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Technical concepts for replacing fire-based land clearance

Palm oil production in Indonesia

In the south-eastern Asiatic region, as in all tropical areas, clearing land by fire represents a simple, cost effective and therefore common possibility for clearing growing areas for economically-attractive plantation crops, especially oil palms. For reasons that are widely known, this procedure is not acceptable. If not before, it became very clear to the governments on the spot after the tremendous bush fires of autumn 1997 that the finding of alternatives for fire clearances is crucial. The first alternative concepts, the solving of the problem through mechanical means, are discussed here.

In the last decades the production of palm oil has shown a sharply increasing tendency through high demand from the industrialised countries as well as from the tropical production lands themselves. It is believed that this trend will continue (*fig. 1*).

For the main production lands in the south eastern Asiatic region, particularly Malaysia and Indonesia, palm oil production represents an important economic factor for earnings on the world market which is why the production is supported to a great extent by the governments. Because of the high demand for palm oil, it is estimated that cultivation area will be greatly extended in the coming years. In particular, this extension will make itself strongly felt in Indonesia because there, large areas particularly suitable for oil palm cultivation are available. The Indonesian government is therefore aiming to increase cultivation area from a current 2.4 m ha to around 5.5 m ha by the year 2005 [2], in order to build further on its strong position as the second largest supplier on the world market. Largest producer at the moment is Malaysia and this country has, to a large extent, used all available areas for cultivation so that further expansion is hardly possible.

Before oil palms are established , the area to be planted has to be cleared of the vegetation already growing there. In current practice, vegetation clearance through burning has proved the most cost-effective and simple method. For ecological and political reasons, though, the burning-off of vegetation as used in south eastern Asia as well as the world over is regarded in an exceptionally negative light. If not before the autumn 1997 bush fires in Indonesia, which raged out of control and were to a great extent laid by plantation firms wishing to clear new land for oil palms, this problem is now recognised by the tropical developing countries and it is clearly seen that there is an urgent need for action. Indonesia in particular, with its general ban on clearance by fire, tried to tackle the problem. Up until now, however, there are hardly any practical alternative concepts for preparing land other than by burning. The result is that, as before, large areas are still put to the torch.

The only alternative method – through which the vegetation is cleared, chopped and finally left to degrade naturally with the help of modified construction vehicles – leaves a large number of questions open in that in many points of general concept as well as of detail, the method has not been fully developed.

It is thus urgently necessary to work on the development of well thought-out machinery concepts for the clearing, by non-burning means, of areas destined for establishment of oil palm plantations. In this many, very multifaceted, aspects have to be taken account of: subjects which stretch from the type of vegetation on the spot over the utilisation of

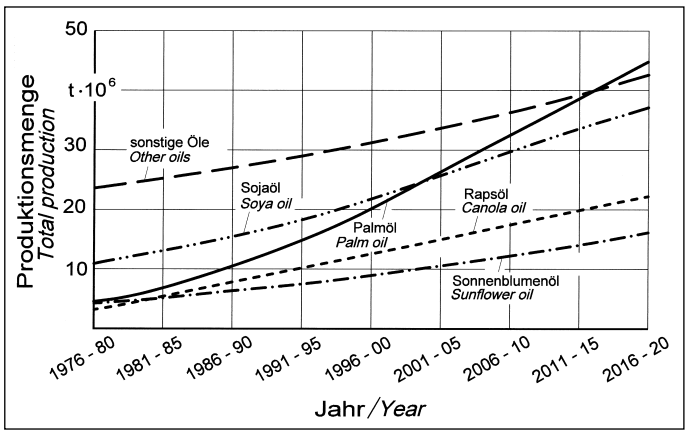

Fig. 1: Future development in world production of vegetable oils [1]

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the material by products from the clearing operations, plant production and phytomedicinal aspects through to the socio-economical requirements and possibilities in a tropical'threshold' land.

For instance, alone with regard to the vegetation on the sites, there are already several scenarios to consider:

- Growth with natural secondary vegetation (e.g. through former slash and burn operations for migratory agriculture or degraded grass or bush areas following poor farming methods)
- Growth featuring plantation crops (e.g. *Elaeis guineensis* Jacq., *Hevea brasiliensis* Willd., Muell. Arg.), that should be cleared at the end of their cropping period and replanted.

Because of the very different starting-off conditions, these two scenarios demand the development of two different technical concepts fitted to the individual conditions. These will be demonstrated later.

In the case of the first scenario, the initial condition of the area (natural secondary vegetation) is typified by mainly grass/bush growth with scattered thicker-stemmed (trunk diameter around 15 cm) vegetation. Basically, two technical possibilities are suitable for clearing this type of vegetation:

1) Using a commercially-available forest mulching implement mounted on a suitable tractor. This type of implement can also handle larger stems and leave the resultant chopped-up material on the ground as mulch. Additionally, the ground would be cultivated leading to destruction of underground vegetation and thus prevention of re-growth of root material. This approach means an area can be fully-cleared and prepared directly for planting in a single work operation. The principle of the main piece of equipment here is based on the chopping-up of the material through chisel points attached to a horizontally rotating shaft.
2) Using a "Göttingen Double Rotor Chopper" (Bush-Chopper). Contrary to the above-mentioned forest mulch implement, this equipment was specially developed specifically for clearance of above-ground secondary vegetation in such a way that leaves most of the rooting systems undamaged, so making re-growth possible. The working principle consists of two contra-revolving chopping augers, each fitted vertically onto an individual circular saw blade. Used thus, the two augers take care of the chopping-up of the material while the circular saw blades ensure clean separation of the material from the rootstocks. Once again, the chopped-up material is left on the ground as a mulch layer.

Because of their different working principles, both machines offer two completely different concepts for establishing oil plantations. The first-mentioned implement aims at a complete and long-term area clearance – a system which has proved successful up until now for the establishment of plantations in tropical regions. Additionally, the system allows the utilisation of resultant chopped-up biomass as a complete mulch cover. This in turn avoids plant nutrient loss and reduces soil erosion dangers. Another advantage of this implement is that it is already fully-developed as far as technological conception is concerned and is, as a commercially-available implement, relatively cheap.

The Göttingen Double Rotor Chopper, on the other hand, purposely allows a re-growth of the rootstock remaining in the ground. This concept means the above-ground vegetation is carefully separated from the rootstock, chopped and then laid on the ground as a mulch. The ground itself is not disturbed thus effectively reducing soil erosion risk – a particular danger in tropical regions. Finally, the oil palm saplings are planted between the remaining rootstocks. With this concept, however, it's still not clear which interactions (competition for nutrients and growing space, phytopathalogical aspects) exist between the saplings and the regrowth from the rootstocks left in the ground, and to what extent these could be a negative influence on speedy establishment of a viable oil palm crop.

The second of the scenarios introduced at the beginning of this paper, i.e. the re-use of old oil palm or rubber tree plantations, is substantially different from the first. Here, the established vegetation is characterised by consisting almost completely of large trunks. For instance a plantation 25 to 30 years old could feature tree trunks with diameters up to 75 cm. For this sort of clearance, the two machines mentioned above are unsuitable and cannot be used. Additionally, there's the phytopathalogical problem of using the remains of such old trees as a mulch. The oil palm'waste product' timber should be removed from the plantation site. This, however, opens up other possibilities for targeted use of the resultant material or the production of energy from it. In this case, there are further demands on the clearing technique in that this must be capable of harvesting the material a form appropriate for its further use and then transporting it out of the plantation area via a suitable logistic chain.

Up until now, there is no special mechanical technology available for such demands.

Because of this, the Institute for Agricultural Engineering at Göttingen, together with the firm AHWI Maschinenbau GmbH, Herdwangen in Allgäu, and as part of a larger-scale combined research project especially concerned with the environmentally-suitable production of palm oil, is to try to find technical possibilities leading to a simple, robust and economic solution – under the demands of tropical conditions – making possible an appropriate harvest and further processing of oil palms so that the necessity for disposing of the old plantations through burning can be avoided. Several concepts have been thought-out for such an approach One possibility would be, for example, to harvest the above-ground vegetation with an appropriately large dimension of auger-chopper with horizontal chopping auger and pre-activated cutting equipment. This machine should be able to drive through the plantation and chop-up the palms on the spot. In such a case, the destruction of the underground vegetation could be accomplished by a following forest mulching implement. Another possibility would be the retrieval of the entire trunk along with its attached roots and transport of the material out of the plantation for processing at a centrally-situated large-capacity chopper. The third possibility envisaged is based on the application of a very large-dimension self-propelled forest mulcher that simply rolls-down the palms on the spot, chops the material while driving over it, and subsequently works the wood remains into the soil.

Each of these possibilities has specific advantages and disadvantages the effects of which still remain to be clarified. Which of the envisaged concepts can, in the end, be realised under tropical conditions is a question to be explored with comparative trials in Indonesia. Quite independently from the system which, in the end, proves most suitable for application under practical conditions, every one of the solutional concepts represents high demands on the constructional and mechanical engineering performance potential of agri-technical research in Germany. High demands, too, on as the country's farm machinery manufacturing sector which will finally have the task of transferring the research results into practice, which should give the firms involved an opening into a growing overseas market.

Literature

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