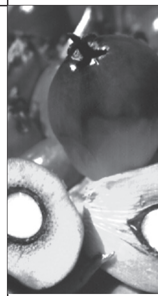

Declining Trends in Oil Extraction Rate (OER): Are We Facing an Impasse?

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INTRODUCTION

Are we facing an impasse in our drive for an increase in productivity? All the efforts taken to ensure that only good quality crop is delivered to the mill do not seem to have made any significant impact in achieving the goals. There are limitations in what human beings can do as many contributing factors for increased production are beyond human control. While oil loss, harvesting ripe crop and trash control are manageable by human effort, climatic conditions, weevil activity, inflorescence sex ratio *etc*. fall under the domain of mother nature, where we have little control. Many papers have been presented on all the possible areas where oil losses can take place leading eventually to a decline in the oil extraction rate (OER). They were written by different authors representing different plantation agencies and as a result they were not fully integrated to give the operational people a holistic view for them to effectively enforce them. The agronomists, planters and millers often present their views from different angles that may confuse the owners or the Chief Executive Officers (CEO) of companies who would be unable to make the right decision to benefit the company as a whole.

In our enthusiasm to achieve a continuous increase in the OER, we have overlooked certain environmental factors that will not permit us to follow our vision-based direction. This can be achieved provided ideal conditions prevail in all quarters and mother nature is obedient to our biddings. This article intends to review as much information as possible from different sources in order to generate a platform for making focused decisions (MFD) so that palm oil productivity may hopefully increase to meet the desired targets.

REVIEW OF PUBLISHED PAPERS

Our focus thus far has been on the efficiency of field activities and milling as contributing factors for the decline in the mill oil extraction rates. These two components have played such an important role in OER, that other factors have been virtually ignored and have became non-existent. Some of the comments of the researchers are reviewed here.

- Hor (1996) commented that the bunches had lower oil contents and that low

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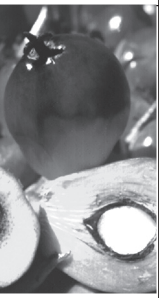

oil content and the low OER could not be blamed on poor oil recoveries as a result of declines in field and mill efficiencies. According to Ng (1993), there is nothing seriously wrong with the mills or the supplying estates to bring about a drastic decline in OER based on his studies in Kumpulan Guthrie.

- The impact of fertiliser application is usually limited to crop yields and is seldom linked to the oil content but Wood (1978) in the two trials he conducted in Malaysia observed that potassium chloride fertiliser treatments depressed oil-to-bunch ratios on inland soils. This was confirmed by Foster *et al.* (1987) in a trail conducted in Papua New Guinea. Similar depression of oil-to-bunch was reported by Green (1976) based on a trial conducted in Zaire (now known as the Democratic Republic of Congo) when using potassium chloride as well as magnesium chloride. However on coastal soils, the reverse was true. The potassium chloride increased the oil-to-bunch ratios!

- According to the observation by Ng (1993), moisture plays a very important role in depressing OER. As can be expected, a 5% increase or decrease in moisture content in fresh fruit bunch (FFB) can either depress or increase the mill OER. On rainy days, the mill OER will be easily depressed by 1%. In cases of this nature, there should be a provision to incorporate a FFB correction factor to eliminate the error due to the additional moisture content caused by the rain. This is a gain by the estate but a loss for the mill. For private mills, the bunch moisture content can be artificially created by the dealer by spraying water comparable to that of a rainy day. In addition, the moisture in the bunch could also serve as an adhering base for sand on the bunch. The impact of moisture is clearly illustrated in *Table 1.*

Ozone concentrations caused by vehicle exhausts and other industrial activities and excess sunshine in even unpolluted areas were reported to be 5 to 10 times that of the levels prevailing about a century ago. Ozone has many quantitative and qualitative effects on plant lipids. Higher concentrations can cause membrane degradation, catabolism of membrane lipids and fatty acid oxidation. Acute exposure to high ozone can reduce normal chloroplast and increase the accumulation of triacylglycerol (Sakakai *et al.*, 1990). With the above evidence, Harwood (1996) was convinced that ozone has the potential of reducing agricultural production significantly. As the vehicle emissions are not likely to diminish with the passage of time, we may expect a gradual rise in the concentration of ground level ozone from the average 100 parts per billion (ppb) now to perhaps more than 200 ppb. Currently, the specific impact of ozone on oil palm crop yields has not been investigated.

Excessive rain and the resulting water logging can cause oxygen starvation to palms producing toxic effects, according to Harwood (1995).

Harwood (1989) and Maksymiec *et al.* (1992) also observed that the heavy metals like copper, cadmium or nickel can also contribute towards suppression of fatty acid de-saturation. In oil palm plantations, where intercropping with pineapple is carried out, the use of copper sulphate and its toxic effect on the palms may have to be monitored closely.

Several fungicides have been proven to affect lipid metabolism. If herbicides are used near oil palms, they are likely to cause adverse effects on yield or quality. In such cases, Harwood (1996) cautions the indiscriminate use of herbicides as it may play a role on oil quality if not the yield.

Rajanaidu *et al.* (1996) in a trail conducted on the bunch weight and its influence on

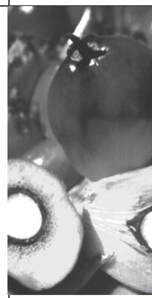

TABLE 1. FRESH FRUIT BUNCH MOISTURE EFFECT ON OIL EXTRACTION RATE

Parameters	Dry day	Normal day	Wet day
Fresh fruit bunch (t)	95.0	100.0	105.0
Moisture loss on sterilisation (%)	8.4	13.0	17.1
Sterilised fruit bunches (t)	87.0	87.0	87.0
Oil recovered (t)	20.0	20.0	20.0
Oil extraction rate	21.0	20.0	19.0

bunch components noted that there was an increase in all bunch components except the mesocarp to fruit ratio which decreased with the bunch weight. He observed that the adequate pollination by weevils, could have produced compact bunches with insufficient space for the inner fruits to develop their mesocarp.

Chin *et al.* (1996) observed that there is a declining trend in mean fruit weight (MFW) and also an increasing trend for the estimated number of fruits per bunch. Observations did not suggest any declining trend in the percentage oil-to-bunch but the fruit weight reduced from 12 - 16 g to 7 - 11 g.

Problems associated with pollination has been a much discussed topic, especially with the voluntary assistance offered by weevils.

- Turner and Gillbanks (2003) after their detailed investigation in the oil palm growing countries, have highlighted some aspects of the adverse impact of the prevailing weevil (*Elaeidobius kamerunicus* Faust) pollination despite its major benefits.

- According to Henson (1996), pollination is the most critical 'environmental' factor affecting O/B and K/B and as such extra vigilance is recommended. He also warned that the sex ratio must be kept low. Periodic poor pollination results in poor fruit set containing a significant percentage of parthenocarpic fruits that will drastically reduce the mill OER. Fruit growth can still take place without fertilisation, but the resulting parthenocarpic fruits will not attain the normal healthy fruit size but the dry matter and the oil content in such fruit will be very low.

- Apart from the pollination inefficiency, the vapour of the herbicide picloram can also induce parthenocarpic fruit sets in bunches (Turner and Gillbank, 2003).

- Low male inflorescence will invariably cause the decline in the population of weevils, as they are completely dependent on male inflorescence for their life cycle. New replants without the older palms in the vicinity are subjected to a low male to female inflorescence ratio of below 10% in which case, the likelihood of poor fruit set is high. If the weather conditions are unfavourable, it is possible to even have zero male inflorescence and in such situations the productivity will decline significantly. Such bunches most likely may be mistaken for unripe bunches. There will be a large number of unfertilised ovaries in partially pollinated inflorescence brought about by rains that restrict weevil activities.

- Another problem is the possible decline of the weevil population caused by the annihilation of weevil larvae by rats, and the adults by birds and frogs, even

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though its impact has not been reported as significant enough to have a drastic impact on its population. But it can add on to the other adverse conditions affecting productivity.

- The rats feeding on the weevils are likely to increase its population. Rats are reported to be responsible for a crop loss of 10% of the loose fruits in a field, producing 25 t FFB ha^{-1} according to Liau (1990). This is significant, as a loss of 2.5 t ha^{-1} on a 5000 ha estate is 12 500 t of crop per year, worth RM 7.5 million at a FFB price of RM 600 per tonne.

- Floral abortion believed to be due to earlier drought will reduce the development of inflorescence and eventually also influence the sex ratio in young palms.

In Costa Rica, it was reported by Sterling *et al.* (1996) that between 1990 to 1995 the fruit-to-bunch ratio dropped significantly due to a drop in the population of pollinating weevil that resulted in low fruit set value. This same scenario may be applicable to Malaysia now.

According to Sterling *et al.* (1996), the yearly variations in solar radiation and rainfall distribution will also change the oil content in the mesocarp.

After conducting extensive investigations on declining OER, Lim *et al.* (1996) concluded that there were no significant changes in the oil content in the bunch during the monitoring period. They suggested that the declining OER can be addressed by improving the management standards in all aspects of harvesting and crop quality. Although their conclusion has its merits, other factors such as weather patterns, weevil inactivity, declining weevil population and the unfavourable sex ratio of inflorescence, which have a profound influence on fruit-to-bunch ratios seem to have been overlooked.

The trash content in FFB is one of the major contributors of low OER in mills but the trash content can be eliminated. A 10% trash in the FFB consignment will cause a decline of OER by 2.2%. In FFB consignment of 1000 t containing 10% (or 100 t trash) the oil produced is 200 t. The declared OER will be 20%, but the actual OER based on the FFB weight of 900 t will be (200/900) x 100 = 22.22% boosting the OER by 2.22%. If a plantation can actually reduce the trash content in its consignment, then the mill OER will experience a welcome boost. The other quality boosters are long stalks, empty fruits and unripe bunches.

Loose fruit collections do not seem to be getting the attention they deserve. This is a controllable loss. Gan *et al.* (1993) have demonstrated that a loss of 20 loose fruits per bunch from 6 to 15 years old palms can reduce the mill OER by 0.46%. If 100 fruits per bunch are uncollected, the OER depression will be 2.3%. This is a very significant contributor of declining OER. The shortage of labour is considered to be one of the factors.

Water deficit can also play a major role in lower yields as can be seen in *Table 2* by Corley and Hong (1982).

Milling losses as compiled by Ng (1993) are given in *Table 3*.

The mill losses in general range from 1.5% to about 2.0%. If the target for the losses is 1.77%, and if a mill which has a process loss of 2.0%, it means that the loss exceeded the target by only 0.23%. This, compared to the trash and loose fruit contribution is 2.22 % + 2.3% = 4.45%, or 19 times more than the difference between the mill target and its actual losses. Now this is something worth pondering upon.

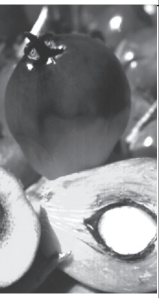

TABLE 2. THE EFFECT OF IRRIGATION ON FRESH FRUIT BUNCH (FFB) YIELD AND BUNCH COMPONENTS IN MALAYSIA

Treatment	FFB ($t\ ha^{-1}\ yr^{-1}$)	Oil/WM (%)	Oil/DM (%)	Oil/bunch (%)	PO yield ($t\ ha^{-1}\ yr^{-1}$)
Control	24.72	48.51	74.53	25.25	6.24
Irrigated	25.32	49.93	75.28	26.05	6.60
% gain	2.4	2.9	1.0	3.2	5.8

Note: WM – wet mesocarp. DM – dry matter. PO – palm oil.

TABLE 3. APPROXIMATE OIL LOSS IN PALM OIL MILLS

Source	% on loss/fresh fruit bunch
Fruit trapped in empty bunches (EFB)	0.02
Unstripped bunches (USB)	0.05
Oil absorbed on the surface of EFB	0.45
Condensate from sterilisation	0.10
Nut surface after pressing	0.05
Fibre after pressing	0.55
Sludge from the separators	0.45
General oil spillages or washing from tanks	0.10
Total milling losses	1.77

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