 26.4 | 26.4 | 26.4 |
| 1st year | 26.3 (-0.4%) | 26.2 (-1%) | 26.0 (-2%) | 25.8 (-2%) |
| 2nd year | 26.0 (-2%) | 25.6 (-3%) | 24.8 (-6%) | 23.7 (-10%) |
| 3rd year | 25.7 (-3%) | 25.0 (-5%) | 23.3 (-12%) | 21.4 (-19%) |
| 4th year | 25.5 (-3%) | 24.6 (-7%) | 22.6 (-14%) | 20.2 (-23%) |
| Age 16 years:current year | 25.4 | 25.4 | 25.4 | 25.4 |
| 1st year | 25.3 (-0.4%) | 25.2 (-1%) | 25.0 (-2%) | 24.9 (-2%) |
| 2nd year | 25.0 (-2%) | 24.1 (-5%) | 22.5 (-11%) | 21.9 (-14%) |
| 3rd year | 24.5 (-4%) | 22.9 (-10%) | 19.7 (-22%) | 18.5 (-27%) |
| 4th year | 24.2 (-5%) | 22.1 (-13%) | 18.1 (-29%) | 16.5 (-35%) |

Source: Mohd Tayeb and Tarmizi (2001).

technology respectively). Efficiency in agro-management inputs would lead to higher yield, thus lowering the cost of production (Soh and Goh, 2002).

**Ineffective and Inadequate Management**

Ineffective and inadequate implementation of good estate practices will lead to low quality output. A notable example is the poor control in the harvesting standards which results in many unripe and under-ripe bunches being cut, leading to low OER (*Tables 3, 8* and *9*). The category of ripe bunches has been known to be as low as 68% although the standard is set usually at over 90%.

**Shortage of Skilled Labour**

The shortage of skilled labour supply has resulted in low productivity. The plantations rely heavily on immigrant workers who are mainly unskilled and lack experience as they work only for the short-term. The result is low productivity leading to low harvesting standards and low OER, as

**TABLE 7. GOOD COASTAL SOIL (*e.g.* Selangor Series – Aeric Tropic Fluvaquent): EXPECTED FRESH FRUIT BUNCH YIELD (t/ha/yr) and PERCENTAGE YIELD DECLINE (in parenthesis) AFTER FERTILIZER REDUCTION**

| Period | Fertilizer reduction | | | |
|---|---|---|---|---|
| | 25% | 50% | 75% | 100% |
| Age 8 years:current year | 29.1 | 29.1 | 29.1 | 29.1 |
| 1st year | 29.0 (%) | 28.8 (-1%) | 28.6 (-2%) | 28.3 (-3%) |
| 2nd year | 28.8 (-1%) | 28.3 (-3%) | 27.6 (-5%) | 26.8 (-8%) |
| 3rd year | 28.6 (-2%) | 27.8 (-4%) | 27.6 (-9%) | 25.3 (-13%) |
| 4th year | 28.5 (-2%) | 27.5 (-6%) | 26.1 (-10%) | 24.5 (-16%) |
| Age 12 years:current year | 29.1 | 29.1 | 29.1 | 29.1 |
| 1st year | 29.0 (0%) | 29.0 (0%) | 28.8 (-1%) | 28.7 (-1%) |
| 2nd year | 28.9 (-1%) | 28.5 (-2%) | 28.0 (-4%) | 27.4 (-6%) |
| 3rd year | 28.7 (-1%) | 28.0 (-4%) | 27.0 (-7%) | 25.9 (-11%) |
| 4th year | 28.6 (-2%) | 27.7 (-5%) | 26.5 (-8%) | 25.1 (-14%) |
| Age 16 years:current year | 29.1 | 29.1 | 29.1 | 29.1 |
| 1st year | 29.1 (0%) | 29.0 (0%) | 29.0 (0%) | 28.9 (-1%) |
| 2nd year | 28.9 (-1%) | 28.6 (-2%) | 28.2 (-3%) | 27.8 (-4%) |
| 3rd year | 28.7 (-1%) | 28.0 (-4%) | 27.3 (-6%) | 26.4 (-9%) |
| 4th year | 28.6 (-2%) | 27.7 (-5%) | 26.8 (-8%) | 25.7 (-12%) |

Source: Mohd Tayeb and Tarmizi (2001).

shown in *Tables 8* and *9*, higher turnover of labour and higher costs.

### Low Replanting Rate

The low replanting rate which has contributed to the present high percentage of old palms, *i.e.* >20 years old (*Tables 10* and *11*), has posed harvesting difficulties and hence lowered productivity. Replanting will provide an opportunity for the industry to replace the low yielding old palms (which originated from the seeds of the 1960's and 1970's) with the new higher yielding materials of the 1990's.

*Table 11* indicates that replanting has been delayed with the increase in percentage of trees over 25 years old.

### Imbalance in Extension Capability

There is an imbalance in the extension capability vis-à-vis oil palm area compared to the total agricultural area. Oil palm covers nearly 60% of the cultivated land in Malaysia. Private estates, Felda, Felcra, Risda, LPP and state land schemes have their in-house advisory services and some even engage consultants to give advice.

However, there are over 90 000 smallholdings which cover 343 342 ha (*Table 12*) and they do not have extension services as the Department of Agriculture does not provide these services to oil palm smallholders.

Yusof (2002) suggested that

**TABLE 8. COMPARISON IMPACT OF FRESH FRUIT BUNCH QUALITY ON OIL EXTRACTION RATE**

| FFB quality category | Percentage (%) | | | | | | | | MPOB grading manual (%) |
|---|---|---|---|---|---|---|---|---|---|
| | P. Malaysia | | | | | | Sabah | | |
| | Mill A | Mill B | Mill C | Mill D | Mill G | Mill H | Mill I | Mill J | |
| Unripe | 2.3 | 4.4 | 7.0 | 10.4 | 0.2 | 9.2 | 1.5 | 3.4 | 0 |
| Under-ripe | 21.1 | 21.6 | 15.5 | 16.5 | 5.3 | 10.5 | 5.4 | 7.1 | <10 |
| Ripe | 73.6 | 67.3 | 73.2 | 64.7 | 94.1 | 75.9 | 86.2 | 83.8 | >90 |
| Rotten | 2.0 | 6.0 | 2.2 | 4.8 | 0.1 | 2.1 | 6.0 | 4.6 | 0 |
| Empty | 1.0 | 0.7 | 2.1 | 3.6 | 0.3 | 2.3 | 0.9 | 1.1 | 0 |
| Long stalk | 30.0 | 3.0 | 16.0 | 21.4 | 0.2 | 9.8 | 0.13 | 0.2 | 0 |
| Dirty | 0 | 0 | 0 | 0.1 | 0 | 0.1 | 0 | 0.2 | 0 |
| *Dura* | 5.0 | 10.0 | 1.9 | 7.1 | 0.2 | 4.7 | 1.8 | 4.5 | 0 |
| Mill OER % | 18.12 | 17.41 | 16.31 | 16.85 | 20.14 | 18.47 | 19.14 | 20.21 | - |

Source: Adapted from Zulkifli (1995).

**TABLE 9. FRESH FRUIT BUNCH QUALITY OF A SEPARATE ASSESSMENT AT MILL C**

| Bunch type | Own estate (%) | Organized smallholders (%) | Dealers (%) | Total (%) |
|---|---|---|---|---|
| Unripe | 5 | 11 | 11 | 9 |
| Under-ripe | 12 | 20 | 25 | 19 |
| Ripe | 78 | 65 | 61 | 68 |
| Rotten | 3 | 2 | 1 | 2 |
| Empty | 2 | 2 | 2 | 2 |
| Total | 100 | 100 | 100 | 100 |
| Long stalks | 12 | 12 | 34 | 19 |
| Dirty bunches | 0 | 0 | 0 | 0 |
| *Dura* | 1 | 8 | 2 | 4 |

Source: Adapted from Zulkifli (1995).-

**TABLE 10. TOTAL AND IMMATURE AREAS UNDER OIL PALM AND ANNUAL RATES OF REPLANTING**

| Periods | Mean total planting (ha) | Immature | | New planting (%) | Replanting (%) | Annual rates of replanting | New over replanting (%) |
|---|---|---|---|---|---|---|---|
| | | (ha) | (%) | | | | |
| 1975-79 | 786 009 | 259 100 | 32.96 | 9.44 | 23.51 | 7.84 | 40.15 |
| 1980-84 | 1 179 454 | 259 958 | 22.04 | 6.68 | 15.35 | 5.12 | 43.51 |
| 1984-89 | 1 701 413 | 273 865 | 16.09 | 7.24 | 8.85 | 2.95 | 81.81 |
| 1990-94 | 2 207 394 | 282 378 | 12.79 | 4.22 | 8.56 | 2.85 | 49.30 |
| 1995-99 | 2 903 394 | 390 785 | 13.46 | 6.21 | 7.25 | 2.41 | 85.66 |

Source: Jalani *et al.* (2001).

**TABLE 11. AGE PROFILE OF OIL PALM BY AGE GROUP (% of total area)**

| Period | Mean area (ha) | Age group (years) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1-3 | 4-8 | 9-13 | 14-18 | 19-24 | >25 |
| 1975 – 79 | 786 009 | **33.52** | **42.30** | 14.73 | 8.29 | 1.16 | 0.1 |
| 1980 – 84 | 1 179 454 | 22.21 | 40.10 | 21.55 | 9.85 | 6.29 | 0.0 |
| 1985 – 89 | 1 701 413 | 16.23 | 35.72 | **24.42** | 14.93 | 7.30 | 1.40 |
| 1990 – 94 | 2 207 815 | 12.84 | 34.12 | 19.77 | **18.70** | 13.05 | 1.50 |
| 1995 – 99 | 2 903 394 | 13.36 | 30.04 | 21.42 | 15.07 | **16.87** | 3.24 |
| 2000 | 3 374 485 | 15.39 | 28.89 | 17.22 | 16.92 | 13.81 | **7.77** |

Source: Jalani *et al.* (2001).

these independent smallholders should be provided with appropriate extension services. The FFB yield is estimated at an average of only 15.0 t/ha with an OER of 18.84% so that the total oil produced from the above area is estimated at only 970 285 t per year.

Yusof (2002) further argued that with good extension services, for example, the same area would be able to produce FFB yield of 20 t/ha with 20% OER which could translate to 1 373 368 t of oil. The net increase in oil yield will be 403 083 t with a value (price @ RM 1150/t) of RM 463 545 450 (*Table 13*). This would be a huge extra earning to the smallholders!

How can the cost of these extension services be covered? Yusof (2002) proposed that MPOB will earn an extra cess (MPOB RM 9, MPOPC RM 2 and RM 4 for palm oil price stabilization) from the increase in oil production to the tune of RM 3 627 747 (403 083 t x RM 9). Part of this extra cess can be used to finance the hiring of new extension service technicians (at a cost of RM 900 000 per year).

The authors have noted that *Table 13* shows an idea but no exact

**TABLE 12. DISTRIBUTION OF OIL PALM AREA IN 2001**

| Category | ha | % |
|---|---|---|
| Private estates | 2 079 342 | 59.43 |
| Felda | 621 742 | 17.51 |
| Felcra | 165 528 | 4.73 |
| Risda | 48 605 | 1.39 |
| State schemes | 249 454 | 7.13 |
| Smallholders | 343 342 | 9.81 |
| Total | 3 499 012 | 100 |

cost for all situations can be forwarded here as the final costing will be the subject of another paper.

### Combination of Low Fresh Fruit Bunch (FFB) with Low Oil Extraction Rate (OER)

The effects of the above six causes of stagnating FFB yield and OER will result in lower productivity (*Tables 3, 8* and *9*) which will subsequently lead to a higher cost of production, thus making the production of palm oil unsustainable and uncompetitive.

The above issues have affected the overall productivity, profitability and competitiveness of the industry. They must be addressed, partly with the employment of extension technicians. In addition, the industry has to face competition from other countries producing palm oil as well as other oils and fats.

**TABLE 13. COST BENEFIT OF INTENSIVE EXTENSION TO SMALLHOLDERS**

| | |
|---|---|
| 1. Current situation (2001) | |
| a. Total area of independent smallholders | 343 342 ha |
| b. Average FFB yield | 15 t/ha |
| c. Oil yield at 18.44% OER | 970 285 t |
| d. Income (c x RM 1150/t) | RM 1 115 827 750.00 |
| 2. After intensive extension | |
| e. Expected increase in FFB yield | 20 t/ha |
| f. Expected oil yield at 20% OER | 1 373 368 t |
| g. Expected income (f x RM 1150/t) | RM 1 579 373 200.00 |
| h. Difference in oil yield (f – c) | 403 083 t |
| i. Difference in income (g - d) | RM 463 545 450.00 |
| 4. MPOB | |
| j. Expected increase in cess income (h x RM 9) | RM 3 627 747.00 |
| k. Cost to employ 50 extension technicians per year | RM 900 000.00 |

**TABLE 14. STEPWISE INCREMENT TO ACHIEVE NATIONAL AVERAGE YIELD**

| Year | FFB yield (t/ha) | OER (%) | Oil yield (t/ha) | Remark |
|---|---|---|---|---|
| 1992-2001 average | 18.7 | 18.8 | 3.5 | Benchmark |
| 2003 | 20.5 | 19.5 | 4.0 | Target |
| 2005 | 22.5 | 21.5 | 4.8 | Target |
| 2010 | 25.0 | 22.5 | 5.6 | Target |
| 2015 | 30.0 | 23.5 | 7.1 | Target |
| 2020 | 35.0 | 25.0 | 8.8 | Vision |

## APPROACHES TO INCREASE YIELD

### Target Dates for Achieving Stepwise Yield Increase

The industry needs to be forward looking and should have pragmatic and innovative plans of action to increase the national average yield. The industry also needs a long-term strategy to achieve the vision of 35 t/ha FFB with 25% OER to yield 8.8 t/ha oil (*Table 14*).

The set goals will enable the industry to continue having a sustainable high productivity, cost-effectiveness, competitiveness by achieving the vision of having oil yield at 8.8 t/ha through 35 t/ha FFB with 25% OER. To attain this vision, there must be stepwise increments of the national oil yield from the 10-year average of 3.5 t/ha to 4.0 t/ha in 2003 and subsequent increases to 4.8, 5.6, 7.1 and finally to the envisioned 8.8 t/ha in 2005, 2010, 2015 and 2020 respectively. The industry needs to form pragmatic, immediate- and medium- to long-term strategies to realize these yield targets.

### Immediate Strategies

To increase the oil yield from the 10-year average of 3.5 t/ha to 4.0 t/ha in the year 2003, the following strategies need to be implemented immediately:

- apply the appropriate fertilizer dosages, timings and methods;
- practise good harvesting standards: ripe bunches and collect all loose fruits;
- evacuate all ripe bunches and loose fruits to the mill; and
- practise a replanting programme to have the optimal age profile.

**Medium to Long-term Strategies**

To increase the national oil yield average from 4.0 t/ha in 2003 to 8.8 t/ha in 2020, there is a need to minimize the constraints and issues mentioned in *Reasons for Low Fresh Fruit Bunch, Oil Extraction Rate and Oil Yield*. This can be achieved by increasing productivity through the following strategies:

- continue planting on Class 1 and 2 soils, but reduce or stop planting on Class 3 (marginal) and Class 4 (unsuitable) soils by reverting the latter to some plantation forest crops;
- continue active replanting programme to obtain appropriate ratio of the age profile of immature-young (1-7 years), mature (8-19 years) and old (• 20 years) palms at 20%, 70% and 10% respectively as alluded earlier;
- plant the latest high yielding and resource-efficient planting materials of both conventional and clonal materials;
- apply the latest agronomic inputs using precision agriculture practices;
- increase mechanization to further improve labour productivity and operational efficiency to reduce cost;
- apply pragmatic and innovative the plantation management practices; and
- conduct effective extension programmes to the various upstream sectors of the industry.

## PREDICTED YIELD, PRODUCTION AND REVENUE

Using the standard statistical methods, the predicted yield per hectare has been used to estimate the oil production from 2002 to 2020 (*Table 15*). For example, the palm oil production will increase from 12.40 to 18.81 million tonnes in the year 2003 to 2020.

In the year 2003, the industry with the predicted yield of 12.40 million tonnes will earn a revenue of RM 15.50 billion (@ RM 1250/t) while using the target yield of 4 t/ha the production will be 13.26 million tonnes with a revenue of RM 16.58 billion.

The difference of revenue between predicted and target yield is RM 1.08 billion in 2003, and this increases to RM 4.21, 9.51, 20.74 and 31.23 billion in 2005, 2010, 2015 and 2020 respectively in accordance with the target yield.

It is therefore, very pertinent for the industry to have a long-term vision and implement strategies and plans of action to recover the otherwise lost revenue. At the same time, higher oil yield would lower production cost, thus making palm oil more competitive, profitable and sustainable.

## DISCUSSION AND CONCLUSION

The challenge in the immediate-term is to embark on an aggressive replanting programme to replace the older palms that are no longer productive with new *teneras* which are higher yielding. In Malaysia, where labour is a problem, the need for mechanization is all the more compelling as a strategy to increase productivity.

Mechanization and automation are to be adopted in all sectors from planting to processing. Care must be exercised in planting and replanting on marginal soils where the yields and returns do not increase in proportion to the inputs applied. R&D should be stepped up to refine the techniques of precision agriculture practices and manuring programmes in the industry. The new knowledge is to be widely extended to the large number of smallholders. The increased productivity and yield will help supply the growing demand for oils and fats in line with the increase in world population. If the issues and challenges outlined in this paper are addressed and effectively implemented, the future of the oil palm industry will remain bright.

**TABLE 15. PREDICTED YIELD, PRODUCTION AND REVENUE**

| Year | Predicted yield (t/ha) | Production (million t) | Revenue @ RM 1250/t (RM billion) | Target yield (t/ha) | Production (million t) | Revenue @RM 1250/t (RM billion) | Difference in revenue (RM billion) |
|---|---|---|---|---|---|---|---|
| 2002 | 3.70 | 11.64 | 14.55 | - | - | - | - |
| 2003 | 3.74 | 12.40 | 15.50 | 4.00 | 13.26 | 16.58 | 1.08 |
| 2005 | 3.86 | 13.86 | 17.33 | 4.80 | 17.23 | 21.34 | 4.21 |
| 2010 | 3.83 | 16.47 | 20.59 | 5.60 | 24.08 | 30.10 | 9.51 |
| 2015 | 3.75 | 18.58 | 23.23 | 7.10 | 33.18 | 43.97 | 20.74 |
| 2020 | 3.78 | 18.81 | 23.51 | 8.80 | 43.74 | 54.74 | 31.23 |

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