An Economic Perspective of Oil Extraction Rate in the Oil Palm Industry of Malaysia

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ABSTRACT

The national average oil extraction rates (OER) in Malaysia since 1980 until 2002, have fluctuated from a low of 18.48% in 1982 to a high of 19.87% in 1987/1988, although many individual mills have obtained more than 20% OER.

In times of low prices of crude palm oil (CPO) as seen in the recent period of 2000/2001 and low yield productivity, producers are challenged to improve the performance of OER as this measurement is a management tool in assessing the profitability of a plantation enterprise.

Historical OERs for the past 10 years are used to estimate at the macro level, the quantity and value of CPO loss or gain, arising from the annual change of OER. The differentials of the annual OERs and the 20% benchmark OER are also used to estimate the loss in revenue, since until now, the benchmark OER of 20% has not been attained. The highest loss of CPO revenue amounted to about RM 255 million in 1999 arising from an annual change of minus 0.31% OER, whilst that arising from the differential of the OER in 1999 and the benchmark 20% OER, or a drop of 1.4%, amounted to an astounding RM 1.15 billion in a single year based on an average CPO price of RM 1449.50 in 1999.

If CPO is considered in the downstream processing, value adding that could have been achieved ranged from RM 21.53 to RM 54.66/t in the five-year period of 1997-2001.

INTRODUCTION

Malaysian palm oil accounts for 21% and 46% of the global oils and fats production and trade respectively. Malaysia is the world's largest producer and exporter of palm oil with a 50% share of world's palm oil production and 61% share of exports.

For the past three years of 2000, 2001 and 2002, the production of CPO in Malaysia was 10.84 million tonnes, 11.80 million tonnes and 11.91 million tonnes respectively. The export of oil palm products for the same period generated an export revenue of RM 14.94 billion, RM 14.22 billion and RM 19.62 billion.

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The first step in the milling of oil palm fruits is the production of CPO and palm kernel (PK). OER and kernel extraction rate (KER) are two important parameters that are directly related to the profitability of an oil palm enterprise. The main objective of the mills is to contribute to the attainment of as high as possible on these two extraction rates in order to achieve maximum production of CPO and kernel per hectare. The CPO produced is a function of the quantity/quality of the fresh fruit bunches (FFB) milled and the OER of the mills.

This paper attempts to analyse the economic perspective of OER by using data obtained from the mandatory submission of the monthly statement returns by palm oil mills in Malaysia.

USE OF OIL EXTRACTION RATE (OER)

OER can be used as a management tool in assessing the performance of a mill and plantation, as profitability of a plantation group is to a great extent influenced by the amount of oil realized per hectare of land under cultivation. OER is the percentage of the weight of oil physically recovered from a known weight of FFB processed. This is represented as shown below:

$$\text{OER} = \frac{\text{Oil recovered}}{\text{FFB processed}} \times 100$$

Although there are many factors affecting the measurement of OER, such as crop weight, cage weight, ullaging, *etc*, it is assumed that the figures submitted by the mills are reliable as mills are subject to regular enforcement work carried out by MPOB.

FACTORS AFFECTING OIL EXTRACTION RATE (OER)

There are many factors affecting OER, the major factors being:

- bunch fruit-set arising from pre- and post-introduction of the pollinating weevil (*Elaeidobius kamerunicus*) in 1982, which have changed the bunch composition and bunch geometry;
- planting materials of the latter generation of hybrids of DxP, including *dura* contamination;
- machineries/equipment that are not properly maintained and upgraded;
- management in respect to optimum ripeness standard, harvesting round, loose fruit collection, supervision of harvesters, adequate labour force especially harvesters and the level of mechanization. Efficiency of processing; and
- climatic, seasonal and geographical variations.

OIL EXTRACTION RATE (OER) PERFORMANCE IN MALAYSIA

For the last 20 years, there was a general downtrend in the performance of OER in Malaysia. Although East Malaysia has a generally slightly higher OER than Peninsular Malaysia, the trend still exists as seen in *Figure 1*. The highest average OER in Malaysia was 19.87% recorded in 1987/88, which then declined gradually to 18.67% in 1993 with a drop of 1.2%.

Following a campaign to increase the OER in 1995, spearheaded by erstwhile PORLA, the national OER improved from 18.51% in 1995 to reach 19.03% in 1997. However, the OER declined again for the next two years until 2002, when it recovered to 19.91%. The average 2002 OER of 19.91%, is a tremendous

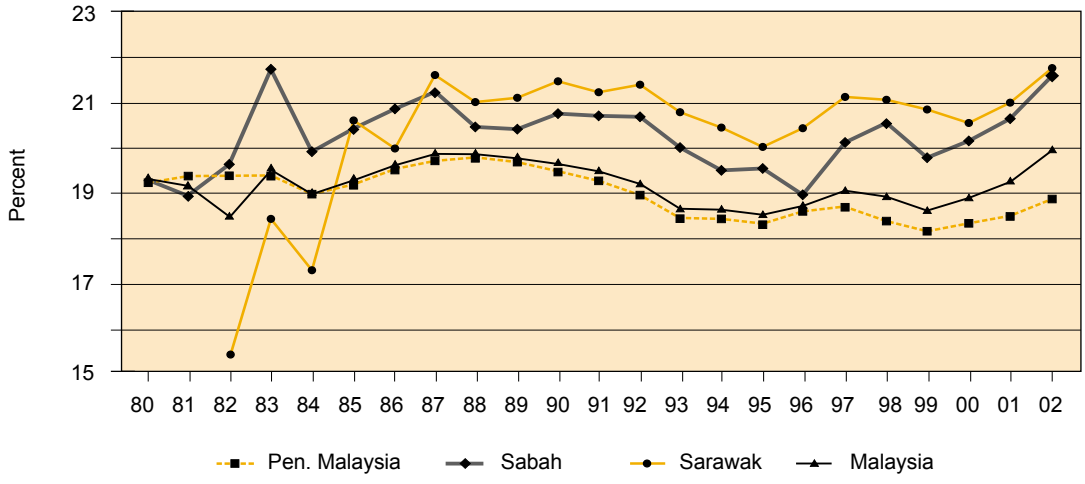

Figure 1. Performance of oil extraction rate (OER) in Malaysia, 1980-2002.

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improvement arising from the on-going national productivity campaign conducted by MPOB. The producers and millers are now more aware of the importance and benefits of improving OER.

The OER in Peninsular Malaysia is slightly lower than the average for Malaysia and the trend generally follows that of the OER of Malaysia arising from the larger number of mills (constituting 69% of the total mills in Malaysia) in Peninsular Malaysia.

On the other hand, OER in East Malaysia is generally higher than that of Malaysia, with Sabah and Sarawak having OERs higher than the national average by about 0.5% to 1.5% and 1.5% to 2% respectively. The difference in OER between Sabah and Sarawak is generally narrow, *i.e.* about 0.5% to 1%, however, in recent years especially from 2000 to 2002, OER in Sabah has been on the increase resulting in the narrowing of the OER gap between Sabah and Sarawak.

As at the end of 2002, there were a total of 362 mills operating in Malaysia, with 113 mills located in East Malaysia. In recent years, their OER performance has shown some improvement with more mills achieving higher OER in the period 2000-2002 as depicted in *Figure 2*. Overall, the number of mills with OER of 20% & above had increased from 60 in 2000 to 135 in 2002, or a 125% increase.

The improvement of OER was most pronounced in 2001 and 2002 for several categories namely, the 20%-20.9%, 21%-21.9% and 22% & above OER categories where the number of mills in these categories increased by 3, 11 and 32 respectively from 2001 to 2002.

In the 22% & above OER category, there was a marked increase in the number of mills achieving this level, from only one mill in 2000 to eight mills in 2001 and again to 40 mills in the year 2002. From the 40 mills in 2002, 31 were from Sabah, eight from Sarawak and one from Peninsular Malaysia.

In the 21%-21.99% OER category, there was also encouraging improvement, *i.e.* from 15 mills in 2000 to 31 mills and 42 mills in 2001 and 2002 respectively. Most of these 42 mills in 2002 were from East Malaysia, Sabah with 32, Sarawak with four and Peninsular Malaysia with six mills.

In the 20%-20.99% OER category, there was progressive improvement in the number of mills achieving this level of OER from 41 mills in 2000 to 50 mills in 2001 and 53 mills in 2002. Of the 53 mills in 2002, 28 mills were in Peninsular Malaysia, 21 mills were in Sabah and four in Sarawak.

There was relatively little change in the 19%-19.99% OER category in the three-year period, with only an addition of two mills in 2002 achieving this category from 59 mills in 2001. The additional two mills came from Peninsular Malaysia, which predominated in this category with a total of 61 mills in 2002.

The largest number of mills were in the 18%-18.99% OER category which saw a decline of 122 mills in 2001 to 98 mills in 2002. Again Peninsular Malaysia is the largest in this category with 96 mills and two mills in Sarawak.

The 17%-17.99% OER category also saw a progressive decline in the number of mills from 93 mills in 2000 to 55 mills in 2002, indicating that most mills have improved their OERs.

Until now, the highest OER obtained by an individual mill was 24.11% in Sabah, 23.32% in Sarawak and 21.76% in Peninsular Malaysia, all in the year 2001.

There are three basic groups in the ownership of mills in Malaysia namely, the plantation-based or private mills (141), resource-dependent or private independent mills (138) and government or government-related mills (83). The proportion of mills in the respective order was 39%, 38% and 23% of the total number of mill at the end of 2002.

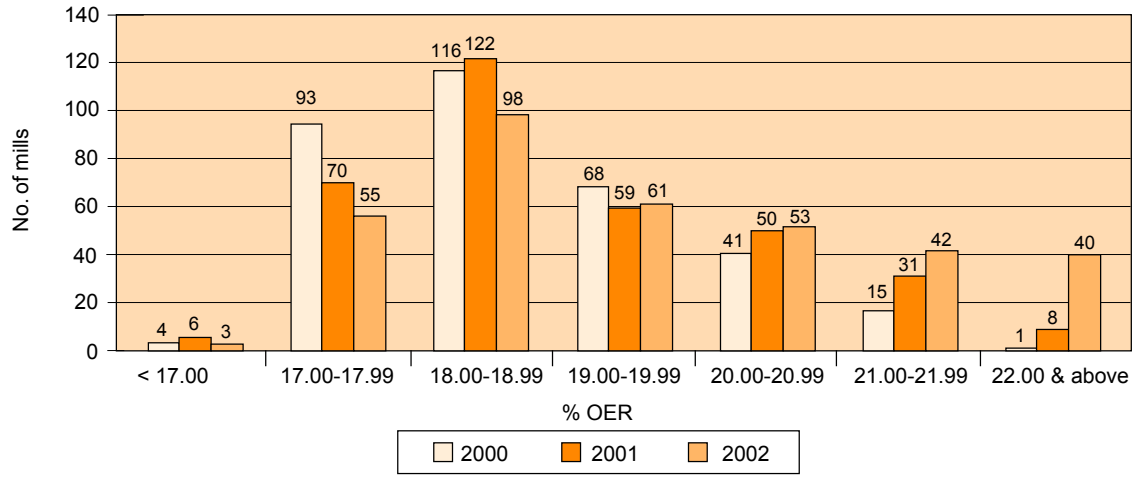

Figure 2. Distribution of mills in oil extraction rate (OER) performance, 2000-2002.

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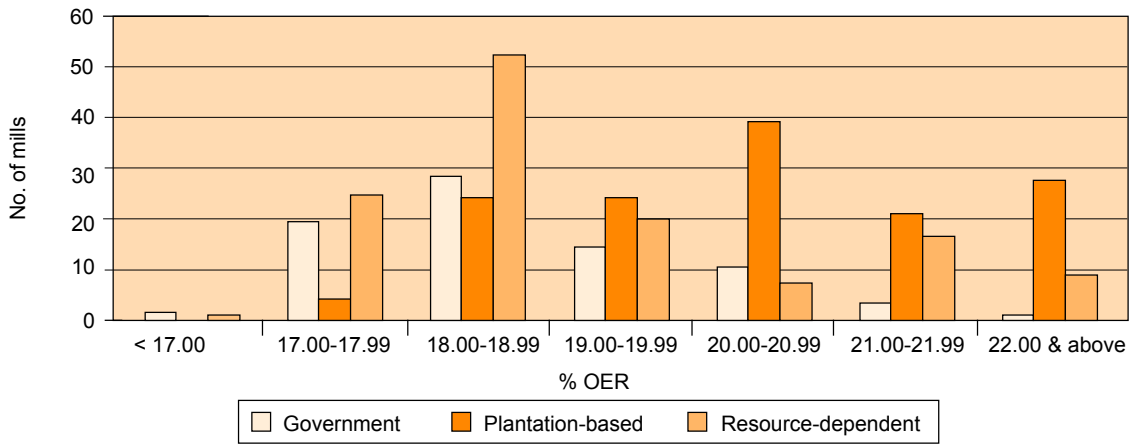

Figure 3. Ownership of mills on oil extraction rate (OER) performance.

Generally, the performance of the plantation-based mills is better than the independent mills, which in turn, is better than the government, or government-related mills as shown in *Figure 3* for the year 2002.

Between the two categories of 20% & above OER category and below 20% OER category, the plantation-based mills in 2002 recorded 90 mills with OER of 20% and above, followed by 35 mills by the private independent mills and 17 mills by the government mills, and they accounted for 63%, 25% and 12% respectively of the total number of mills in this category.

On the other hand, in the 20% & less OER category, the number of mills by the plantation-based group was 51, 103 by the private independent group and 66 by the government group accounting for 23%, 47% and 30% respectively of the total number of mills in this category.

In the 22% & above OER category, the most number of mills was from the plantation-based group with 28 followed by 10 mills from the private independent group and only two mills from the government group. This ranking of the three groups of mills also prevailed for the 21%-21.99% OER category and the 19%-19.99% OER category. However, for the 20%-20.99% OER category, the ranking of the groups of mills was: the plantation-based group with 40, government group with 11 and followed closely by the private independent group with eight mills.

In the 18%-18.99% OER category, the private independent group recorded the highest number of 55, followed by the government group with 29 mills and the plantation-based group with 23 mills.

In the 17%-17.99% OER category, only three mills were recorded in the plantation-based group compared with more than 20 mills in each of the other two groups.

In the 17% & less OER category, there was only one mill each from the government and private independent groups.

THE POTENTIAL GAIN/LOSS OF CRUDE PALM OIL (CPO) ARISING FROM THE ANNUAL CHANGE IN OIL EXTRACTION RATE (OER)

Changes in OER have a bearing on the economy as such changes can result in higher or lower output of CPO from a given land area. With the information on OER, the production of CPO and the price of CPO traded in the domestic market, the quantity and value of CPO can be calculated. Records for the past 10-year OER from 1992–2001 are used to calculate the annual change in the previous year's OER to determine the potential gain/loss in terms of the quantity and value of CPO in the following year as shown in *Tables 1* and 2 and *Figure 4*.

Table 1 and *Figure 4* show that there were only four years out of a total of 10, *i.e.* in 1996-1997 and 2000-2001 when the annual change in OER registered some gains in the revenue of CPO, from a low of RM 107 million in 1996 to a high of RM 207 million in 1997. On the other hand, the lowest and highest CPO revenue loss amounted to RM 126 million in 1998 and RM 255 million in 1999. Overall, for the past 10 years, the total CPO revenue loss arising from the annual change in OER amounted to RM 88 million (summation of the last column of *Table 1*).

The potential loss to economy can also be gauged when the national average OER is compared to a realistic benchmark OER. For this purpose, a 20% OER is used as it is realizable with good management at the plantation and mill levels.

Table 2 and *Figure 4* compare the annual OER to the benchmark OER of 20% to calculate the difference in the quantity and value of CPO obtained. Obviously, the loss in CPO revenue was greater arising from a larger difference of OER and a larger quantity in the

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TABLE 1. QUANTITY AND REVENUE OF CRUDE PALM OIL (CPO) ARISING FROM THE ANNUAL CHANGE IN OIL EXTRACTION RATE (OER)

Year	OER (%)	Annual change in OER (%)	Production CPO (mil. tonnes)	Price CPO (RM/t)	Quantity of CPO gain / (loss) (mil. tonnes)	Revenue gain / (loss) (RM mil.)
1992	19.21	-0.26	6.37	916.50	-0.09	(79.02)
1993	18.67	-0.54	7.40	890.00	-0.21	(190.49)
1994	18.63	-0.04	7.22	1 283.50	-0.02	(19.90)
1995	18.51	-0.12	7.81	1 472.50	-0.05	(74.56)
1996	18.71	0.20	8.39	1 191.50	0.09	106.86
1997	19.03	0.32	9.07	1 358.00	0.15	207.12
1998	18.91	-0.12	8.32	2 377.50	-0.05	(125.53)
1999	18.60	-0.31	10.55	1 449.50	-0.18	(254.87)
2000	18.86	0.26	10.84	966.50	0.15	144.43
2001	19.22	0.36	11.80	894.50	0.22	197.70

TABLE 2. QUANTITY AND REVENUE OF CRUDE PALM OIL (CPO) ARISING FROM THE DIFFERENTIALS OF ANNUAL OIL EXTRACTION RATES (OERs) AND 20% BENCHMARK OIL EXTRACTION RATE (OER)

Year	OER (%)	Diff. in year's & 20% OER (%)	Production CPO (mil. tonnes)	Price CPO (RM/t)	Quantity of CPO loss (mil. tonnes)	Revenue loss (RM mil.)	Revenue loss per tonne of CPO (RM)
1992	19.21	-0.79	6.37	916.50	-0.26	(240.09)	(37.69)
1993	18.67	-1.33	7.40	890.00	-0.53	(469.17)	(63.40)
1994	18.63	-1.37	7.22	1 283.50	-0.53	(681.46)	(94.39)
1995	18.51	-1.49	7.81	1 472.50	-0.63	(925.73)	(118.53)
1996	18.71	-1.29	8.39	1 191.50	-0.58	(689.24)	(82.15)
1997	19.03	-0.97	9.07	1 358.00	-0.46	(627.83)	(69.22)
1998	18.91	-1.09	8.32	2 377.50	-0.48	(1 140.19)	(137.04)
1999	18.60	-1.40	10.55	1 449.50	-0.79	(1 151.03)	(109.10)
2000	18.86	-1.14	10.84	966.50	-0.66	(633.28)	(58.42)
2001	19.22	-0.78	11.80	894.50	-0.48	(428.35)	(36.30)

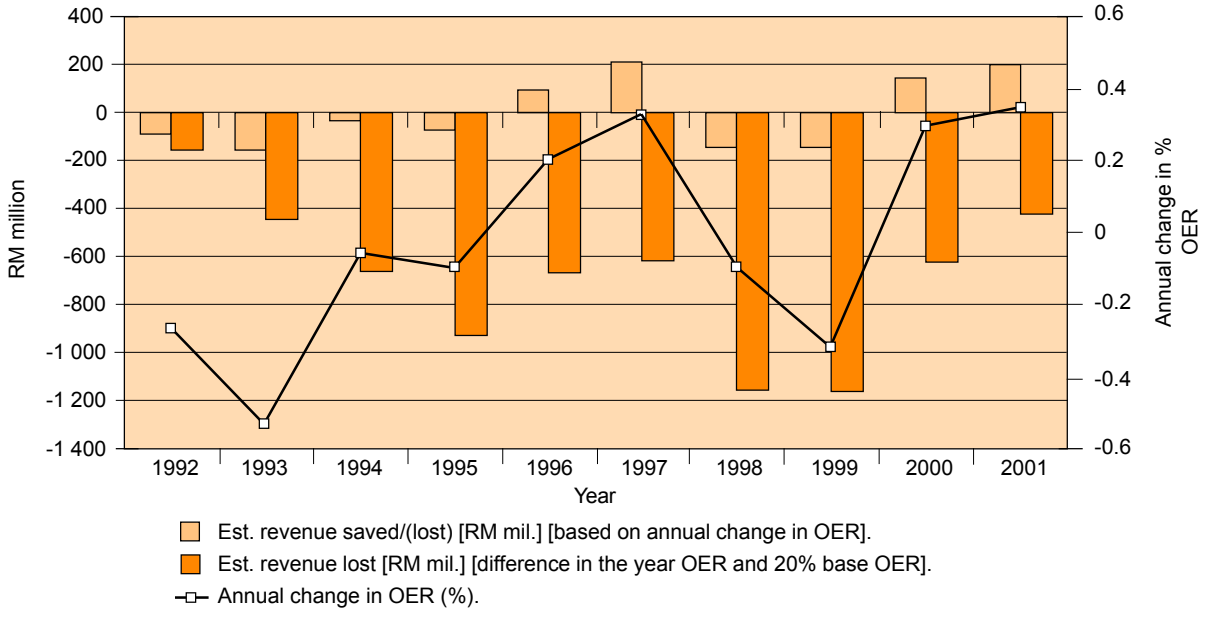

Figure 4. Revenue of crude palm oil (CPO) gain/loss arising from the annual change in oil extraction rate (OER) and differential of annual oil extraction rate (OER) and 20% benchmark oil extraction rate (OER).

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loss of CPO. The greatest loss was in 1999 with an oil loss of 790 000 t, (or 7.5% of the year's CPO production) incurring a revenue loss of RM 1.15 billion in a single year. This is equivalent to a loss of RM 109/t of CPO. This loss alone amounted to almost 8% of the export revenue of palm oil of RM 14.42 billion in 1999. The CPO revenue loss in 1998 was almost the same amounting to RM 1.14 billion. It is to be noted that 1998 was the year when the price of CPO was the highest at RM 2377.50/t. Overall, for the past 10 years, the total revenue loss of CPO arising from the difference of the annual OER and the benchmark OER of 20% amounted to an astounding RM 6.9 billion.

THE POTENTIAL REVENUE LOSS OF REFINED CRUDE PALM OIL (CPO)

The potential revenue loss of CPO would be greater, if it had been fully refined and fractionated down the value chain as processed products. In 2001, the major processed palm oil exported from Malaysia were RBD palm oil (RBD PO), RBD palm olein (RBD PL) and RBD palm stearin (RBD PS), constituting 77% of the total palm oil exports of 10.62 million tonnes. The quantity and export value of the three products amounted to 2.69 million tonnes (RM 2.56 billion), 4.58 million tonnes (RM 4.63 billion) and 0.88 million tonnes (RM 687 million) respectively. The total export value of the three products was also large, amounting to RM 7.88 billion or 78% of the total export value of RM 10.13 billion.

In this paper, the loss in quantity of CPO derived from the differentials of the annual OERs and the benchmark OER of 20% for the past five years is used. The four products namely, RBD PO, PFAD (palm fatty acid distillate), RBD PL and RBD PS and their equivalent quantities are used to estimate the value adding in the downstream process as shown in *Table 3*.

In the past five years, the total equivalent quantities of RBD PO, PFAD, RBD PL and RBD PS loss were 1.36, 0.14, 1.02, and 0.34 million tonnes respectively. The total revenue loss in the past five years for the four processed products ranged from a low of RM 120.88 million for PFAD to a high of RM 1988.41 million for RBD PO.

The total potential loss of revenue in the downstream processing of the products amounted to RM 4074.66 million as against that of the unprocessed CPO of RM 3980.68 million. The net added value that could have accrued to the economy amounted to RM 94 million for the five-year period. On the basis of a per tonne of palm oil, the value-added ranged from RM 21.53 in 2001 to RM 54.66 in 1997 or RM 32.74 for the whole of five years.

CONCLUSION

The use of OER is a useful management tool to assess the quantity of CPO produced per area of planted oil palm. An oil palm enterprise can estimate its loss or gain by benchmarking its OER performance with that of its counterparts or even with the national and state OER figures released monthly by MPOB. Indeed, monthly OER figures for all the states in Malaysia are available at MPOB website: *http://mpob.gov.my*.

Generally, the regional and national OERs differ by about 0.5% to 2% and follow the trend: OER Sarawak > OER Sabah > OER Malaysia > OER Peninsular Malaysia.

The loss of revenue in the oil palm industry as a result of low OER is quite substantial in the FFB if the yield and the quality of FFB are not given serious attention by the management. In 2002, the national OER of 19.91% obtained was better than the previous year and was close to the benchmark OER of 20%. Although a mere marginal reduction of 0.09% from the benchmark, the oil palm industry in 2002 incurred a national loss of 53 834 t of CPO amounting to a value of RM 73.4 million, based on the production of 11 909 297 t of CPO and the CPO average price of RM 1363.50/t in 2002. This was a tremendous improvement of almost six-fold, compared to the previous year, which incurred a national loss of RM 428 million with a reduction of 0.78% OER, with a production of 11.8 million tonnes and a CPO price of RM 894.50/t in 2001.

The impact on the potential loss in revenue is greater when value adding of CPO in the downstream processing in refineries and oleochemical plants is considered. This potential loss in revenue would amount to about RM 22 to RM 55/t of CPO depending on the loss in quantity of CPO and the price of palm oil.

The national OER in 2002 stands at 19.91%. It is the aspiration of the oil palm industry in Malaysia to target an OER of 20% and 21.5% in 2003 and 2005 respectively. Subsequently, an OER of 22.5% and 23.5% are targeted in 2010 and 2015 respectively. By then, the peak OER of 25% is hopefully attainable in the year 2020. The industry will require to improve further and find new ways so that the target of 25% OER can be achieved in the year 2020.

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TABLE 3. QUANTITY AND REVENUE OF REFINED/FRACTIONATED PRODUCTS ARISING FROM THE LOSS OF CRUDE PALM OIL (CPO) [based on the differentials of annual oil extraction rates (OERs) and 20% oil extraction rate (OER)]

Particulars	1997	1998	1999	2000	2001	Total
Qty. CPO loss mil. tonne	0.46	0.48	0.79	0.66	0.48	2.87
Equiv. Qty. RBD PO (x0.95x0.5) mil. tonne	0.22	0.23	0.38	0.31	0.23	1.36
Equiv. Qty. PFAD (x0.05) mil. tonne	0.02	0.02	0.04	0.03	0.02	0.14
Equiv. Qty. RBD PL (x0.95x0.75x0.5) mil. tonne	0.16	0.17	0.28	0.23	0.17	1.02
Equiv. Qty. RBD PS (x0.95x0.25x0.5) mil. tonne	0.06	0.06	0.09	0.08	0.06	0.34
Price RBD PO *RM /t*	1 444	2 487	1 514	1 030	937	-
Price RBD PFAD *RM /t*	741	1 430	852.5	604	661	-
Price RBD PL *RM /t*	1 559	2 614	1 639	1 084	968	-
Price RBD PS *RM /t*	1 132	1 955	1 076	787	784	-
Revenue RBD PO *RM million*	317.10	566.54	571.07	320.57	213.14	1 988.41
Revenue RBD PFAD *RM million*	17.13	34.29	33.85	19.79	15.83	120.88
Revenue RBD PL *RM million*	256.59	446.29	463.20	252.74	165.02	1 583.83
Revenue RBD PS *RM million*	62.28	111.57	101.68	61.33	44.68	381.53
Total revenue *RM million*	653.10	1 158.68	1 169.79	654.42	438.66	4 074.66
Revenue CPO loss *RM million*	627.83	1 140.19	1 151.03	633.28	428.35	3 980.68
Total revenue added *RM million*	25.27	18.49	18.76	21.14	10.31	**93.97**
Revenue added /t *RM*	54.66	38.55	23.63	32.27	21.53	**32.74**

Note: Assumptions (a) a unit quantity of CPO when refined, gives a proportion of 95% RBD PO and 5% PFAD and a refined unit quantity of RBD PO when fractionated, gives a proportion of 75% RBD PL and 25% RBD PS and (b) 50% of the quantity of RBD PO in this example, is fractionated into RBD PL and RBD PS.

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