The Oil Palm Industry: Its Impact on the Environment

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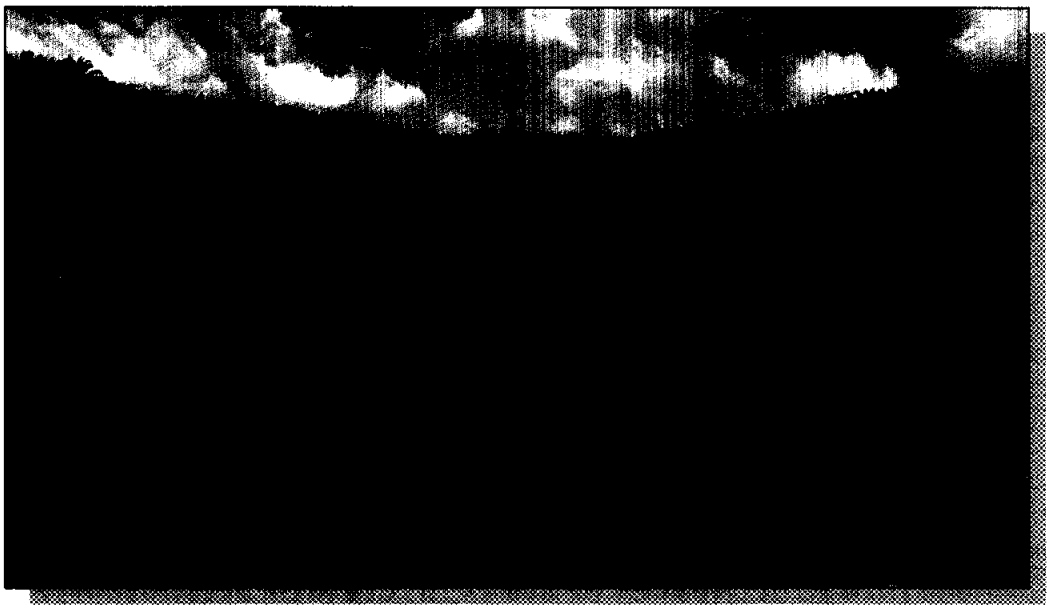

A Bird's Eye View of an Oil Palm Plantations

INTRODUCTION

The oil palm industry in Malaysia has grown phenomenally in the last 30 years. The area planted increased from 55 000 hectares in 1960 to 2.0 million hectares in 1991. Oil palm has been planted on land previously occupied by forest, rubber or other crops or on reclaimed land. Currently there are 262 palm oil mills, 37 refineries and seven oleochemical plants in the country.

Recently, a number of groups have raised questions concerning the impact of the industry on the environment and its economic and social effects.

This article discusses various sectors of the industry–plantations, mills, refineries and the oleochemical sector–and their impact on the environment (*Table 1*).

PLANTATIONS

In Malaysia oil palm plantations were originally developed from forests, 60 000-100 000 ha of forests being cleared annually since 1960. In future, most new planting will be in the form of replanting of old oil palm. Thus, future conversion of forests will be minimal. It is worthwhile to point out that 60% of Malaysia is still covered with forests and the Government has declared that 50% will remain as permanent forest. If we include oil palm, rubber and cocoa

TABLE 1. THE MAIN SECTORS OF THE PALM OIL INDUSTRY, THEIR WASTES, AND WASTE CONVERSION TO BY-PRODUCTS.

Sector	Area, production or number of installations in Malaysia	Type of waste generated	Useful materials from waste products
Plantations	2×10^6 hectares 6×10^6 tonnes of oil	1. Trunk 2. Fronds for nutrients	1. and 2. Recycle *in situ*
Mills	262	1. Empty fruit bunches (EFB) 2. Palm Oil mill effluent (POME) 3. Pressed fibres and shell	1. Mulch/ fertilizer 2. Fertilizer/ irrigation 3. Boiler fuels/ activated carbon
Refineries	37	1. Liquid effluent: Palm Oil refinery effluent (PORE) 2. Spent bleaching earth	
Oleochemical plants		1. Liquid effluent	

Young Palms with Cover Crops

plantations, then nearly 74% of Malaysia has some form of tree cover. It is acknowledged that when forest is cleared for agriculture, damage will be done to the indigenous fauna and flora. However, the remaining permanent forest in Malaysia should be able to preserve the bulk of the biodiversity of the country.

At the time of clearing of forest, damage is obviously done to soil and plant species. However, under a tropical crop plantation management system mitigating measures are always taken to minimize the damage; for example, the cleared ground is quickly planted with cover crops, thus minimizing soil erosion and thereby protecting the landscape.

The level of fertilizer application in oil palm plantations is much less than that used for cultivation of arable crops such as soyabean, wheat, *etc.* For example, 100 kg Nitrogen per hectare is normally the maximum amount used in oil palm plantations, while over 150 kg Nitrogen is commonly used on rape in Europe and North America. The application of mineral fertilizer to oil palm is further reduced by the use of empty fruit bunches (EFB) obtained from the oil palm mills (*Table 1*). In the past the EFB were converted into bunch ash by slow incineration. The bunch ash is a potash-rich fertilizer used in the oil palm plantations. However, in recent years the Department of Environment (DOE) regulations have restricted the burning of EFB and most of it is now applied as mulch in the estates. The pruned fronds are stacked between the oil palm rows and biodegradation recycles the plant nutrients to the palms.

Oil palm plantations are replanted every 25-30 years. In the past, the trees were burnt to clear the land. With new guidelines from the DOE, the recommended practice is to shred the palms into small pieces; burning is discouraged in order to avoid generation of smoke. New regulations of the DOE also make it more difficult to plant oil palm from forest. After extracting the valuable timber, the remaining trees are felled and removed: burning on the site is no longer allowed.

The inputs required for oil palm growth are modest. The energy value of the crop is high and input:output ratios of over 9.0 in energy terms have been calculated (Wood and Corley, 1991). Generally, there are relatively few major pest and disease problems in oil palm plantations, so that the quantity of pesticides and fungicides used is very low. Several biological control methods are being employed in oil palm plantations, the control of rats using barn owls being a prime example.

Application of POME as Fertilizer

Weed control represents the major use of chemicals on estates. However, the level of herbicide usage can be reduced by careful management and use of livestock to control the weeds. In the early years after

planting, weeds are suppressed by the use of leguminous cover crops. These also, as mentioned above, reduce soil erosion prior to the development of the oil palm canopy, and they supply the palms with nitrogen through their association with nodule bacteria.

The yields of oil palm are the highest of all oil bearing crops (*Table 2*). The mean palm oil yield per unit area is ten times that of soyabean. Oil seed crops occupy nearly 120 million ha world-wide and produce nearly 60 million tonnes of oil per year. In the case of palm oil, 5 million ha produce 15 million tonnes of oil per year. To produce 60 million tonnes of vegetable oil using oil palm trees, we would need only 20 million hectares. Theoretically 100 million hectares (120 - 20) could then be released by the vegetable oil seed producers for reforestation. Thus oil palms could supply most of the world's requirement for vegetable oils and fats from an area much less than that under oilseed crops now.

TABLE 2. AVERAGE PRODUCTIVITY OF VARIOUS OIL CROPS

Crops	Yield of oil (kg/ha/year)
Soyabean	338.6
Rape seed	561.9
Palm oil (mesocarp)	3200.0
Palm kernel oil	414.5

Source: Mielke (1989)

MILLING

The fresh fruit bunches (FFB) from the plantations are processed at the palm oil mills. In 1990, there were 262 mills in the country with a processing capacity of 8720 tonnes of FFB per hour. During the processing, the waste materials produced are:-

1) Palm oil mill effluent (POME). This has a very high content of organic matter as indicated by its high biochemical oxygen demand (BOD). The effluent is otherwise non-toxic as no chemical is added during the oil extraction process.

2) Solid by-products
i) Mesocarp fibre (press cake fibre)
ii) Empty fruit bunches (EFB)
iii) Shell (produced when the kernels are extracted from the seeds)

Since the enactment of the environment laws in 1978, several treatment systems have been developed to handle POME. In recent years POME has become a useful by-product which can be converted into animal feed, fertilizer and a source of energy (Ma *et al.*, 1991), at the same time reducing the level of effluent discharged into streams.

The fibre and shell are the main sources of energy in palm oil mills. When burnt, they produce more than sufficient energy to meet the mills' energy requirements. As indicated earlier, EFB are now largely used as mulch since burning them is discouraged.

With the proper handling of POME and solid by-products it is possible to attain 'zero waste' from the palm oil mills. Recent years have witnessed a change in the concept of waste management in the oil palm industry, from treatment and disposal to beneficial utilization.

Effuent Treatment : The Sequencing Batch Reactor developed by PORIM

REFINERIES AND OLEOCHEMICAL INSTALLATIONS

At present nearly all Malaysian palm oil is refined locally. There are 37 refineries in operation with a total annual installed capacity of 10.45 million tonnes of crude palm oil. Most of the refineries now use the physical refining process, which is cheaper than the traditional chemical refining method.

Palm oil refinery effluent (PORE) from the physical refineries can be treated by a sequencing batch reactor (SBR) or other aerobic processes.

However, the SBR process is a more cost-effective system for PORE. The treated effluent has a BOD consistently below 50 milligrams per litre.

There are now seven oleochemical manufacturers in Malaysia with a total capacity of 336 000 tonnes of fatty acids, methyl esters, fatty alcohols and fatty esters a year. The production capacity is expected to double to 676 000 tonnes in 1992 when another five oleochemical manufacturers commence operation. The effluents from these manufacturing plants are handled similarly to those from the refineries.

CONCLUSION

The environment laws enacted by the Malaysian Government to control pollution by the oil palm industry will, if observed, enable the industry to move towards a 'zero waste' situation. The oil palm industry should then have very little impact on the environment; in fact it will be extremely environmental friendly when compared with those dealing with other major oil bearing crops.

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