Photo: Theo Guiking

The oil palm, growing in the lowlands of the humid tropics is an ideal crop. It provides a permanent cover for the land, high quantities of organic matter and nutrients are returned to the field the whole year round. Agricultural waste can be used as source of energy for processing the product. But recycling of high amounts of crop residues is not an easy job and may be a threat to the environment.

Recycle or pollute?

Theo Guiking

The oil palm produces fruits that have the size of small eggs and that grow in bunches. A good palm may produce up to 20 bunches per year. When it is more than 4 years old annual yields can go up to 20 tonnes/ha with a dry matter content of about 10 tonnes. The fibrous flesh of the fruit contains the marketable product palm oil.

Processing

With steam the fruits are removed from the bunches. Loosened fruits are scraped and flesh and kernel are separated. For ease of transport within the processing plant water is added. The oil, pressed from the fibrous flesh, floats on water and can be decanted easily. What remains is water with organic particles, so called raw palm oil mill effluent. Direct disposal of effluent into rivers may kill all river life, since biological oxygen demand for fermentation is very high. Therefore, most processing plants have a fermentation pond or tank. The latter offers the possibility to harvest biogas.

Environmental effects

Empty bunches used to be free fuel for the production of steam. The remaining ash is a useful fertiliser, containing about 25% potash, with a liming effect as well. But burning empty bunches releases soot into the atmosphere. Therefore governments tend to forbid it nowadays. Alternative use is sought in carrying empty bunches, about 5.5 tonnes dry matter per hectare, back to the field as mulch. The bunches can be transported on return trips with the same trucks that pick up the harvest. In-field transport and spreading is a problem. Some companies try to make this easier by chipping the material, which makes mechanical spreading easier. Thick layers of mulch can cause fly problems. Single layers usually do not give such negative side effects. Composting this waste material would require very large sites near the mill and sometimes the housing area, which would create many problems with flies, rats and bad smell. It is therefore unacceptable.

Fermentation of effluent yields biogas. But who will use the gas? The factory is, or was self-supporting in fuel. Only in cases of non-continuous processing, some gas instead of diesel can be used to start the machines. The factories are usually far away from housing areas, which makes use as cooking gas also expensive. Compressing gas for use in trucks is - with the present prices of diesel and petrol - relatively expensive too. The remainder of digested effluent is sludge. This can be used in the plantation as soil ameliorant, or sold for use in horticulture or as feed for livestock. But in all cases saturation of the direct surroundings is quickly reached.

There is another important by-product: the pruned leaves or fronds, as they are called by oilpalm growers. To harvest the bunches from the axils, the suspending leaf must be cut first. Pruned leaves are placed in alternate rows, frond heaps, between the palms. Together with the decaying roots this provides an annual input of 10 tonnes dry matter per hectare. Besides being a source of organic material, all these crop residues, with a maximum dry matter content of 16.2 tonnes/ha, contribute to the recycling of a relatively high percentage of harvested nutrients (see table).

Conclusion

Perennial crops are relatively soil friendly. Compared with annual crops, removal of nutrients is less and return of organic matter is higher. But quantities of crop residues are high. This means that recycling is laborious and options to absorb these by-products are easily saturated. Methods to reduce the bulk, by burning or composting, may have harmful environmental effects. ■

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The nutrient cycle

The total uptake of nutrients by the oil palm is high, but most nutrients 60-70% (for P 50-60%) are returned through crop residues and decaying roots. Apart from that, 5-10% of the annual uptake is stored in the trunk, and will become available when the palms are felled after 15-20 years. Based on literature data, the following ranges for nutrient flows are found for a crop yielding 20 tonnes of bunches:

Table 1: Annual uptake and removal of nutrients (kg/ha) by 1 ha oil palm, yielding 20 tonnes fresh fruit bunches

	total uptake	stored in trunk	recycled (leaves + roots)	removed by bunches
N	185 - 395	11 - 32	122 - 269	52 - 94
P	18 - 52	2 - 6	9 - 31	7 -15
K	190 - 335	8 - 13	122 - 206	60 -116
Ca	47 - 162	6 - 14	32 -128	9 - 20
Mg	37 - 126	8	21 - 102	8 - 16

Use of bunch ash or empty bunches in the field will make the balance even better.