

**FOREST FIRE PREVENTION AND CONTROL PROJECT
DINAS KEHUTANAN PROPINSI SUMATERA SELATAN**

**VEGETATION FIRES IN SUMATRA INDONESIA.
OIL PALM AGRICULTURE IN THE
WETLANDS OF SUMATRA:
DESTRUCTION or DEVELOPMENT?**

Howard J. Sargeant



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Project Reports

Fifteen reports have been prepared since January 1999 by the Forest Fire Prevention and Control Project. Together they cover the field-level prevention, detection and control of vegetation fires in Sumatra and examine the policies and practices that underlie the continuing fires within the island. Titles in the series are:

Vegetation fires in Indonesia: operating procedures for the NOAA-GIS station in Palembang, Sumatra. I.P. Anderson, I.D. Imanda and Muhndandar. (January 1999)

Vegetation fires in Sumatra, Indonesia: the presentation and distribution of NOAA-derived data. I.P. Anderson, I.D. Imanda and Muhndandar. (January 1999)

Vegetation fires in Indonesia: the interpretation of NOAA-derived hot-spot data. I.P. Anderson, I.D. Imanda and Muhndandar. (March 1999)

The training of forest firefighters in Indonesia. M.V.J. Nicolas and G.S. Beebe (Joint publication with GTZ). (April 1999)

Fire management in the logging concessions and plantation forests of Indonesia. M.V.J. Nicolas and G.S. Beebe (Joint publication with GTZ). (April 1999)

A field-level approach to coastal peat and coal-seam fires in South Sumatra province, Indonesia. M.V.J. Nicolas and M.R. Bowen. (April 1999)

Vegetation fires in Indonesia: the fire history of the Sumatra provinces 1996 - 1998 as a predictor of future areas at risk. I.P. Anderson, M.R. Bowen, I.D. Imanda and Muhndandar. (May 1999)

Vegetation fires in Sumatra, Indonesia: a first look at vegetation indices and soil dryness indices in relation to fire occurrence. I.P. Anderson, I.D. Imanda and Muhndandar. (May 1999)

Environmental education - with special reference to fire prevention - in primary schools in the province of South Sumatra, Indonesia. With 'Desa Ilalang', a story for children in Bahasa Indonesia. M. Idris, S. Porte, J.M. Bompard, F. Agustono (illustrator) and staff of FFPCP and Kanwil Kehutanan dan Perkebunan, Palembang, in collaboration with Kanwil Departemen Pendidikan dan Kebudayaan Tk I, South Sumatra. (July 1999)

The sustainable development of tree crops and the prevention of vegetation fires in South Sumatra Province, Indonesia. Jungle rubber. A. Gouyon. (August 1999)

Land management in South Sumatra Province, Indonesia. Fanning the flames: the institutional causes of vegetation fires. J.M. Bompard and P. Guizol. (September 1999)

Vegetation fires in Sumatra, Indonesia: reflections on the 1999 fires. I.P. Anderson, I.D. Imanda, and Muhndandar. (August 2000)

Fire zones and the threat to the wetlands of Sumatra, Indonesia. I.P. Anderson and M.R. Bowen. (October 2000)

Vegetation fires in Sumatra, Indonesia. Oil palm agriculture in the wetlands of Sumatra: destruction or development? H.J. Sargeant. (February 2001)

Anthropogenic fires in Indonesia: a view from Sumatra. M.R. Bowen, J.M. Bompard, I.P. Anderson, P. Guizol and A. Gouyon. Reprinted from, 'Forest fire and regional haze in Southeast Asia' Editors M. Radojevic and P. Eaton. Nova Science, New York, USA. (March 2001)

Printed copies of the first five reports are also available in Bahasa Indonesia.

English language copies of the reports, excluding numbers 4, 5 and 6, are available on the FFPCP homepage <http://www.mdp.co.id/ffpcp.htm> Summaries of all reports can be found at the same location. Printed copies of reports four to fifteen and those in Bahasa Indonesia can be obtained from:

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A daily overview map that shows the locations of vegetation fires in Sumatra can be found on the FFPCP homepage.

SUMMARY

Vegetation fires in Sumatra, Indonesia. Oil palm agriculture in the wetlands of Sumatra: destruction or development? H.J. Sargeant (2001). European Union Forest Fire Prevention and Control Project with Dinas Kehutanan Propinsi Sumatera Selatan. European Union and Ministry of Forestry, Jakarta, Indonesia. 50 pp.

Ten leading conglomerates, one Malaysian owned, drive the expansion of the palm oil industry within Indonesia. They are encouraged by a Government aware of the need to alleviate poverty and to provide food and employment on an economically sound and sustainable basis to an already large and rapidly increasing population. Current plantings throughout Indonesia are estimated to total 2.8 million hectares.

However the oil palm (*Elaeis guineensis*) estates face mounting criticism, particularly because of their use of fire to clear further new land. Much of this reproach is directed towards companies operating in Sumatra where, together with smallholders, they occupy 2.1 million hectares. Many of the new estates lie within the 11.5 million hectares of wetlands of the island, often on peat soils. The initial fire set to clear the residual wood debris enters the peat, which continues to smoulder and emit dense smoke haze long after the surface fire has died. The pollution drifts from Sumatra to Peninsular Malaysia and Singapore on three or four occasions each year.

Indonesian law expressly forbids the use of fire to clear land. The courts, however, for a variety of reasons, remain reluctant to convict companies that burn. Satellite-derived data and imagery show fire locations in near real-time and with locational precision. Burn scars remain visible for at least three years. Despite - up to now - largely escaping successful prosecution, the oil palm companies must accept the reality; the fires they set are known and this information is freely available worldwide on the Internet.

There is no compelling reason to use fire to clear land for new plantations. The cost of establishing an estate from the first step of government approval through to full production is identical whether the land is cleared by purely mechanical means with no burning, or is first cleared mechanically and the debris then burnt. Leading companies already recognise this and enforce zero-burn land clearance. Regrettably, in other companies the senior executives may have a “no-burn policy” but this does not translate into a “no-burn practice”. Middle-level managers continue to prefer the ‘clean look’ of burnt land and set fire to the debris. Head Office turns a blind eye. Zero-burn land clearing must become a standard ‘best practice’ with no compromise.

As the laws that govern the use of fire to clear land have proved to be toothless, international and national environmental pressure groups are now exerting their demands on the companies from a different direction. These organisations make full use of the fire location / time of burning data to persuade financial institutions to curb lending to the companies. The same pressure groups also seek to raise the environmental consciousness of downstream palm oil consumers. There is a growing probability that money to finance the expansion of the estates within Indonesia will dry-up, and that the Indonesian oil palm industry will face a Western boycott of its products.

The many who would prefer the plantations to keep away from the ecologically valuable and fragile wetlands have pinned their hopes on the belief that oil palm will not thrive on peat soils. This, however, appears not to be the case; with careful water management and the application of trace elements, fruit yields are, to date, excellent. Establishment costs are higher as the peats require compaction prior to planting and drainage / irrigation canals must be dug, but profit margins remain adequate.

The case for second and subsequent replantings within the peatlands of Sumatra has, however, until now not been made. If 'drainability' can not be sustained in the long-term (i.e. for over 25 and up to 100 years) the estates will fail.

The world demand for palm oil is forecast to increase from its present 20.2 million tonnes a year to 40 million tonnes in 2020. If this demand is to be met, 300 000 ha of new estates will need to be planted in each of the next 20 years. We predict that by far the largest slice of this new land will come from within Indonesia where labour and land remain plentiful. And we expect that Sumatra, with its relatively well-developed infrastructure and nucleus of skilled labour, will absorb 1.6 million hectares of this expansion. It is inevitable that most new oil palm will be in the wetlands, as the more 'desirable' drylands of the island are now occupied. We expect that of the new areas, half will be developed by estates and half by smallholders.

The positive part played by the palm oil sector in the nation's development process is often ignored in the controversy over the conversion of the wetlands to agriculture and the resultant smoke haze. The crop in itself is environmentally friendly. Some 400 000 rural workers are permanently employed by the estates and enjoy free or heavily subsidised housing, schools, health care and other amenities. A further 500 000 farmers derive a significant income from estate-linked smallholder schemes. With down-stream processing and service industries added, the total number of people (workers and immediate families) that rely on the success of the oil palm estates within Indonesia is at least 4.5 million. Palm oil sales currently contribute \$1.7 billion to the Indonesian economy (Sumatra \$1.4 billion.). These figures are expected to rise sharply as prices recover from a 15-year low.

If the Indonesian oil palm industry wishes to publicise these substantial contributions it makes to the development of the nation, it needs to come together in a single trade association and speak with a unified voice.

A prime task for such an association must be to regulate the activities of its members, and exert moral and trade pressure on companies who continue to use fire to clear land. The same fire location data used by its opponents are also freely available to the industry when it needs to refute unfair accusations.

The recent setting-up of a Haze Prevention Group financed by two leading conglomerates in the oil palm and the pulp sectors is a welcome step to improve the reality and image of the estates. The initiative must be followed-through with vigour and the Group must not be subverted into becoming an apologist for the industry. An early and sincere dialogue must be started with conservation groups. Neither 'zero economic development' nor the extinction of the Sumatran *orangutan*, rhinoceros and tiger are sensible choices.

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1. SETTING THE SCENE

A Summary Of The Case For And Against The Oil Palm Sector

Supporters of oil palm (*Elaeis guineensis*) agriculture point to the very considerable economic benefits that the palm oil industry brings to Indonesia. From their perspective the rapid expansion of the industry is a business success story of which they can be proud but which is not praised as inept publicity continues to mask the achievement of the industry in poverty alleviation and sustainable agriculture. The view of the champions of oil palm is recognised in the design on the reverse of the Rp 1000 coin first minted in 1994 (Plate 1).

Opponents of the industry cite the companies unfair acquisition of land to the detriment of local communities (e.g. WAHLI and Down To Earth, 2000). Conservationists also draw attention to the loss of wildlife habitats caused by the conversion of forest to agriculture, and to the fires and smoke haze pollution that are associated with the change of land-use, particularly on peat soils. The many who would prefer the plantations to keep away from the ecologically valuable and fragile wetlands have pinned their hopes on the belief that oil palm will not thrive on peat soils. This, however, appears not to be the case; with careful water management and the application of trace elements, fruit yields are, to date, excellent. Establishment costs are higher as the peats require compaction prior to planting and drainage / irrigation canals must be dug, but profit margins remain adequate. (See amongst others Gurmit Singh, Tan, Rajah Padman and Lee 1987; Kuruvilla, 1999; Gurmit Singh, 1999).

In this report we shall consider only the fire question in detail, although much of the information presented is relevant to the wider debate.

Past reports by the Forest Fire Prevention and Control Project (FFPCP) can be seen as favouring the case of the 'conservationists'. For example FFPCP was quick to point out that land clearance by estate crop companies¹, not by 'slash-and-burn' farmers², was responsible for many of the *el-Nino* promoted fires of 1997. Based on work carried out by FFPCP, it is now widely accepted that **all** fires of importance in Sumatra in years of average rainfall are associated with the commercial clearance of land. It is also

¹ Estate crops in Indonesia are often taken to refer only to oil palm plantations. There are however, within Sumatra, numerous rubber estates - most long established and in the north of the island - and at least one large, productive, coconut estate on peat soils. Wood pulp estates are becoming more extensive and new land for their establishment has invariably been cleared by fire. Barr (in press) will examine in depth the economic aspects of both the oil palm and the pulp and paper industries in Indonesia. Coffee, cocoa and pepper cover significant areas of Sumatra but are essentially smallholder crops, as is rubber in the south.

² In Sumatra there are no slash-and-burn farmers in the sense that the term is most commonly used, i.e. farmers who clear plots at the forest edge, cultivate for a short period and then move on to repeat the process in a new area. There are many thousands of smallholders who cultivate their permanent farms on a rotational basis. They have an excellent knowledge of fire behaviour and well-established fire management systems.

recognised that the companies bear responsibility for the episodes of transboundary smoke haze pollution of 1998, 1999 and 2000 (Wakker, 1998; Anderson *et al*, 1999; Anderson, Imanda and Muhndandar, 2000; Lim, Liew, Kwoh and Lim, 2000). Five major fire-zones caused by estate clearance have now been identified within Sumatra (Anderson and Bowen, 2000).

FFPCP does, however, appreciate the need for sustainable rural development, poverty alleviation and the betterment of living standards, and that such advances are commonly linked to the profitability of private companies that operate in rural areas. Here our concern is that unregulated development - particularly of estate agriculture - is often at the expense of the environment.

Plate 1. Fruiting oil palm design on the reverse of the Indonesian Rp. 1000 coin minted in 1994.



FFPCP has noted many times that it is the transboundary smoke haze pollution associated with the change of land-use from forest to plantation that has served to keep Indonesia in the critical international eye during years of average or above average rainfall. The fires *per se* and the widespread loss of specialized wildlife habitats have received far less attention. In this, Singapore and Malaysia, as the recipients of the smoke haze from the peatlands of Jambi and Riau, have exerted strong diplomatic pressure on Indonesia to stop oil palm estates clearing their land by fire.

It is ironic that a daily air-pollution index published by Malaysia as part of this campaign was discontinued as being more damaging to its own tourist industry than to Indonesian pride. And that there is now some embarrassment within Malaysia with the realisation that many of the estate companies accused of starting the fires within Indonesia are owned by Malaysians (Kuruvilla, 1999; Rieley, 2000; Casson, 2000, amongst others). Many have also detected a degree of hypocrisy in the use of political persuasion: for example, as noted by Saw (2001), "Decisions on land conversion in Malaysia are based exclusively on economic returns on investment." The great majority of oil palm plantations in Malaysia, particularly those in Sabah and Sarawak, were until very recently developed using fire.

Without effective control either by external authorities or through internal self-regulation, the episodes of smoke haze arising from the clearance of land by oil palm

estates seem set to continue. When asked about over-supplied Western markets or product substitution, those within the oil palm industry reply, “India, China and an expanding world population”. One correspondent carried the concept further and described Sumatra as, “The garden of China”. Although an exaggeration, this highly descriptive phrase sums-up the long-term confidence of those within the oil palm companies, and it will certainly reinforce the fears of the conservation lobby.

In this report FFPCP seeks to widen the perspectives and to broaden the debate that surrounds oil palm agriculture in Sumatra through a better knowledge of the day-to-day operations and the viewpoint of the oil palm plantation companies. We recognize that in this we will satisfy neither the supporters nor the detractors of the companies. But without mutual understanding followed by accommodation on both sides, it seems to us that the battle between the ‘capitalists’ and the ‘protectionists’ will remain unresolved. In this eventuality both sides will be losers.

The Satellite Detection Of Vegetation Fires

There are no detailed records of vegetation fires in Indonesia prior to 1996. Since then three NOAA satellite data receivers with the capability to detect fires on a routine basis have been set up. These cover both Borneo (GTZ-IFFM) and Sumatra (EC-FFPCP) in depth, with JICA-FFPMP maintaining an overview of both islands.

The strengths and weaknesses of using NOAA systems to detect vegetation fires have been exhaustively dealt with by both FFPCP and IFFM and the results published in a number of reports and papers. The evidence is overwhelmingly that the systems are well suited to locate and monitor the larger fires that last for longer than a few hours, i.e. typical commercial-scale land clearance fires (Bowen *et al.*, 2000).

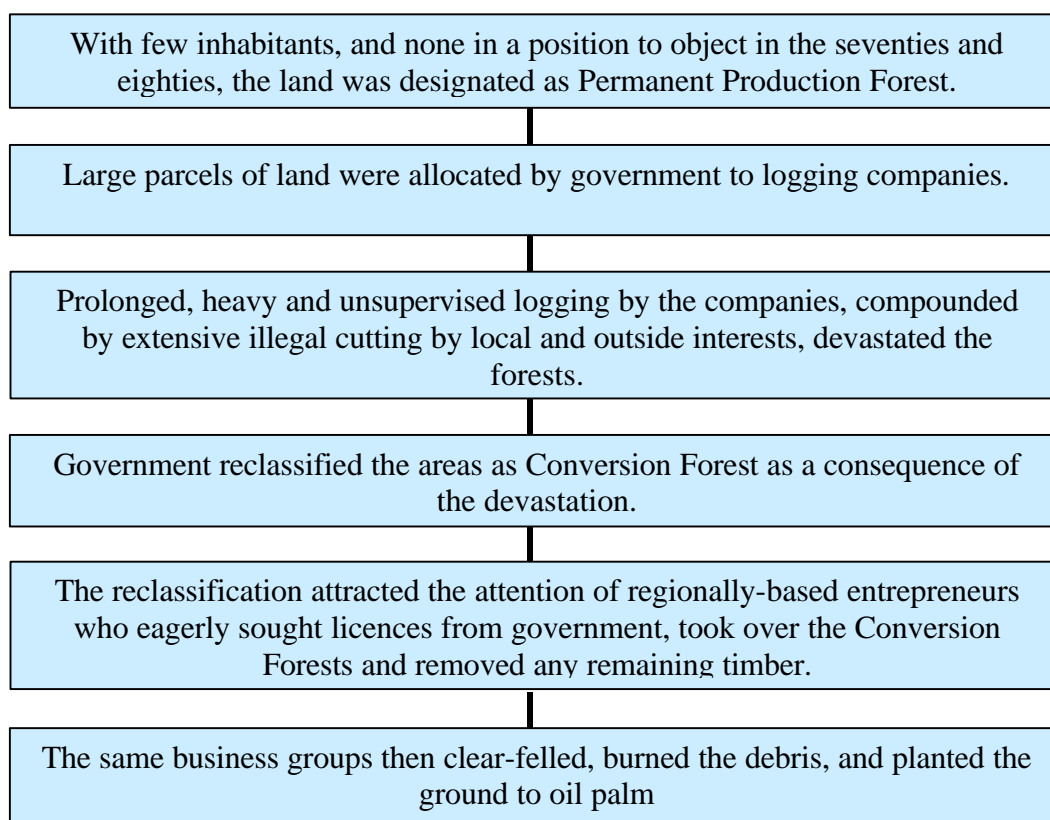
More recently the NOAA data have been augmented by Landsat and SPOT imagery - the latter provided by the Centre For Remote Imaging, Sensing and Processing (CRISP) at the National University of Singapore. These pictures, with a resolution of 20 m, clearly show any smoke plumes at the time of the overpass and, more importantly, they show burn-scars for at least three years after the event. Put simply, those who burn the land can run but they can not hide.

The Record Of Vegetation Fires Associated With Land Clearing By Estate Crop Companies In Sumatra

The connection between land clearance for oil palm and the incidence of fires has been noted by Potter and Lee (1998 and 'date unknown'), Wakker (2000) and by numerous other authors. For example, five of the seven 'fire zones' in Sumatra listed by Anderson and Bowen (2000) are directly linked to land clearing on a commercial scale.

Anderson and Bowen (2000) note the common chain of events that led to the formation of the five fire zones. The sequence is well demonstrated by the start and then expansion of the zone in the east-coast wetlands of the Kampar River in Riau province (Diagram 1). The fires have been, and remain, numerous, frequent, persistent, polluting-causing and concentrated within distinct areas.

Diagram 1. The formation of a fire zone in the Kampar River area of Riau province.



Estate Managers frequently blame arson for fires on estates under their charge and cite "Land disputes" as the reason. In our opinion arson is rare although there is disturbing evidence that outright violence is on the increase (Pye-Smith, 2001; Anonymous³).

The annual patterns of fires set by the oil palm estates to clear land, and the progressive nature of this clearance is well illustrated in Plate 2, which shows part of the Kampar River basin in Riau province. Plate 2a is a SPOT image captured on 12 September 2000. The burn scars from fires that were set in 1998, 1999 and 2000 appear as 'rectangular' green and blue-green areas south of the river, i.e. to the center and lower-center of the plate. The pale-red areas to the center-right indicate the growth of young oil palm planted on the land cleared by the fires of 1996 and 1997. The darker red areas both to the north of the river and to the south-west (lower left) of the image indicate logged secondary forest.

Plates 2b - 2f show the locations of NOAA-detected fires that occurred in each of the years 1996, 1997, 1998, 1999 and up to the end of August 2000 overlaid on the SPOT image of 12 September 2000. Plate 2g shows the cumulative overlay of fires for the total five-year period. The steady expansion of the burning sequence is very evident, as are the parts within the estates that have been burnt on more than one occasion. Re-burning occurs when the cleared area is not planted immediately after the first burn and the scrub and grass re-growth needs to be cleared again in the next dry period.

³ In early February 2001 FFPCP spoke to an oil palm Estate Manager from central Sumatra who had recently been threatened and forced from his plantation, the offices of which were then burned.

The total area of new land cleared by fire during the five years in the parts of the Kampar Estuary shown in Plate 2g is estimated to be over 250 000 ha.

Estate Managers in Riau suggest that typically the top 100 mm of peat are burnt in each land clearance fire. Various calculations can be made - based on information published by Coulter (1950), Levine *et al.* (1999), and Rieley (undated) - of how much carbon is released into the atmosphere when peat burns. We judge this figure to be 600 tonnes per metre depth burned per hectare. A conservative estimate for the total release of carbon from the Kampar wetlands *alone* over the last five years is thus 12 million tonnes - an astonishing figure - to which must be added, other ozone depleting gases.

Plate 2. (2a) SPOT Quicklook image of 12 September 2000 showing the Kampar River wetlands some 200 km to the east of Pekanbaru, Riau province and overlaid with the locations of NOAA-detected fires that burned in 1996 (2b), 1997 (2c), 1998 (2d), 1999 (2e) and to the end of August 2000 (2f). Plate 2g shows the combined location of the fires in the five years. Note: The location of individual 'fire pixels' are shown in yellow when overlaid on the SPOT image and in red when they fall outside the edges of the plate; this is only for clarity of presentation.

2a. SPOT image of 12 September 2000.

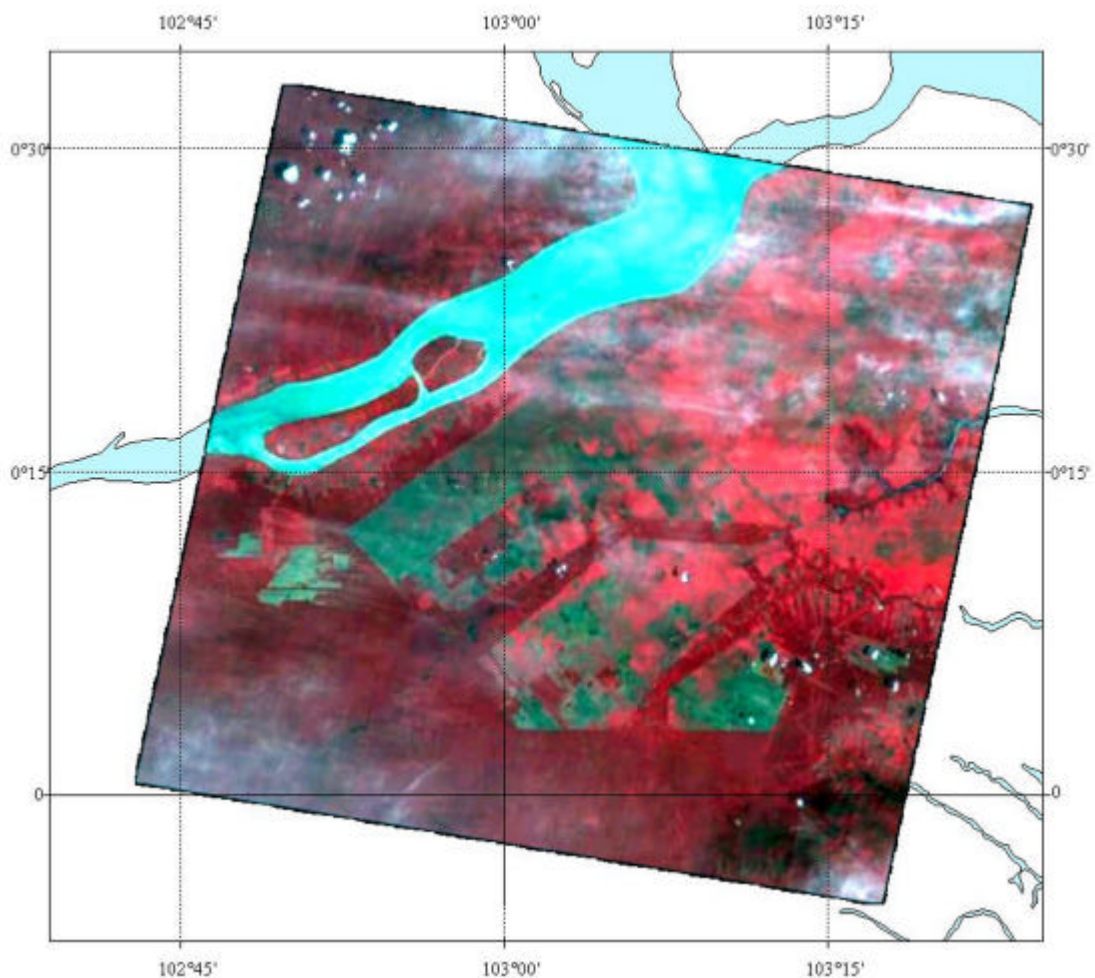


Plate 2 continued

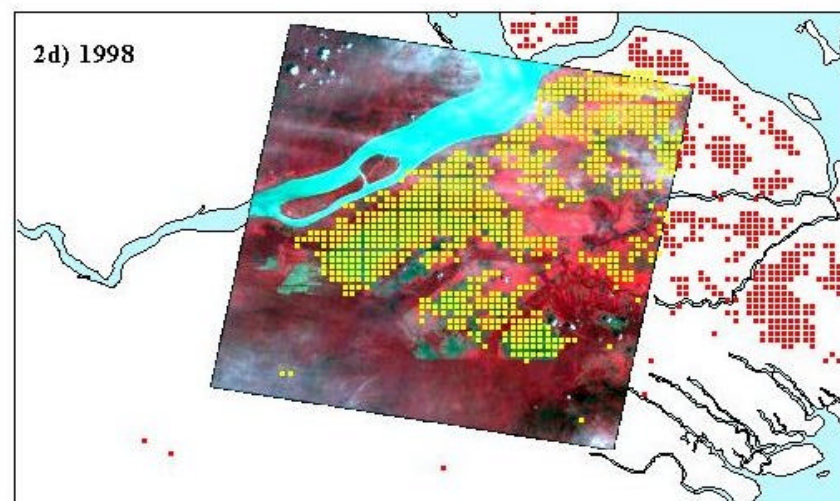
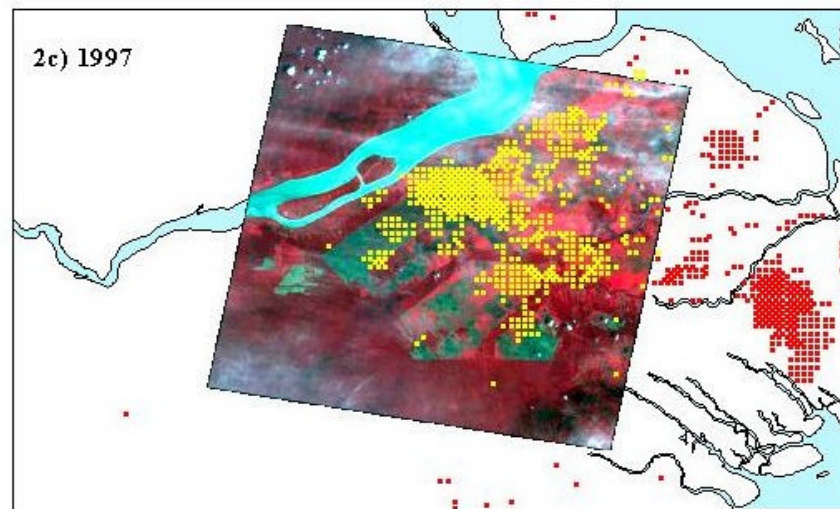
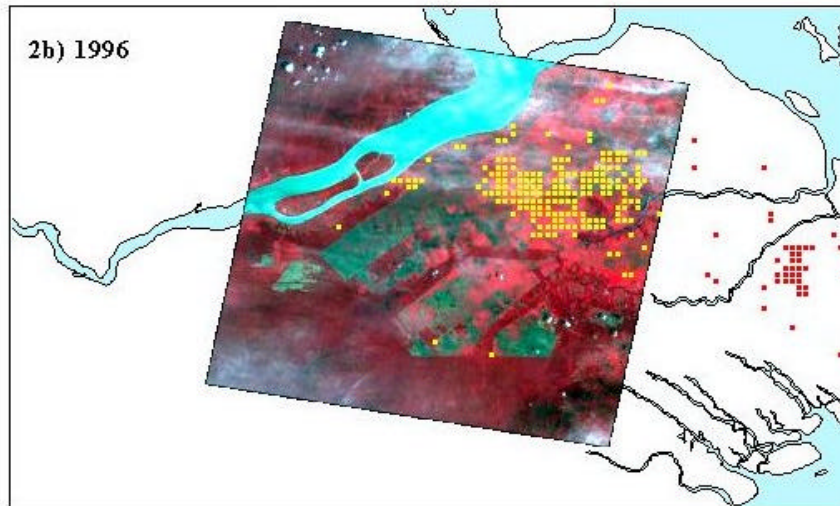
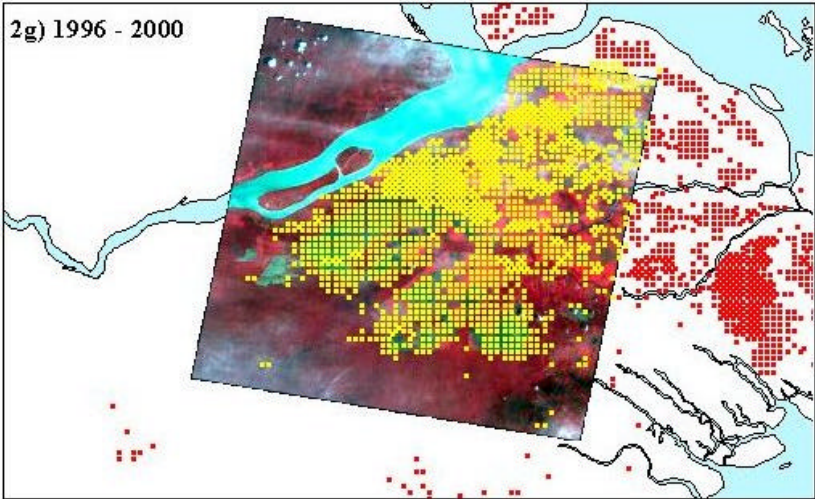
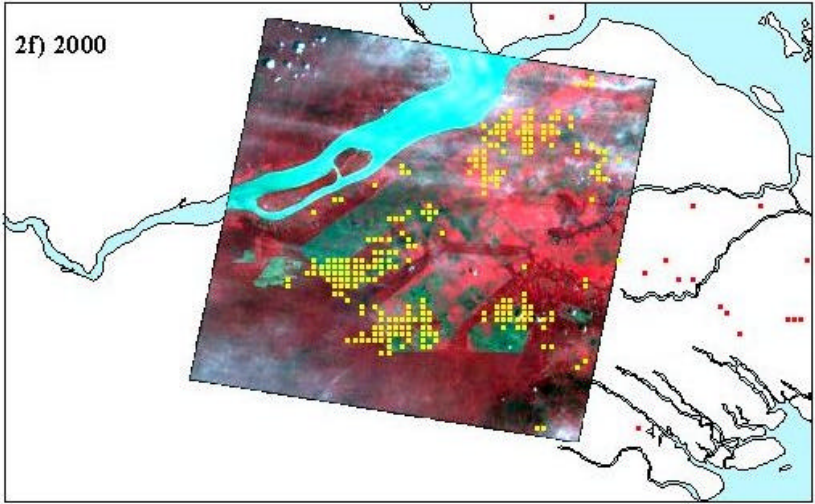
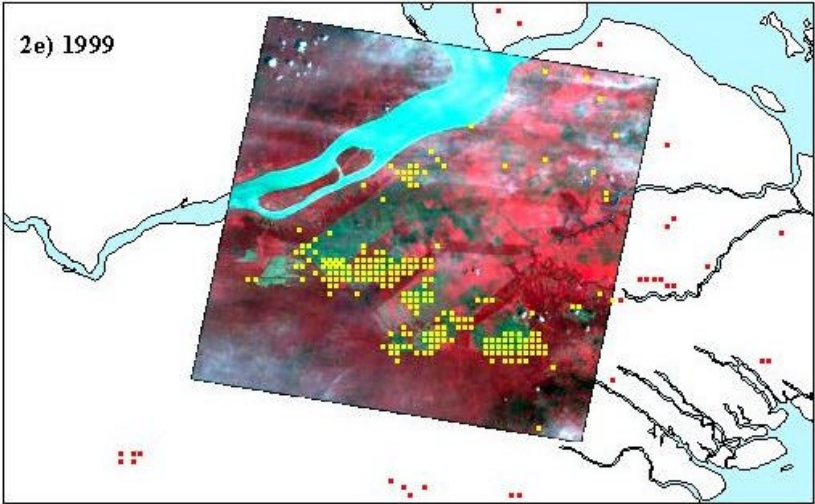


Plate 2 continued

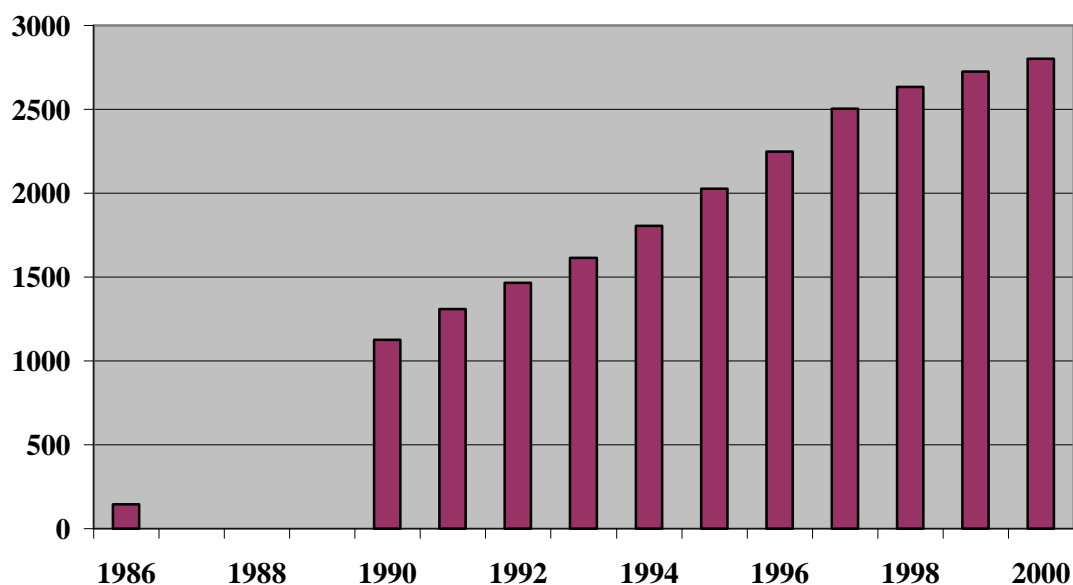


2. THE SCALE OF OIL PALM PLANTINGS

Past And Present

By today's standards there was little oil palm planting in Indonesia before 1980. The areas that were planted were owned by government 'PTP estates', of which fourteen continue to operate, and some at least to expand⁴. From the early eighties the private sector estate companies sprang into action and the sector as a whole has experienced phenomenal growth with area planted rising from 144 000 ha in 1986 to 2.25 million hectares in 1996 (Dept. Dirjenbun, 1998). By 1997 official government figures show that the combined total - government estates and private estates plus smallholders⁵ - of over 2.6 million hectares had been planted in Indonesia. Of these 1.98 million hectares were in Sumatra, 409 000 ha in Kalimantan and 129 000 ha elsewhere (Appendix 1).

Figure 1. Land areas (x1000 ha) throughout Indonesia estimated to be planted to oil palm from 1986 to 2000.



⁴ See PT. Perkebunan Nusantara III page <http://www.ptpn3/pocommo.htm>

⁵ The private sector - in coordination with government - helped to promote first the PIR-TRANS Inti/Plasma and now the Inti/KKPA schemes. Smallholders eagerly joined-in when the crop proved to be highly profitable.

Much larger figures for Sumatra, and thus for Indonesia as a whole, are implied by Kepala Dinas Perkebunan Riau [Head of the Riau Provincial Estates Crops Office]⁶. Speaking to the press in late November 2000 he claimed that the area of oil palm in Riau alone was 2.1 million hectares, i.e. 22 percent of the province. Further rapid expansion is also earmarked for Jambi province where WAHLI is pressing for the cancellation of a one million hectare oil palm project to be funded by the Asian Development Bank.

FFPCP estimates that at the end of 2000 there were 2.8 million hectares under oil palm in Indonesia (Figure 1). The division between government estates, company estates and smallholders is placed at 450 000 ha : 1 350 000 ha : 1 000 000 ha.

Accurate, up-to-date and readily available land-use maps in support of these statistics are difficult to find or, in many instances, do not exist and all these figures are best regarded as 'indicative'. Land in Sumatra re-allocated by government from forestry to oil palm estate companies up to 1998 is shown in Map 1⁷. Similar maps of land-use are available on the Ministry of Forestry website⁸.

The Pressure To Expand

Worldwide production of palm oil increased from 3.2 million tonnes in 1976 to 17.3 million tonnes in 1997 and was estimated to have been 20.2 million tonnes in 2000 Mielke (2000). Malaysia and Indonesia were by far the largest suppliers and together produced 16.9 million tonnes, the rest of the world contributed only 3.3 million tonnes to the 2000 production.

The supply of palm oil currently exceeds consumption and is forecast to do so until the end of 2002. However Mielke (2000) predicts that demand will rise to 40 million tonnes a year by 2020, a reflection of both an opening of new markets and an increase in world population from 6 billion to 8 billion.

Based on a knowledge of the industry, we have translated Mielke's increase in demand tonnes into demand for increased planting of oil palm. We assume that of the additional 19.8 million tonnes demand, 11.1 million tonnes will be met by Indonesia, 5.2 million tonnes by Malaysia and 3.5 million tonnes by the rest of the world. If this is the case, then 3.0 million hectares ha of new land will have to be cleared in Indonesia over the next 20 years.

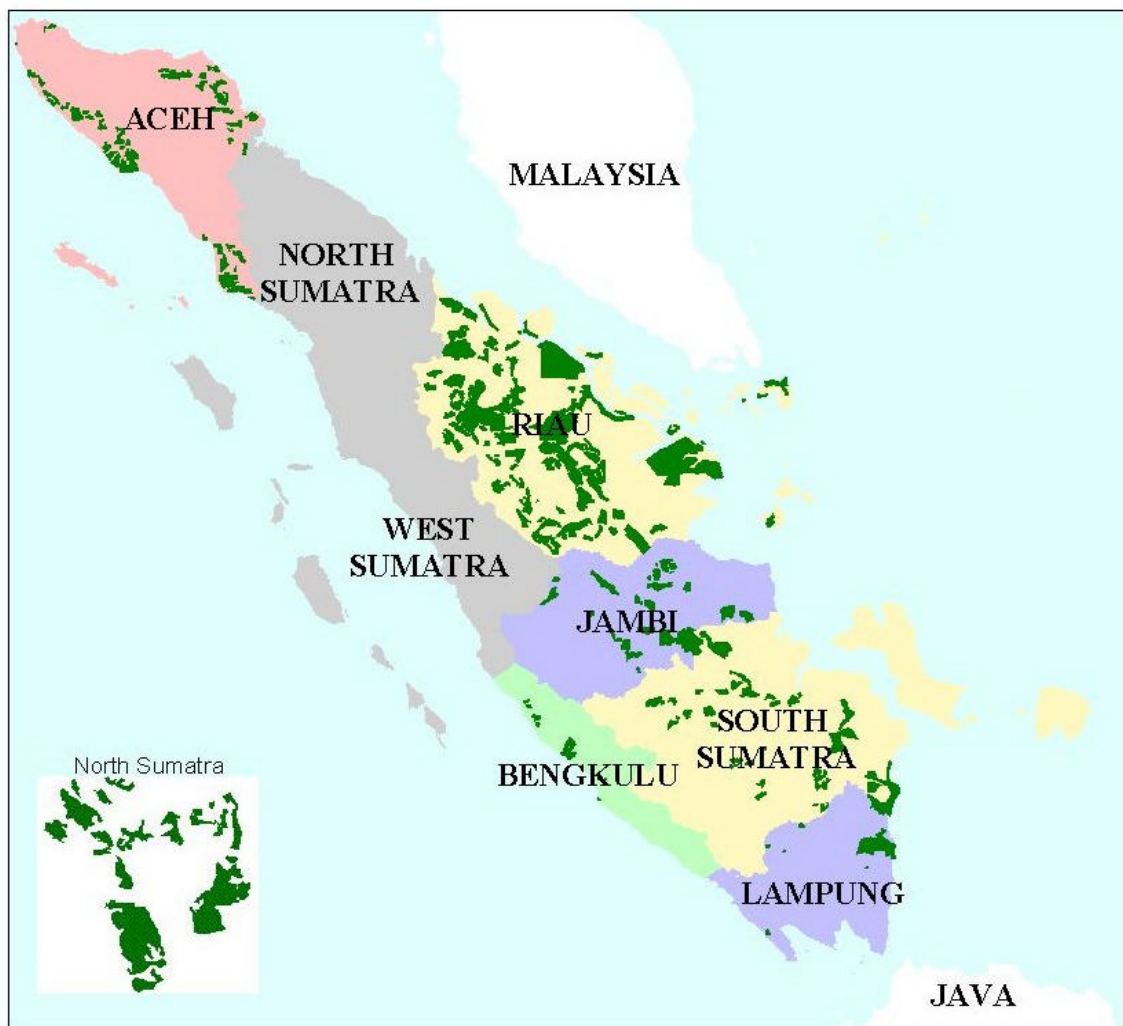
Out of the total of 3.0 million hectares that will be planted, we estimate that 1.6 million hectares will be in Sumatra, 1.0 million hectares in Kalimantan, and 400 000 ha in Irian Jaya. These estimates are based on political considerations and on a knowledge of the land and labour available in the producing regions.

⁶ Reported by Sawit Watch info@sawitwatch.com

⁷ Data supplied by the European Union-funded Forest Inventory and Mapping Project.

⁸ http://mofrinet.cbn.net.id/e_informasi/e_nfi/sdh.htm

Map 1. Land allocated in Sumatra by government to oil palm estate companies as of 1998. (No data are available for the province of West Sumatra, estates in North Sumatra are shown separately).



Source; EU-Forest Inventory And Mapping Project and EU-Gunung Leuser Programme

We further expect that of the new plantings in Indonesia, smallholders will own 50 percent - provided the government policy of promoting smallholder participation continues - and that the remaining 50 percent will be held by private companies

The realities of politics, economics and demographics suggest that when Crude Palm Oil (CPO) prices recover and the general investment climate improves, the oil palm conglomerates will pressure government to permit their expansion. The economics may be ripe by the end of 2002. Smallholder oil palm will similarly increase. In both cases the immediate target will be the wetlands of Sumatra with their high watertables that promise excellent yields through the reduction of moisture stress during drought years.

3. GOVERNMENT AND THE USE OF FIRE

FFPCP has looked at the institutional factors that lie behind the vegetation fires: in particular the project has examined government land-use policy, land-use planning and the laws that regulate the use of forest-land. All were found to be weak at both the national and the provincial levels, and government agencies are poorly equipped to make informed decisions when considering applications to develop new estates (Bompard and Guizol, 1999).

State land in Indonesia is controlled under the new Basic Forestry Law 1999 and the 1960 Basic Agrarian Law. Over the years, numerous government laws, and ministerial and gubernatorial decrees have attempted to regulate or ban the use of fire in land clearance. None has been successfully enforced, although in recent years token efforts have been made. As put by Aditjondro (2001):

“Regardless of the national and international criticism, three consecutive regimes in Jakarta (Suharto, Habibie, Abdurrahman Wahid) have not been able to cope with these recurrent forest fires. In fact, from the 144 companies which had their licences revoked in October 1997 by the Minister of Forestry Djamiludin Suryohadikusumo, two months later 45 permits were reinstated. And even after a new forestry law was enacted in 1999, which carries a sentence of a maximum of five years in prison or a fine of Rp. 5 billion (around \$500 000), no company owner or executive has been charged and found guilty of lighting the fires. From the Forestry Ministry’s initial list of 176 suspects, 133 were oil palm and pulpwood estates. Of these, two oil palm developments had the biggest share, since 60 percent of all big fires took place on these concessions”.

A list of 18 agricultural estate companies in Riau province and six in North Sumatra accused by the Centre for Emergency Preparedness in Environmental Disaster (PUSTADAL), of burning in 2000 is published on the BAPEDAL website at <http://www.bapedal.go.id/kebakaran/permantauan%20spot.htm>

Indonesia's Ministry of Environment, under strong diplomatic pressure from Malaysia and Singapore, is now trying again to obtain convictions in the courts. Earlier failures are attributed to confusion on the part of judges as to the correct interpretation of the present laws. To this end a new Regulation on the, 'Control of Environmental Damage and/or Pollution Related to Land and/or Forest Fires' came into effect on 5 February 2001 (GoI, 2001). It remains to be seen whether prosecutions initiated under this new law are more successful

Corruption, lack of clarity and incompetence undoubtedly all play a part in lax law enforcement, but the government is also well aware that an exceptionally high percentage of Indonesia’s population of 210 million is under the age of 25 and its

priorities are to provide food and employment to rural youth. The development of oil palm estates provides both, and has the additional benefit of earning substantial foreign exchange.

Since 1 January 2001 considerable powers to regulate land use have passed from central to regional government, in particular to the individual Districts within each Province. It is far too early to see how these new regulations will operate in practice but it appears to us unlikely that there will be any improvement of no-burning enforcement in the foreseeable future.

The right to allocate land for tree crop cultivation also passed to the individual Districts. Sources within the industry expect that this will result in easier and quicker processing of new land-development applications. Conservationists rightly fear that this will indeed be the case and that it will lead to an uncontrolled scramble to clear the remaining undeveloped land bank of Sumatra.

Plate 3. Overgrown oil palm seedlings being unloaded from a boat after transport from the nursery to a peat-soil planting site.



4. THE OIL PALM COMPANIES

Company Structure

Many of the larger Groups (Conglomerates) that dominate the Indonesian oil palm business have Holding Companies - often listed on the Singapore stock exchange - who, in turn, own the Indonesian listed company. These companies, again in turn, own up to 30 subsidiary companies each with a different name - a ploy that circumvents the Indonesian law that forbids any single company from owning over 20 000 ha in any one province. The ten major Groups, their Holding Companies, the areas that they have planted, and the areas that they hold in their land bank⁹ are listed in Table 1. The number of 'minor' companies involved in oil palm development, i.e. those that hold no more than 10 000 ha, runs into hundreds. The intricacies of company ownership, who owns whom and what, are explained in some detail by Casson (2000) and Aditjondro (2001).

Estates are merely internal administrative divisions and are not legal entities. A typical 20 000 ha company is divided into four or five estates of roughly equal size. [All land areas of estates are referred to in 'nett-planted' hectares: companies normally allow for an additional 5 percent of land to be cleared which is subsequently found unsuitable for planting.]

Table 1. Estimated area planted (ha) and 'land banks' held by each of the ten largest Indonesian oil palm Groups and their Holding Companies.

Group	Holding Company	Total area planted (ha)	Land bank (ha)
Salim Group	PT Salim Plantations*	240 000	400 000
Sinar Mas Group	PT Golden Agri Resources	360 000	520 500
Texmaco Group	None	35 500	168 000
Raja Garuda Mas	PT Asian Agri	220 000	259 100
Astra Group	PT Astra Agro Lestari Tbk	125 500	192 400
Hashim Group	None	105 300	244 200
Surya Dumai Group	None	61 000	154 100
Napan Group	PT PP London Sumatera Indonesia Tbk	79 000	245 600
Duta Palma Group	None	45 500	65 800
Bakrie Group	PT Bakrie Sumatra Plantations	34 400	49 300
		1 304 000	2 299 000

Sources: Casson (2000); WALHI Kalteng & Down To Earth (2000) revised and updated.

* Purchased in December 2000 by Malaysian owned Kumpulan Guthrie Bhd.

⁹ The widely quoted 'land bank' hectares do not imply a promise of future ownership or development and are thus of little meaning. They normally signify that a company holds an '*izin prinsip*' (a provisional rights permit) to develop the area, but will not have surveyed its suitability for oil palm but simply claimed it as adjacent to current land being developed.

A Lack Of Transparency

The lack of transparency by the Indonesian oil palm companies has, over the years, developed into a culture of wilful obfuscation. The situation hinders the collection of accurate data as an aid to government decision-making and, as almost certainly intended, confuses prying eyes. But, in the final analysis, the strategy is detrimental to the industry. Secrecy prevents effective communication and thus engenders mistrust.

An essential step on the road to openness is for companies to publish accurate boundary maps and the geographic coordinates (latitudes and longitudes) of all their land holdings. These maps must include the positions of lands held by enclave villages, as well as of associated smallholder oil palm. With this information available to all, responsible companies that adhere to no-burn practices will no longer risk being accused of burning along with the 'cowboys'.

As a second step it is imperative that the major companies get together within an umbrella organisation to publicize the perspective and achievements of the oil palm industry. Only under a common banner will the companies be in an effective position to inform and influence government, NGOs, donors and the press - and thus also public opinion - to a more balanced impression of the industry. As things now stand in early 2001 only the increasingly powerful voice of the 'green movement' is being heard. The industry is in danger of a Western-world backlash against its expansion and its products.

Plate 4. Trial of improved transport system for fresh fruit bunches from field to factory for use in areas where labour is short.



5. OIL PALM AND THE ENVIRONMENT: THE POSITIVE SIDE

Forest and estate-crop land in Indonesia is owned by government. The rights to exploit this land are issued by government to companies. The duration of each license is liable to vary with changes in government policy but currently stands at 20 years for a forest plantation area (HPHTI) and 30 years leasehold title for Right of Exploitation (HGU) in respect of oil palm estates.

Lobbyists for environmental groups are quick to point out the negative impacts of the palm oil industry on natural ecosystems. The industry has been slow to rebut these claims, although there are many counterpoints.

The most obvious benefits that arise from the presence of the oil palm estates are the substantial levels of rural employment that they create (see Chapter 6), and the tangible extra income that the industry as a whole generates for the economy (Chapter 7). In this chapter we examine the positive side of the palm oil industry and the environment.

A frequently heard complaint is that oil palm is a mono-culture but this ignores the reality that the great majority of the world's food derives from mono-crops. And that of the major oil-seed crops, the yield per hectare from oil palm is more than double that from its nearest competitor, coconut (Table 2). Thus less needs to be converted from forest to agriculture. The current productivity of 3.5 tonnes per hectare per year for Indonesian estates, as against 5.0 tonnes in Malaysia, reflects the young average age of the Indonesia palm planting, not that productivity or yields at maturity are inherently lower.

Table 2. Average oil yield (tonnes per hectare per year) from four major oil-seed producing crops.

Crop	Yield (tonnes per hectare per year)
Soya bean	0.5
Peanut	1.0
Coconut	1.5
Oil palm (Indonesian estates)	3.5
Oil palm (Malaysian estates)	5.0

Source, Gurmit Singh (1999).

Environmentally sound, standard practices at estate level include contour terracing on sloping land, the use of buffalo carts to haul the fresh fruit bunches to the roadside, and leaving old trunks to rot - not burn - at replanting. (Occasionally trunks can be marketed for lumber). The use of nitrogen-fixing legumes to prevent soil erosion and the encouragement of owls to control fruit loss to rats are covered in more detail in Chapter 8.

The use of insecticides is now considered a last resort. The majority of estates run an 'early warning system' to pick up pest attacks and they encourage the presence of natural predators and biological control agents within an 'Integrated System of Pest Management' that tolerates limited pest damage.

Biodiversity is encouraged by retaining permanent forest as buffer zones within the plantation. These 'reservoirs' act as a source of insect and fungal predators to control crop pest, and retain, albeit limited, numbers of birds and animals. Riparian forest is retained to reduce flooding, steep hill land remains forested, and semi-permanently flooded areas are not cleared. However, wildlife corridors to connect areas of permanent forest on the estate boundaries are not yet common.

Good environmental practices are carried beyond estate production into processing. The oil palm factory is self sufficient in energy and burns excess fruit-bunch fibre and shell to produce steam to generate electricity, as well as to sterilize the in-coming fruits.

Factory-waste management is a well-developed science. Palm oil cake is an established animal feed and is exported to Europe; empty fruit bunches (EFB) and palm oil mill effluent (POME) are recycled back to the land to reduce fertilizer costs and improve soil structure.

We acknowledge that some irresponsible companies do not meet these high standards and complaints about the unauthorised discharge of untreated effluent, with a high biological oxygen demand, into watercourses does occur. AMDAL, the responsible Directorate of BAPEDAL, must prosecute in these cases and the mature companies within the trade must exert pressure on the non-compliant.

In Malaysia frond- and trunk-fibres are increasingly used as raw material for the manufacture of fibreboard.

6. RURAL EMPLOYMENT AND THE ESTATES

As already noted, one of the most visible benefits that arises from the presence of the palm oil estates is the considerable level of rural employment that they create. Estate companies recruit local labour where possible and only after this becomes limiting do they consider taking workers from outside the District/Province. This they do under the Labour Recruitment From Districts Schemes (AKAD) and care is taken to match the religious and ethnic background of the recruits to that of the local residents.

Estate Communities

Companies take an interest in the welfare of their workers, seventy percent of whom are commonly resident while thirty percent commute daily from surrounding villages. All are full-time employees.

An oil palm plantation is permanent and aims to be sustainable - although the tree crop is replanted in 25 year cycles - and generally covers 10 000 ha. The plantation area is traditionally divided into two estates for internal control, each under a separate manager and his staff. A single oil palm factory to process the fresh fruit bunches (FFB) into crude palm oil serves both estates. The whole represents an investment of \$40 million including the factory, recoverable over 8-10 years assuming the price of palm oil again rises, as expected in the medium-term future, to \$400 per tonne

A 5000 ha estate ordinarily contains two company-provided 'emplacements' (small townships) for the workers and their families who live in semi-detached houses provided with 24-hour electricity and water. Additional amenities made available by the company routinely include primary school, health clinic with visiting doctor, mosque / church, community hall, cooperative shop, crèche, football field and volley-ball, badminton and tennis courts. The policy is to attract and retain a community within which workers are committed to long-term employment.

House ownership schemes for the workers - built on sites adjacent to the estate - are particularly successful in Malaysia where the industry has a longer history.

Employment On The Estates

The contractor appointed by the Head Office carries out the initial land clearing while in the early stages, workers hired directly by the company concentrate on the establishment and upkeep of the nursery. Many companies opt for a semi-manual nursery watering system in the interests of creating employment and early goodwill.

They thus take on 200 people to water as well as to fill seedling bags, weed and apply fertilizer. As the seedlings are field-planted and tended, around a further 1000 workers are progressively employed.

The number of workers needed once the plantation is mature is ‘standardized’, calculated on the basis of a requirement of 1 man-day for every 5 hectares. Thus 800 harvesters and loose fruit collectors plus 1 200 general maintenance workers are employed on a 10 000 ha plantation divided into two or three estates.

With holdings of around 1.8 million hectares, the Indonesian oil palm estates directly employ around 360 000 rural individuals. A further 500 000 smallholders (see below) also depend upon oil palm for their income. When urban down-stream processing and service industries are added, the total number of people (workers and their immediate families) that rely on the success of oil palm is at least 4 500 000. A number no government can afford to ignore.

This view, however, is not shared by WAHLI Kalteng & Down To Earth (2000) and Colijn (2001). These groups contentiously argue that the oil palm industry has *lowered*, not improved, average incomes, as villagers who were able to make a living from small rubber plantations and other activities had no choice but to become labourers on the palm oil developments.

Plate 5. Semi-ripe fruits developing on a young palm growing on deep peat soil in eastern Sumatra.



Smallholder Schemes

Local farmers are encouraged, and have been keen, to participate in the development of their rural areas, and thus also increase their individual wealth, by planting oil palm. These schemes started in the mid- to late-1980s. The idea was to encourage smallholders living around the boundaries of large oil palm estates - often in government transmigration settlements - to develop 2 ha of their own palms. The government lent funds to the company to clear and plant the smallholder plots. The company, in turn, charged the farmer for clearing and planting as a repayable debt.

Smallholders plots are laid out as contiguous blocks with a road system and, to all intent, look identical to the adjacent 'nucleus' company estate. Formal ownership transfers to the smallholder 48 months after planting. The smallholder's debt is repaid from the profits he makes selling his FFB to the company-owned central fruit processing factory (palm oil mill).

There have been two similar schemes, PIR-Trans Inti/Plasma (late-1980s to mid 1990's) and, since 1995, Inti/KKPA which is a cooperative credit for members scheme channeled through the local Village Cooperative Unit (KUD). As noted earlier, the schemes involve some 500 000 smallholders on one million hectares of land.

No funds are presently available from Bank Indonesia to finance further KKPA schemes, which, in any event, have been criticized by the smallholders as giving them too large a debt and interest burden as the high development costs are charged to their account.

A rethink of smallholder / company partnership schemes is needed. One possibility would be for the companies to supply the oil palm seedlings to ensure genetic quality, while land clearing and drainage work is carried out by the smallholder to reduce his development costs. This, however, presents difficulties. Zero burn cultivation of 2 ha blocks is not feasible and even if cooperating farmers cleared their contiguous blocks by hand, they would almost certainly burn the debris as has been their practice for generations. Such burns would inevitably reflect on the associated company who would, rightly, deny responsibility but nevertheless be tarnished.

Smallholder schemes also need to re-examine the relative merits of central processing at the company palm oil mill against the alternative of mini-mills directly run and owned by the smallholders with technical and quality control assistance from the company. Mini-mills would remove the friction over prices paid to the smallholders at the company mill gate. They would also eliminate smallholders' demands that their crops have priority when processing during peak cropping seasons. At these times, company mills frequently have limited capacity and they then have to divert company crop to more distant mills.

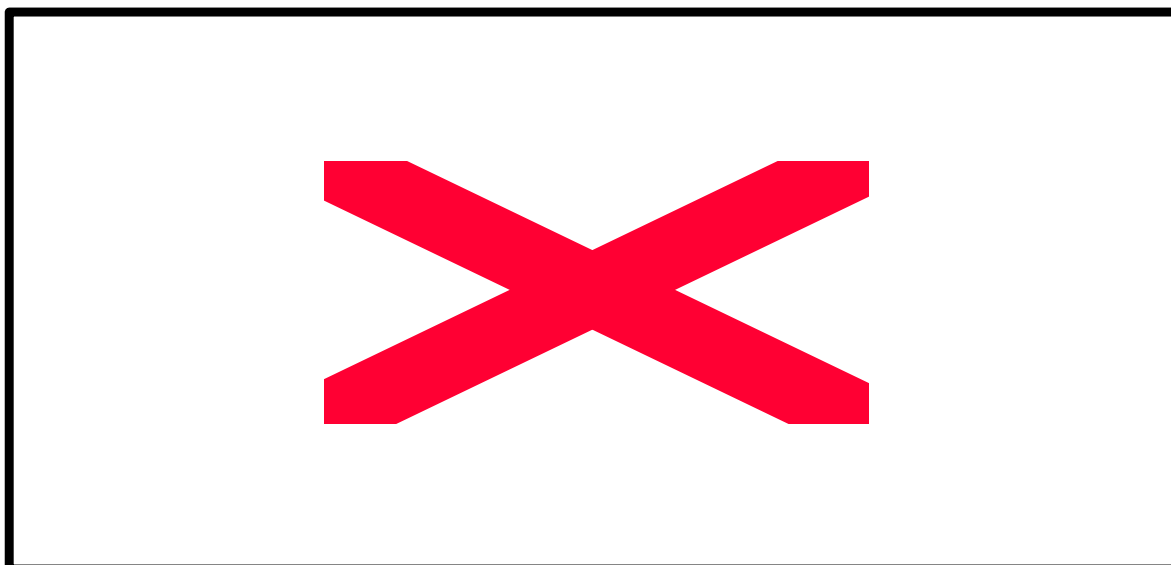
7. PALM OIL AND THE INDONESIAN ECONOMY

Sale Value

Palm oil prices have remained predominantly buoyant over the last 20 years (Figure 1), indicative of the world's increased demand for vegetable oils as a whole and of the major role played by palm oil within this. (Prices given in Figure 2 are in Malaysian ringgits: the ringgit prices accord with those in other currencies.)

From a high of \$626 per tonne in 1998 selling prices declined in 1999 and collapsed to an average of \$250 for the year. Spot prices in February 2001 were at a low of \$194 per tonne. The decreased price reflected substantial stocks at the start of the year and an increase in the worldwide production of the seventeen major oils and fats (Table 3).

Figure 2 Annual average selling prices (\$ per tonne) of crude palm from 1980 to 2000.



Source: MPOB (1999) and the Indonesian press.

Despite these lower prices we estimate that the production of palm oil in Indonesia in 2000 totaled 6.9 million tonnes with a value to the economy of \$1.7 billion¹⁰ of which \$1.38 billion originated from Sumatra.

¹⁰ The additional revenue accruing from the sale of palm kernel oil (PKO) is not included but may be expected to contribute a further \$ 340 million to the economy.

Over the past ten years Indonesia has, on average, exported around 40 percent of its CPO production (CIC, 1999). Thus exports in 2000 are estimated to have earned \$690 million in foreign exchange.

Table 3. World balance of the seventeen major oils and fats (x 1000 tonnes) in 1998, 1999 and 2000. Figures for 1999 are estimates, those for 2000, forecasts.

	1998	1999	Percent change	2000	Percent change
Opening stock	13 300	12 700	- 4.5	13 500	+ 6.3
Production	102 600	108 800	+ 6.0	112 600	+ 3.5
Consumption	103 200	108 000	+ 4.6	112 700	+ 4.4
Ending stock	12 700	13 500	+ 6.3	13 400	-0.8

Source: after MPOB (1999).

Profits

Production costs of CPO in Indonesia average \$200 per tonne and currently producers are, at best, only breaking even. The continued devaluation of the rupiah (Rp. 9 800 = \$1.0 at 28 February 2001) appears to reduce internal costs when these are expressed in dollar terms. In reality it is a handicap as many companies have high off-shore dollar loans and costs of imported fertilizers, herbicides and machinery rise.

A comparison of profitability between similar sized estates on dry undulating land and those on peat wetlands will not be possible until such a time as a large, well-managed estate comes into full production on the peat soils of Indonesia.

Subsidies

The Indonesian government has lessened the burden on the industry by cutting export tax to 5 percent, with an imminent prospect of a further reduction to 3 percent. However government gives no cash subsidy or equivalent incentives, and allows market forces of supply and demand to govern the price of palm oil paid to the producer.

This is also the case in Malaysia, although there is recognition that the current CPO market price paid to smallholders is insufficient to maintain a reasonable standard of living. As a result there is now a proposal from the Malaysian government to pay an "incentive" of \$260 per planted hectare to both smallholders and to estates that re-plant palms over 25 years of age. The scheme would run for one year.

In contrast, fat and vegetable oil producers in the United States and Europe are subsidised. The United States Department of Agriculture (USDA) provided \$28 billion to its farmers and ranchers in the financial year 1999-2000, equivalent to almost half of total farm income. An additional \$500 million 'emergency assistance' was available in 2000 to 600 000 producers of oil seed (canola, crambe, flaxseed, mustard, rapeseed,

safflower, sesame, soybean and sunflower). Further cash is available to all farmers if natural disasters cause losses (MPOA, 2000).

Within the European Union the producers of rapeseed recently received a subsidy of 46 percent of their production costs (MPOA, 2000).

The spirit of the World Trade Organization agreements to stop farming subsidies is clearly being broken to the detriment of the Indonesian and Malaysian producers of palm oil.

Plate 6. Mature oil palm growing on gently undulating mineral soils typical of the inland areas of Sumatra developed by estate companies in the early 1980s.



8. LAND CLEARANCE: TO BURN OR NOT TO BURN?

Establishment Costs For Oil Palm On Dry - And Wetland Sites

Contrary to popular opinion, it is not cheaper to establish oil palms using fire to clear the land than by any alternative method. Establishment costs per hectare, taken from 'secondary forest' to fruit producing, 'mature' palms at the end of Year 3, are largely determined by terrain and soil type (Table 4). The figures given in the table include the cost of the clearance itself plus roading (or drainage / transport canals), weeding, fertilizer applications and minor additional expenses. Detailed costings are given in Appendix 3, Tables A3a – d.

Table 4. Typical establishment costs (rupiah) for oil palm including capital and infrastructure (excluding factory) from the start of land clearing to the end of Year 3 in Sumatra in 1999 by land type.

Land Type	Cost (Rp per ha)
Secondary forest – undulating	13 100 000
Sandy areas	14 100 000
Secondary forest – hilly (50 percent terraced)	15 100 000
Secondary forest - peat soils	18 400 000

Source: after PT. SMART Tbk¹¹

Ramli (1999) suggests that the use of bulldozers on peat is impossible and that the stacking of debris by excavator is a slow process. In fact smaller bulldozers or excavators fitted with swamp-tracks can work on deep peats in all except the wettest periods, and they serve the additional task of compacting the peat. The establishment costs on peat are however 40 percent greater than on 'ideal' dry, undulating land but the additional costs arise primarily from the necessity to dig drainage / transport canals instead of making roads, and from the need to compact the peat. For a company that has the 'standard' 20 000 ha holding, this is equivalent to an additional \$12.5 million at current exchange rates¹².

Whatever the land-types, there is no difference in establishment cost whether the debris are burnt or left to rot.

¹¹ Internal document

¹² An exchange rate of US\$ 1.0 = Rp 8000 is used throughout the report.

The Role Of The Contractor In Land Clearing

The majority of oil palm companies employ an experienced contractor with skilled machinery operators and ancillary workers to clear land at the start of the development stage of an oil palm project. This reduces their capital expenditure needed to purchase heavy equipment and allows early, rapid progress.

The land clearing contract is a detailed legal document signed and stamped by both parties. The contract is normally signed on behalf of the company by senior staff in the Head Office with a copy given to the Estate Manager. It clearly lists the land clearing specifications and, according to reliable sources within a number of major companies, always with a clause that forbids burning. Sub-clauses specify financial penalties where there is non-compliance with specifications or failure to keep within the time schedule.

Legally, therefore, the company has drawn-up the land clearing contract specifications in accordance with Indonesian government laws and regulations that pertain to fire and land clearance. The contractor is legally bound to follow the contract under the supervision of the company and its assigned agents. It is a totally erroneous, but common, misconception that it is the contractor who bears responsibility if fires are lit. The legal onus is clearly on the company, **not** on the contractor **nor** on the individual that struck the match.

Zero-Burning Land Clearing Techniques

Zero-burning is now a well-established policy adopted by the majority of reputable estate companies to clear their land. The spur to its adoption was the widespread fires and smoke haze during the five-month *el Nino* drought of 1997 for which the oil palm companies were correctly held largely to blame.

However, there remains a clear gap between stated company policy of zero-burn and the interpretation by middle management on the ground. Satellite imagery proves that burning remains a regular occurrence on company oil palm development land - even when the company publicly proclaims that it has a zero-burn policy. Field managers have a long-standing desire to burn debris and thus fail to follow instructions from a remote Head Office. Such delinquent management practices require strong disciplinary action to be taken by a company against its managers.

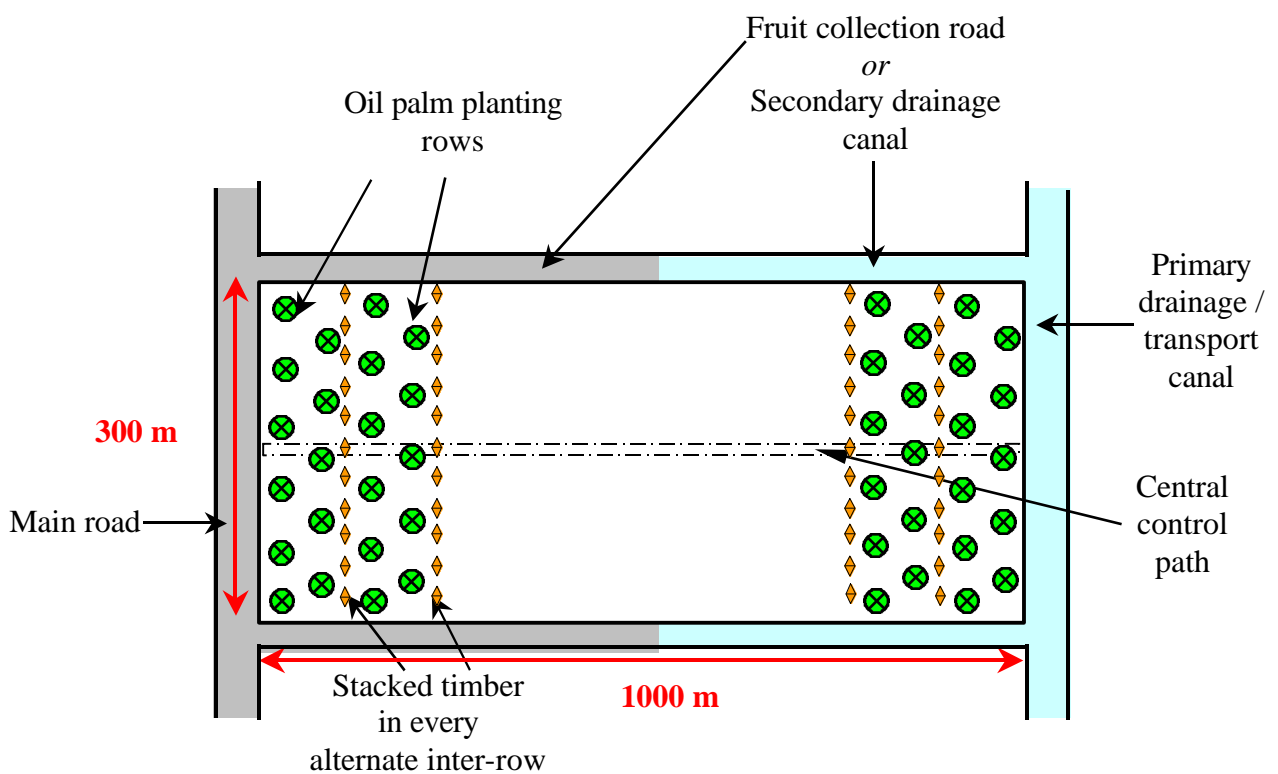
No-burn land clearing is straightforward, although there is a need to pay attention to detail. The steps are:

- Site survey followed by demarcation of the planting blocks.
- Road construction (or digging of primary and secondary canals on peat soils).
- Under-brushing of low-level scrub.
- Chainsaw felling of the residual, non-saleable trees followed by cutting of trunks and branches to manageable size.
- Alignment of the oil palm planting rows.
- Bulldozer / excavator stacking of the wood in every second inter-row, well clear of the planting rows (and compacting of deep peat sites).
- Planting of a leguminous cover crop.
- Planting of the young oil palms from the nursery.

The method is illustrated in Figure 2. Double 'strip-lines' (i.e. wide enough for two planting rows) are cleared at a time by chainsaw and bulldozer to improve efficiency and cost effectiveness. Larger trees are a valuable source of timber for the construction of estate bridges and houses, and are removed by the company. Any residual wood and the debris are stacked in alternate rows. During clearance and stacking the bulldozer blade must be kept clear of the soil surface by 50 to 100 mm to reduce topsoil disturbance. Small roots and branches missed by the blade are left.

There is no necessity or advantage to be gained from burning the stacked timber.

Figure 2. Schematic representation of stacking and planting for a 30 ha block (300 m x 1000 m) - showing road or canal oil palm estate.



A leguminous cover crop (usually a mixture of *Calopogonium caeruleum* or *C. mucunoides* and *Peuraria javanica*) is direct-sown in the inter-rows and adjacent to the piled debris. The legumes quickly scramble over the waste and promote its rapid decomposition over two or three years. The cover-crop is evergreen and also suppresses weeds, fixes nitrogen and reduces fire risk.

Termites are present in both mineral and peat soils and co-exist with the mature palms. In newly cleared areas the termites feed on the stacked wood laid in the inter-rows and are part of the natural decomposition process. Only when this wood is removed by burning do the termites destroy the young palms, although United Plantations in Malaysia have reported that young palms on peat 'replantings' were attacked after the old stand was felled and chipped to destroy breeding sites for rhinoceros beetles.

The Advantages Of Zero-Burning

The advantages of zero-burning land-clearance are noted by Ramli (1997, 1999) as:

- Compliant with Indonesian government regulations.
- Environmentally friendly.
- Preserves soil humus and mulch.
- Retains soil moisture.
- Enhances soil organic matter.
- Recycles nutrients (nitrogen, phosphorous, potassium, magnesium) with reduced need for fertilizer application.

Two points require attention. The stacked timber with its leguminous cover is an ideal breeding ground for rats. Baiting is necessary until the wood rots down. [Barn owls (*Tyto alba*) are frequently introduced as a natural predator after five years when the palms are large enough to accommodate nest-boxes]. And, a central control path running the length of the block needs to be cut by chainsaw to provide freedom of movement across the stacked timber rows. This is at the 150 m mark for a typical 300 m x 1000 m block.

The Disadvantages Of Burning

It is not widely realised that smoke haze has direct negative impacts on the palm oil industry:

- The palms receive reduced solar energy which limits photosynthesis and thus growth.
- The lower levels of sunlight result in the production of male in preference to female inflorescences, i.e. fewer fruits form.
- Populations of the flower-pollinating weevil (*Elaeidobius kameruncis*) fall severely and the fruit bunches that are produced are poorly formed and thus less productive (See Caliman and Southworth (1998) amongst others for further references).

Oil extraction rates at the mills fell by a seemingly small one to two percent for up to four months owing to the smoke haze that accompanied the 1997 *el Nino* fires. However we calculate that this amounted to a loss of \$16.25 million to the Sumatra plantation companies¹³. The losses caused by water-stress that were apparent for 18 months after the drought ended are not included in this total.

¹³ The basis of calculation is given in Appendix 1.

General Fire Management Policy And Practice Within The Estates

A mature oil palm plantation is not a fire risk although estate boundaries, newly cleared areas and stacked debris - including young palms - are vulnerable to fire and a comprehensive and detailed fire management policy must be implemented in the field. It is clearly in the best interests of the estate sector to have a zero-fire policy, and equally important that companies have a well-trained, competently-led firefighting team to extinguish any fires that do occur. It is already standard practice, but little known, that many oil palm development companies have in place:

- Tankers and water trailers.
- Water pumps and hoses.
- Back-pack spray pumps.
- Brooms and rakes.
- Watchtowers at strategic locations.
- Alarm systems using radios and gongs.
- Boundaries swept clean.
- Fire-vulnerable areas back-burnt prior to the dry season.
- Pre-arranged response plans for fire teams on paid stand-by.

Companies need to refine their fire management efforts. A fire detection system should be put in place and estates need to assess fire risk according to location, operational activities within the estate and by their neighbours, and by season, and adjust their equipment and training accordingly.

FFPCP working with the Provincial Office of the Ministry of Forestry in South Sumatra has identified the provision of support to Forestry District Offices [*Cabang Dinas Kehutanan Tingkat II*] as one way to strengthen the government's fire fighting capacity – and fire prevention – in the immediate future (Nicolas, 1999). The points made by Nicolas are equally applicable to oil palm and pulpwood estates.

“The prime need is to form and equip fire crews, the foundation of any future system. To this end FFPCP has advised on team formation and provided training in trial areas. Crew safety is considered paramount: the necessity for protective clothing, risk avoidance and first-aid are stressed. Once understood, training continues in the choice and use of equipment to suppress vegetation fires, and in basic fire tactics.”

“Field experience has shown the necessity to keep equipment simple, compatible and adaptable. Over-complex equipment is never used or is quickly broken. Increased success brings recognition from authorities and community and, with this, increased motivation and achievement.”

“In the longer term there is a need to establish a national fire management organisation that encompasses both prevention and control. Modern methods to anticipate and manage risk, allocate resources, and deal with crises are needed if periodic smoke haze events are to be avoided.”

Government fire management teams at District level throughout Sumatra remain, almost without exception, poorly organised, trained and equipped. Top-down pressure from Jakarta has failed to improve the situation and there seems little likelihood of immediate improvement under the new autonomy laws.

The private sector should lead the way by equipping themselves and then coordinate with, and directly support, the District fire teams.

Plate 7. Processed empty fruit bunches from the palm oil factory applied in alternate rows between mature palms to recycle nutrients and improve soil structure.



9. THE EXPANSION OF AGRICULTURE INTO THE WETLANDS OF SUMATRA

The Wetlands Of The Island

According to RePPPProT (1988,1988a) the wetlands of Sumatra cover a area total of 11.5 million hectares, predominantly along the eastern coast (Table 5). The alarming threat posed by their opening for logging and subsequent development for estate crops is well documented. [See Anderson and Bowen (2000) for a review of the literature]. It is of paramount importance that both central government and provincial administrations pay careful attention to land-use planning. And that within these plans, that the planting of oil palm is best confined to the shallower peats.

The Soils Of The Wetlands

Of the eight land (soil) types within the wetlands (Table 5) listed by RePPPProT, only Type 2 wetland clays, and Type 8 shallow peats, are considered by the authors as suitable for oil palm cultivation. Together they total 4 279 300 ha.

Van den Eelaart (undated) suggests a lower figure of 3.5 million hectares of coastal wetlands - most classified as 'tidal swamps' - as being suitable for development in Sumatra. Of this, 2.5 million hectares are already occupied.

An even more conservative figure is suggested by World Bank (1994) which estimated that around 2.5 million hectares of the wetlands of Sumatra are suitable for cropping. The same organisation notes on its website¹⁴ that most of the wetlands are classified as 'tidal swamps' owing to the influence of 'tidal water incursion', and that, "The global experience in developing swamps, particularly those in temperate countries, can not be directly related to Indonesian conditions".

Despite these - well justified - warnings, experience first in Malaysia and more recently in the three main islands of Indonesia has shown that peat of depths in excess of 1.0 m can be safely planted, at least in the *shorter-term*. Thus perhaps some 10 million of the total 11.5 million hectares *may be considered by the estate industry* as suitable for development. In reality such a widespread invasion of the wetlands would be disastrous for conservation efforts. And, as we emphasise in Chapter 10, may also be of no long-term benefit to estate companies if carried into the extensive areas where continuous drainage over many years is not assured.

¹⁴ <http://www-wds.worldbank.org/cgi-bin/cqcggi@production.env>

Table 5. Wetland areas (ha) sub-divided by land types (soil types) within the eight provinces of Sumatra. (The key to Land Types is given in Table 6).

Land Type	Area (ha)								
	Aceh	North Sumatra	West Sumatra	Riau	Jambi	South Sumatra	Bengkulu	Lampung	Total
1	60 100	95 200	11 000	259 500	18 700	354 500	2 100	56 800	857 900
2	301 600	472 600	82 300	998 000	309 200	1 579 600	8 100	147 100	3 898 500
3	2 500	9 200	3 400	64 400	3 300	30 000	400	24 100	137 300
4	8 200	58 400	14 300	136 500	24 700	508 900	600	113 900	865 500
5	123 000	261 100	69 700	1 605 200	569 900	603 700	18 400	8 000	3 259 000
6	4 000	55 300	78 000	1 673 300	50 300	83 000	0	1 200	1 945 100
7	110 300	0	0	19 700	0	0	0	0	130 000
8	60 900	67 300	52 100	67 500	28 900	44 400	45 500	14 200	380 800
	670 600	1 019 100	310 800	4 824 100	1 005 000	3 204 100	75 100	365 300	11 474 100

Source: RePPProt (1998, 1998a)

Table 6. Land (Soil) Types within the wetlands of Sumatra.

LAND TYPE	PEAT	COMMENT
1. Inter-tidal mudflats	<10cm	Highly saline. Mangrove (80 percent) nipah (20 percent)
2. Coalescent estuarine/riverine plain	<50cm	Peat is local. Levee (10 percent). Seasonal inundation. Some settlement/ cultivation
3. Swamp. Floodplain in narrow valleys	<25cm	Permanently inundated back-swamps except levee (5 percent). Swamp forest
4. Swamp. Peaty floodplains	<50cm	Permanently inundated. Swamp forest and herbaceous swamp
5. Swamp. Shallow peat swamp	50-200cm	No inundation. Peat swamp forest, bush. Often intermediate between land types 2 and 6
6. Swamp. Deep peat swamp	>200cm	No inundation. Peat swamp forest. Commonly domed
7. Old marine terrace	>76cm	Seasonal inundation. Peat swamp forest. Peculiar to Aceh and less so Riau. 1-2 metres of peat overlying white clay
8. Alluvial valleys	<10cm	Seasonal inundation. Minor valley floors within hills. Some settlement and cultivation.

The Law And Deep Peats

We are aware of only one government regulation that relates to the management of development on peat soils. This is Presidential Decree Number 80 of 1999¹⁵ and is specific to Central Kalimantan. It seeks to maintain swamp forests on peats deeper than 3 m as a means of conserving the hydrological functions of peat domes. Similar legislation applicable to all wetlands in Indonesia is needed.

Reducing The Impact Of Wetland Development

The pressure to further expand oil palm plantings into the wetlands of Indonesia is probably irresistible. This however, does not mean that 'development' should go unchecked and without regard to the environment. Oversight and control should be exercised by Government who, in the first instance, must insist that a detailed Environmental Impact Assessment (EIA) be carried out by AMDAL. Such an assessment would allow a distinction to be made between the narrow concerns about the ability of the site to produce a crop and its long-term economic potential for agricultural use.

In many instances responsible companies already commission full environmental impact assessment studies against internationally accepted terms of reference. FFPCP has seen a number of such studies, which give detailed recommendations on environmental conservation practices and which include provision for continuous monitoring schemes. We believe that the concerned companies have followed the programme.

Investment banks also have an important part to play. They are increasingly calling for detailed pre-funding studies that examine not only the economic returns on investment but also assess the impact of the proposed scheme on people and on wildlife and flora in the area, and on those up-and down-stream.

Individual companies routinely carry out their own feasibility study, although this is more directly concerned with protecting their investment than with the environment. A semi-detailed survey of soils, drainage and vegetation is wise prior to deciding upon the location of a proposed new oil palm plantation. And a detailed survey becomes essential after approval of the *izin lokasi*. Estate companies too often go into areas with inadequate soil and topographical surveys, feasibility studies and long-term projections, and attempt to solve problems as they arise. Costly mistakes are made under pressure from management to achieve maximum planting targets, and 'impossible' land is needlessly cleared before it is abandoned.

¹⁵ See http://mofrinet.cbn.net.id/e_informasi/e_nfi/PLG/rapt0300.htm

10. OIL PALM CULTIVATION WITHIN THE WETLANDS: TECHNICAL CONCERNS

Mineral Soils

The freshwater mineral soil swamps of coastal Sumatra typically present a vegetation of 'grass' plains which result from regular burning. Sedges, rather than true grasses, in fact dominate, mostly Cyperaceae such as *Scleria levis* and *Chynchospora corymbosa*. Provided they are carefully drained and the watertable is managed, the mineral soils of the wetlands are well suited to oil palm cultivation.

The mineral soils have clear and potable water - a distinct advantage - although they are sometimes contaminated by the highly acidic 'black-water' flowing out of nearby peats, or by streams draining acid sulphate soils. Such acid sulphate soils interspersed in the mineral soil areas call for care. Oxidized pyretic soils release large quantities of acid groundwater to adjoining canals when they are drained and the drains thus have to be excavated in planned stages and the water levels in the drains and canals carefully controlled. The channels must be periodically flushed making use of water-gates and weirs and tidal movements to achieve progressive removal of the acid sulphate toxicity.

Land-use planners should allocate mineral soil swamps to agriculture in preference to peats despite these potential difficulties and provided that the company is prepared to invest in a hydro-topographical survey before starting a new development.

Peat Soils

The peat lands of Sumatra are extensive and individual peat domes may be large. They form a vital function in the ecosystem and, so far, have acted as a self-regulator for the west to east movement of water from the Barisan mountain range to the mangrove swamps. In the wet periods the water is stored, and in the dry spells the peats release water and help to minimise saltwater intrusion in the coastal regions.

Successful water management is the key to the sustainable cultivation of oil palm on peat soils in the wetlands. This demands the systematic planning, organisation and close control of drainage to maintain water level within the optimum range for crop production. Hand-in-hand with water management is the necessity to compact the peat with a roller or swamp-tractor before it is planted. Surface levels commonly decrease by 0.7 m to 1.0 m after compaction and the firmed soil prevents the mature palms from toppling.

Sustainable 'drainability' is essential. Drainage is by gravity and can only function if the level of the mineral sub-soil that underlies the peat lies above the mean water level of the nearest river, canal or lake into which the drainage water is discharged. Only then will the ground surface remain above water level after the peat decomposes over time - typically at a surface level reduction rate of 60 mm a year.

If the layer of peat extends below mean water level, bunding and/or pumping will be needed to ensure drainage; neither is an effective or economic solution.

A more detailed description of the drainage problems of the tidal swamp wetlands of Indonesia, in particular as these relate to rice cultivation, is given by van den Eelaart (undated).

The Dangers Of Cultivating Deep Peats

The moment that peat swamp forests are 'reclaimed' by drainage for agriculture, the clock starts ticking and it is only a matter of time before the peat is completely destroyed. Subsidence, irreversible drying and oxidation - not to mention fire - mean a loss of peat of around 60 mm a year (Andriessse. 1974, 1988). This figure can be used to estimate the life-span of a peat swamp after drainage. Sustained agriculture on *drained* peat soils is thus a myth. In these cases the economic returns from managing the natural forest may, in the long run, prove more profitable than from agriculture. The case for sustainable agriculture on peats *where the water levels are carefully regulated* remains to be proved.

Indiscriminate development on deep peat soils in Sumatra will cause enormous 'knock-on' damage to the range of ecosystems that exist between the mountains and the sea and will also have deleterious effects on off-coast fishing and coastal aquaculture (Taylor and Sanderson, undated). And if inappropriate oil palm developments fail, the resultant fire zones guarantee that smoke haze will, each year, continue to envelope Singapore and Malaysia.

The dangers for one province in Sumatra - but equally applicable to many swamplands throughout Indonesia - are well summarized by van den Eelart, who worked as a drainage expert in Sumatra for many years, in correspondence with FFPCP. "From my surveys in the eighties we know that deep peat development between the Rohan river and the Kampar river in Riau is for the greater part not sustainable as drainage can not be maintained after subsidence. Between the Kampar river and the Indragiri river most peats are 'okay' as they [the peats] can still drain after subsidence."

"When you can not sustain drainability, then you end up with a complete wasteland, not suitable for anything including forestry. There are already many such wastelands in Malaysia, particularly, as I know, in old rubber plantations. Neither oil palm nor any other tree crop development should ever be allowed in peatland which can not sustain the drainage requirements".

There have been other failures. The most widely publicized scheme that has collapsed is referred to by the Ministry of Forestry as *Proyek Lahan Gambut* [Peat Land Project] and by others as the Mega Rice Project or the One Million Hectare Sawah Project in

Central Kalimantan. To this may be added the several derelict swamp schemes in South Sumatra.

Government should permit - or reject - further development of the peatlands of Sumatra only after the most careful consideration of the larger environmental impact of such schemes on water resources, fire zones and the fragile ecosystem that supports an already severely threatened fauna and flora.

Other Estate Crops Within The Wetlands

It is impossible to estimate with any accuracy the area of wetlands in Sumatra that has been cleared for agriculture and estate crops other than oil palm.

It is known that a major producer of coconut-based products has developed 75 000 ha of estates in the coastal peat wetlands along the River Guntung in Riau. And FFPCP is aware that a private company has recently cleared 1 300 ha on the banks of the River Batanghari in the province of Jambi to establish two hardwood timber species on a logged-out area of peat swamp forest. A further (undated) 1 500 ha of hardwoods are believed to be planted in South Sumatra. (Van den Eelaart, gives figures for wetland rice growing in South Sumatra).

Plate 8. Three-year-old oil palm growing on compacted deep peat soil in the east coast wetlands of Riau province, Sumatra. The fronds are dark green and healthy and the trees are starting to fruit. A fruit collection path runs down the centre of the row.



FFPCP understands that another company has started pre-production trials of *Acacia crassicarpa*, as a pulpwood crop on the coastal wetlands east of Palembang, South Sumatra. If carried through the development is expected to cover around 100 000 ha planted over eight years. Trials of the same species are planned, or are underway, in Riau province.

The two developments in South Sumatra are on land that was heavily logged in the 1980s and the early 1990s and were devastated by the 1997 wildfires. Extensive areas are now largely abandoned grass-and sedge-lands. There is a pressing need to bring the land back into production to prevent wildfires ravaging them in future droughts. The choice appears to lie between fast growing pulpwood species, slow growing swamp timber species and oil palm. The conservationists' ideal of total protection from further fires and the consequent regeneration of a well-wooded landscape is unrealistic. *Sonor* rice is widely sown in drought years (see Bompard and Guizol, 1999), fires are set by hunters and fishermen, and there is heavy exploitation of the *Melaleuca* stands for poles. It would, however, be a prudent decision to set aside representative areas with regeneration in mind.

11. A WAY FORWARD

There is a growing and highly critical international scrutiny of not only the environmental but also the land acquisition and employment track-records of the companies that hold oil palm estates within Indonesia. The industry, as a matter of urgency, must address the charges and in those cases where the criticism is justified, put its house in order. In the instances that the critics are in error, the sector must be patient and provide proof to correct the misconceptions.

Those who oppose some or many of the practices of the oil palm estates and the downstream processors can be divided into four broad, inter-related, groups: several Indonesian government agencies; the governments of a number of neighbouring countries; international NGOs, and; national NGOs.

The government of Indonesia after a long period of studied neglect is now taking more rigorous steps to abolish the use of fire to clear land. As we have noted earlier, PUSTADAL is seeking prosecutions of non-compliant companies and a stricter law to prohibit burning is in place.

International pressure from neighbouring countries continues to be brought to bear on the government of Indonesia at the regular ASOEN meetings and at those of the ASEAN Regional Fire and Haze Action Group at which Malaysia, Singapore and Brunei Darussalem are the driving forces.

The British government's Department for International Development (DFID) is taking a different approach. DFID's Multi-Stakeholder Programme focuses on the social aspects of development in Indonesia, particularly on the issues that relate to deforestation. The programme seeks to facilitate a dialogue between Government, private sector and NGOs and thus to improve land-use policy, to encourage increased participation by those impacted by development, to enhance communication amongst stakeholders and to promote examples of good practice.

International NGOs are well-established and speaking with one voice. Amongst the highly influential and well-informed groups are the World Wide Fund for Nature Conservation (WWF) and the International Union for the Conservation of Nature (IUCN), both of which have representatives in southeast Asia. A number of European environmental NGOs take a particularly close interest in the activities of the oil palm industry. Amongst these are Down to Earth, Friends Of The Earth, the Working Group on Indigenous Peoples, and Greenpeace. This list is by no means exhaustive and many smaller groups in Europe, North America and Australia monitor the industry.

These international NGOs are bringing strong pressure on banks and other lending institutions to release funds to only those who can demonstrate a responsible environmental record. The recent publication of, 'Funding Forest Destruction – The Involvement of Dutch Banks in the Financing of Oil Palm Plantations in Indonesia', a

report commissioned by Greenpeace Netherlands, (Wakker, 2000) is one example of such pressure. Follow-up meetings between this influential group and the Dutch banks were continuing in late-January 2001 (Wakker, *pers.comm.*) and the banks are being asked to subscribe to a set of four conditions before investment is made in oil palm production (de Clerck, *pers. comm.*, 25 February 2001). These demands are for: no deforestation for new plantations; no burning for new plantations; the rights and wishes of local communities to be respected, and; no violation of Indonesian law.

As a result, many of the international lending banks (e.g. Rabobank, ABN Amro Bank NV, ING Bank NV and Fortis), as well as the Commonwealth Development Corporation and the International Finance Corporation, a subsidiary of the World Bank, are paying much greater attention than previously. The banks are sensitive to the damage to their image that results from financing development schemes in ecologically sensitive zones and, as noted in Chapter 9, most Western banks now insist on an environment impact assessment report before funding any new project.

Plate 9. Ripe loose fruit with an oil extraction rate of over 40 percent incidentally detached from the bunch during harvest and gathered separately for processing.



International NGOs are also considering campaigns that target the consumers of palm oil in North America and Europe. Neither the major manufacturers nor individual customers in the shops wish to buy produce they believe to have come from land hacked and burned out of the tropical rain forest. The images of burnt *orangutan* that appear on television and in the newspapers are powerful. Consumer backlash is a highly damaging weapon and one that the oil palm industry would be wise to avoid.

At the national level, Wahana Lingkungan Hidup Indonesia (WALHI) serves as the leading environmental watchdog. It also acts as an umbrella organisation for numerous other local NGOs, e.g. LATIN, ELSAM, TELAPAK, YLBHI and others. There is also a growing number of smaller, more 'focused' groups. Main among these is Sawit Watch established in 1998 with the stated aim of linking over forty Indonesia-wide NGOs in a coordinated network to raise awareness of the environmental and social impacts of irresponsible oil palm expansion. Their work is widely known at local, national and international level.

In contrast, the Indonesian oil palm industry, although covering nearly 3 million hectares, is not organised in a way that allows it to speak with one voice to Government or to national and international conservation agencies.

Groups that currently represent various parties within the industry include:

- BKS – PPS *Badang Kerjasama Perusahaan Perkebunan Sumatera* [Sumatra Planters' Association] that represents employees – mainly in wage negotiations.
- BKS – PPK *Badang Kerjasama Perusahaan Perkebunan Kalimantan* [Kalimantan Planters' Association] with the same purpose as its Sumatra equivalent.
- GAPKI *Gabungan Perusahaan Kelapa Sawit Indonesia* [Indonesian Palm Oil Producers Association] representing the producers of CPO.
- FAMNI *Federasi Assosiasi Minyak Nabati Indonesia* [Indonesian Federal Association of Vegetable Oil Producers], whose title is self-explanatory.
- IOPRI *Pusat Penelitian Kelapa Sawit* [Indonesian Oil Palm Research Institute].

It seems to us that the time is now opportune for the major companies to form a unified Association that could act as an 'umbrella' for the five existing groups as well as bring in wider interests. These wider interests will need to include - perhaps progressively, but in the shorter not the longer term - representatives of the workers employed on the estates and in the refining industry.

The present passive response from the industry to environmental concerns has not, is not, and will not work in the future. Selling image in a window dressing attempt to satisfy public opinion is also not the answer. There must be a totally open and sincere effort by the industry to put its environmental house in order.

The unified Association should be self-regulating and act as a liaison point between the industry and the conservation agencies, as well as engage in dialogue with government. An early declared-objective should be the reduction of smoke haze through the introduction of 'best practice' land clearance.

A bold and highly symbolic step would be to set-up an office to monitor and interpret remotely-sensed (satellite) fire location data. These data, covering Sumatra, Kalimantan and Sulawesi, could be supplied by the three donor-funded 'fire projects' that currently supply data to government and – through the worldwide web – to all those who wish to view it¹⁶.

¹⁶ The EU-funded Forest Fire Prevention and Control Project (FFPCP) based in Palembang, South Sumatra; the GTZ-supported Integrated Forest Fire Management Project (IFFM) based in Samarinda, East Kalimantan, and; the JICA financed, Forest Fire Prevention Management Project (FFPMP) at Bogor, West Java.

There is a welcome sign that this process is beginning. A specialised Haze Prevention Group (HPG), under the direction of an expatriate consultant, and funded by the Sinar Mas Group and the Asia Pacific Resources International Ltd (April Group) started work in January 2001. HPG is based in Jakarta and will need to be supported by a levy per planted hectare charged to new member companies. It is hoped that this will be a major step in the formation of an effective oil palm industry association that will promote environmental awareness and self-policing.

The industry also needs to employ its own internationally recognised environmental management expert to assist the industry to follow sound management practices. A secondary task would be to represent the estates at technical meetings.

Hand-in hand with this must be the setting-up of a partnership between the unified oil palm association and an NGO that is well known for its work in conservation. Such an alliance will face many difficult challenges and there will need to be understanding and accommodation on both sides, but unless mutual understandings are reached both parties will be losers.

FFPCP acknowledges the major contributions made by the oil palm companies to rural employment and development, and of the oil palm industry to the economy of Indonesia but we note that much more needs to be done by the estate crop companies to address the question of land-ownership and land-use rights. The former practices of intimidating local communities and paying-off officials will no longer succeed. Specialist help is again needed, this time from reconciliation experts paid by the industry but working in partnership with local communities.

Once these initiatives are in place, the industry then needs to employ a public relations officer whose task would be to speak for the industry and promote interest in its contribution to the Indonesian economy and in its improving environmental record. The audience would routinely include government ministers, ASEAN, diplomatic missions, trade delegations, customers for oil palm products and the press / television, as well as the NGOs who are now its greatest critics.

Many organisations including FFPCP have argued that expansion of the oil palm estate industry into the peatlands of Indonesia should be prohibited if future, seriously damaging, smoke haze is to be avoided. We now acknowledge that peat land can be cleared and planted without the use of fire, provided the techniques outlined in this report are followed. The technically-challenging drainage, clearance and water-management that are essential to obtain satisfactory economic returns must, however, be left to only the best managed companies. Failed schemes destroy rather than develop land and become fire hazards.

FFPCP does, however, continue to have strong reservation about the unregulated development of the wetlands of the east-and west-coasts of Sumatra and of the interior wetlands, with or without the use of fire. FFPCP, and many others, have repeatedly emphasized their importance as havens of rare plants and animals and as 'green-sponge water-regulators'. The balance to be struck between their conservation and their conversion to alternative land use is for the government of Indonesia to decide. Preservation of meaningful areas would be a wise choice.

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13. ABBREVIATIONS AND ACRONYMS

AKAD	<i>Antar Kerja Antar Daerah</i> [Labour Recruitment from Districts]
AMDAL	<i>Analisa Mengenai Dampak Lingkungan</i> [Environmental Impact Analysis Directorate of BAPEDAL]
ASEAN	Association of South East Asian Nations
ASOEN	ASEAN Senior Officials On The Environment
BAPEDAL	<i>Badan Pengendalian Dampak Lingkungan</i> [National Board for Environmental Impact Management]
BKS – PPK	<i>Badan Kerjasama Perusahaan Perkebunan Kalimantan</i> [Kalimantan Planters' Association]
BKS – PPS	<i>Badan Kerjasama Perusahaan Perkebunan Sumatera</i> [Sumatra Planters' Association]
CFC	Common Fund for Commodities
CPO	crude palm oil
CRISP	Centre for Remote Imaging, Sensing and Processing at the University of Singapore
DFID	Department for International Development (UK)
EC	European Commission (of the European Union)
EIS	Environmental Impact Study
ELSAM	<i>Lembaga Studi dan Advokasi Masyarakat</i> [Society Advocating and Study Foundation]
EU	European Union
FAMNI	<i>Federasi Assosiasi Minyak Nabati Indonesia</i> [Indonesian Federation Association of Vegetable Oil Producers]
FFB	fresh fruit bunch
FFPMP	Forest Fire Prevention Management Project (JICA)
FFPCP	Forest Fire Prevention and Control Project (EU)
GAPKI	<i>Gabungan Perusahaan Kelapa Sawit Indonesia</i> [Indonesian Palm Oil Producers Association]
GTZ	<i>Deutsche Gesellschaft für Technische Zusammenarbeit</i> [German Technical Cooperation]
Ha	Hectare
HGU	Hak Guna Usaha [Right of Exploitation]
HPG	Haze Prevention Group [of Indonesia private industry]
HPH	Hak Pengusahaan Hutan [Forest Concession Right]
HPHTI	Hak Pengusahaan Hutan Tanaman Industri [Forest Concession Right and Industrial Tree Estate or Utilization Right for Industrial Forest Plantation]
IFFM	Integrated Forest Fire Management Project (GTZ)
Inti/KKPA	company nucleus estate / cooperative smallholder plot
Inti/Plasma	company nucleus estate / smallholder plot

IOPRI	<i>Pusat Penelitian Kelapa Sawit</i> [Indonesian Oil Palm Research Institute]
IPM	integrated pest management
ITTO	International Tropical Timber Organization
IUCN	International Union for the Conservation of Nature
JICA	Japanese International Co-operation Agency
KKPA	<i>Kredit Koperasi Primer Anggota</i> [Primary Cooperative Credit for Members Scheme]
KUD	<i>Koperasi Unit Desa</i> [Village Cooperative Unit]
LAPAN	<i>Lembaga Penerbangan dan Antariksa Nasional</i> [Indonesian National Institute for Aeronautics and Space]
LATIN	<i>Lembaga Alam Tropika Indonesia</i> [The Foundation of Indonesian Tropics Nature]
LCC	leguminous cover crop
m	metre
MPOB	Malaysian Palm Oil Board
NGO	Non-governmental organisation
NOAA	National Oceanic and Atmospheric Administration
PHPA	Perlindungan Hutan dan Pelestarian Alam [Directorate General of Forest Protection and Nature Conservation of the Ministry of Forestry]
PIR	<i>Perkebunan Inti Rakyat</i> [Nucleus Estates and Smallholder] (a package program specially intended to develop the potential of smallholders)
PIR - Trans	As above, but smallholders sourced from a transmigration scheme
PKC	Palm kernel cake
POME	Palm oil mill effluent
PORIM	Palm Oil Research Institute of Malaysia
PTP	<i>Perseroan Terbatas Perkebunan</i> [Estate Crop Limited Company]
PUSTADAL	<i>Pusat Kesiagaan dan Tanggap Darurat Bencana Lingkungan</i> [Centre for Emergency Preparedness in Environmental Disaster - an arm of BAPEDAL]
RePPPProt	Regional Physical Planning Programme for Transmigration
SPOT	<i>Satellite Probatoire pour l'Observation de la Terre</i>
t	tonne
Tbk	<i>Terbuka</i> [Limited Company]
TELAPAK	<i>Yayasan Telapak Indonesia</i> [Indonesian Telapak Foundation]
USDA	United States Department of Agriculture
WALHI	<i>Wahana Lingkungan Hidup Indonesia</i> [Indonesian Environmental Forum]
WTO	World Trade Organisation
YLBHI	<i>Yayasan Lembaga Bantuan Hukum Indonesia</i> [Indonesian Legal Aid Foundation]

APPENDIX 1

Oil Palm Plantings In Sumatra By Province

Table A1. Land planted (ha) to oil palm in Sumatra by province, and elsewhere in Indonesia as of 1997, by private sector companies, government estates and smallholder farmers.

Province	Private Sector	Government Estates	Smallholders	Total
Aceh	105 700	31 600	39 200	176 500
North Sumatra	247 700	237 700	99 300	584 700
West Sumatra	85 300	3 300	41 600	130 200
Riau	300 100	56 500	165 900	522 500
Jambi	74 400	8 300	112 700	195 400
South Sumatra	106 200	27 200	113 700	247 100
Bengkulu	38 700	4 300	17 400	60 400
Lampung	26 600	13 000	21 500	61 100
	984 700	381 900	611 300	1 977 900
Kalimantan	212 600	37 600	159 000	409 200
Irian Jaya	0	8 300	11 000	19 300
Elsewhere	56 900	21 000	31 500	109 400
	1 254 200	448 800	812 800	2 515 800

Source: after Departemen Pertanian, Direktorat Jendral Perkebunan (1998)

APPENDIX 2

Loss Of Crude Palm Oil In Sumatra In 1997 Owing To Smoke Haze Pollution; Basis Of Cost Calculation

1. The area of oil palm in Sumatra in 1997 was 1 946 000 ha (CIC, 1999) of which we estimate 66 percent (1 300 000 ha) to be of mature productive trees.
2. Based on field knowledge, an average yield of 15 t of FFB per hectare is assumed; thus total annual production of bunches in Sumatra in 1997 was 19 500 000 t.
3. The oil extraction rate from the FFB averages 23 percent, CPO annual production in 1997 prior to the smoke haze would thus have been 4 485 000 t (i.e. 373 750 t per month.)
4. Industry sources claim that during the smoke haze oil extraction rates decreased to 22 percent and monthly production fell by 16 250 t.
5. Thus total production of CPO fell by 32 500 t during the two months of severe smoke haze.
6. At a sale price of \$500 t⁻¹ at that time, the total revenue lost by the industry in Sumatra because of the 1997 haze was \$16.25 million.

Note. The figures given here refer only to the loss of CPO attributable to smoke haze, not to the - far higher - losses caused by the 1997 drought.

APPENDIX 3

Land Clearing Costs On Mineral And Peat Soils In Sumatra

If a choice is available, oil palm companies prefer to establish their estates on mineral soils than on organic swamp peats. Overall investment costs are lower as no roller compaction nor micro-nutrients (copper and zinc) are needed. The estimated saving to crop maturity at three years is Rp. 5 million ha⁻¹. This equates to a substantial \$12.5 million - at an assumed exchange rate of \$1.0 = Rp. 8000 - for a company that plants its full 20 000 ha entitlement within a province.

Tables A3 a - d. Cost of estate establishment on various land types in Sumatra from clearance to maturity.

Table A3a. Secondary forest on undulating land.

Specification	Rp./Ha		
	Upkeep	Fertiliser and application	Total
Land clearing up to planting			3 383 586
Year 1	1 155 402	630 309	1 785 711
Year 2	1 255 792	988 910	2 244 702
Year 3	1 166 560	1 325 292	2 491 851
	3 577 754	2 944 511	9 905 850
Capital			
Building			1 935 502
Furniture			139 262
Machines			150 562
Vehicle and heavy equipment			924 444
			3 149 770
			13 055 620

Table A3b. Secondary forest on sandy soils.

Specification	Rp./Ha		
	Upkeep	Fertiliser and application	Total
Land clearing up to planting			3 756 719
Year 1	1 146 440	870 526	2 016 966
Year 2	1 214 826	1 248 228	2 463 055
Year 3	1 175 256	1 530 470	2 705 726
	3 536 523	3 649 224	10 942 466
Capital			
Building			1 935 502
Furniture			139 262
Machines			150 562
Vehicle and heavy equipment			924 444
			3 149 770
			14 092 236

Table A3c. Secondary forest on hilly land - 50 percent terraced.

Specification	Rp/Ha		
	Upkeep	Fertiliser and application	Total
Land clearing up to planting			5 383 586
Year 1	1 155 402	630 309	1 785 711
Year 2	1 255 792	988 910	2 244 702
Year 3	1 166 560	1 325 292	2 491 851
	3 577 754	2 944 511	11 905 850
Capital			
Building			1 935 502
Furniture			139 262
Machines			150 562
Vehicles and heavy equipment			924 444
			3 149 770
			15 055 620

Table A3d. Partially forested on peat soils.

Specification	Rp./Ha		
	Upkeep	Fertiliser and application	Total
Land clearing up to planting			7 418 523
Year 1	1 084 263	1 093 486	2 177 748
Year 2	1 311 654	1 553 932	2 865 586
Year 3	1 259 354	1 511 773	2 771 127
	3 655 270	4 159 191	15 232 984
Capital			
Building			1 935 502
Furniture			139 262
Machines			150 562
Vehicle and heavy equipment			924 444
			3 149 770
			18 382 754

APPENDIX 4

Effects Of Peat Compaction On Soil Bulk Density And On Palm Growth And Fruit Yield 64 Months After Planting.

Parameters	Uncompacted peat	Compacted peat
<u>Soil</u>		
Bulk density (gm.ml ²)		
- range	0.09 – 0.13	0.16 – 0.22
- mean	0.1	0.2
<u>Palm</u>		
Percent leaning	49.0	24.3
Girth at 1 m. (m)	1.96	2.04
Rachis length (m)-frond 17	4.36	4.76
Leaf area (m ²)-frond 17	5.40	6.35
Leaf dry matter (kg)-frond 17	2.15	2.58
<u>Fruit Yield</u>		
FFB (t.ha ⁻¹ y ⁻¹)	21.7	27.6
Average bunch weight (kg)	7.3	8.7

Source: Gurmit Singh (1999).