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MINISTRY OF FORESTRY AND ESTATE CROPS

FOREST FIRE PREVENTION AND CONTROL PROJECT
KANWIL KEHUTANAN DAN PERKEBUNAN, PALEMBANG

THE SUSTAINABLE DEVELOPMENT OF TREE CROPS
AND THE PREVENTION OF VEGETATION FIRES IN
SOUTH SUMATRA, INDONESIA

JUNGLE RUBBER

Anne Gouyon



August 1999

Cover photograph : Ivan Anderson. Painting of a rubber tapper on the wall of a house of a merchant latex buyer in Prabumulih, South Sumatra Province. Cover design, Ferdinand Lubis.

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This is one of a series of reports prepared during 1999 by the Forest Fire Prevention and Control Project. Together they cover the field-level prevention, detection and control of vegetation fires in Sumatra. Titles are:

Vegetation fires in Indonesia: operating procedures for the NOAA-GIS station in Palembang, Sumatra. I.P. Anderson, I.D. Imanda and Muhnandar.

Vegetation fires in Indonesia: the interpretation of NOAA-derived hot-spot data. I.P. Anderson, I.D. Imanda and Muhnandar.

Vegetation fires in Sumatra, Indonesia: the presentation and distribution of NOAA-derived data. I.P. Anderson, I.D. Imanda and Muhnandar.

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 Muhnandar.

Vegetation fires in Sumatra, Indonesia: a first look at vegetation indices and fire danger in relation to fire occurrence. I.P. Anderson, I.D. Imanda and Muhnandar.

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

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

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

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.

Land management in South Sumatra Province, Indonesia: fanning the flames. The institutional causes of vegetation fires. J.M. Bompard and P. Guizol.

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

FFPCP will publish a paper on the 1999 vegetation fires as which will also expand on the themes developed in earlier NOAA reports.

Copies of these reports are available in English and Bahasa Indonesia, and can be obtained from;

The Project Leader, FFPCP, PO Box 1229, Palembang 30000, Indonesia

Fax number: +62 711 417 137

or

The Counsellor (Development), Representation of the European Commission, PO. Box 6465 JKPD, Jakarta 10220, Indonesia

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Summaries of the reports together with a daily summary map of the locations of vegetation fires in Sumatra can be found on the Project homepage: <http://www.mdp.co.id/ffpcp.htm>

FOREWORD

Head of Representation of the European Commission in Indonesia

Tropical rain forests cover less than six percent of the surface of the earth, but contain more than 50 percent of the world's biodiversity. Indonesia's forests are considered to be one of the biodiversity centres of the world. However, these vital areas are under threat from over-exploitation, encroachment and destruction because of fire.

The seriousness of the threat to Indonesia's forests has prompted the European Commission to reorient its development co-operation with Indonesia to focus on the sustainable management of forest resources. Based on the Agreed Minutes of a meeting between the Government of Indonesia and the Commission, which were signed in May 1993, the Commission supports a range of projects in the field of conservation and sustainable forest management. The funds for this support have been donated in the form of grants.

The importance of the fire issue cannot be over-emphasised. Estimates have set the economic loss caused by the haze that blanketed the region in 1997 at around Euro 1.4 billion. The loss of wildlife habitat, which will take decades to regenerate or the soil erosion, which is the inevitable result of heavy burning, is too great to be expressed in financial terms.

Because fire prevention and control is such an important issue, the Commission has been willing to support the Forest Fire Prevention and Control Project, which started in April 1995, with a grant of Euro 4.05 million. The long-term objective of the project was to, *"Furnish support, guidance and technical capability at provincial level for the rational and sustainable management of Indonesia's forest resources."* Its immediate purposes were to evaluate the occurrences of fire and its means of control, to ensure that a NOAA-based fire early warning system would be operational in South Sumatra, and that a forest fire protection, prevention and control system would be operational in five Districts within the province.

In co-operation with local government, representatives of the Ministry of Forestry and Estate Crops and the private sector, FFPCP set out to implement a series of activities that would support the achievement of these purposes. The results of these activities are now made available in a series of technical reports of which this is one. We believe that these professional publications will be of considerable value to those concerned in the forestry, agriculture and land-use planning sectors.

Klauspeter Schmallenbach

Head of the Provincial Forestry and Estate Crops Office, South Sumatra

Vegetation fires have undoubtedly become a more urgent focus of concern to the regional office of the Ministry of Forestry and Estate Crops in South Sumatra after the widespread smoke haze pollution of 1997. As part of our commitment to sustainable forest management, considerable efforts have been made to prevent fires happening again on such a scale. We hope that in the new spirit of reform the people of South Sumatra will play a greater role in protecting and managing the forests and their resources.

I warmly welcome the FFPCP series of reports on their work from 1995 to 1999. These reports examine in detail the underlying causes of vegetation fires in the province, and this understanding allows us to suggest how numbers may be reduced. The reports also set out methods of prevention, NOAA satellite detection, and control of fires. These are based on methods that have been shown to work under field conditions and when fully introduced will bring practical benefits to us all.

I also hope that the work will serve as a reminder that we need to keep improving our capability to deal with future fires. While good progress has been made, much work still remains to be done before damaging vegetation fires are a thing of the past.

Ir. Engkos Kosasih

DEFINITIONS

Alang-alang. The coarse invasive tropical grass *Imperata cylindrica* is widely referred to in Indonesia and Malaysia as *alang-alang*. We have chosen to use this common name in preference to the scientific name throughout the report.

Agro-industrial companies. Incorporated agricultural companies with sizeable capital inputs and waged labour. They include:

- large plantations (*perkebunan besar*) of traditional crops such as rubber (for its latex) oil palm, coffee, cocoa and coconut;
- industrial forest plantations (*Hutan Tanaman Industri*, HPHTI) of pulp and timber species such as acacia, eucalyptus, and rubber (for its wood).¹

Fire hazard is a measure of the volume, type, condition, dryness, arrangement and location of a fuel complex in a given cover. It indicates how fast the cover may burn once ignited as well as the ease of ignition and difficulty of suppression. The presence of leaf litter, low vegetation, grasses and dead wood increases fire hazard. (Schweithelm, 1998; Nicolas and Beebe, 1999).

Fire risk is a measure of the probability that a given fuel will ignite. It is related to careless human actions and uncontrolled fires lit to burn waste or for land clearance. (Schweithelm, 1998).

Fuel refers to all combustible organic material in a forest, other vegetation types and agricultural residue. (Nicolas and Beebe, 1999).

Peneplains are areas of Sumatra between 5 and 150 m a.s.l. which are not subject to permanent flooding (swamp areas) and have a rolling landscape with relatively gentle slopes.

Smallholders are farmers who cultivate tree crops under family management, using mostly family labour and resources. The area managed by a smallholder household is between 1 and 30 ha.

Tree crops refer to any tree species planted and managed by man. They include:

- plantation crops (rubber¹, oil palm, coffee, cocoa, coconut)
- fruit trees (durian, citrus, rambutan, etc)
- pulp and timber species (acacia, eucalyptus, sengon, etc)

Wildfire is a fire that has escaped management objectives and thus requires suppression. (Nicolas, 1999).

¹ Rubber (*Hevea brasiliensis*) has retained many features from its recent Amazonian origins as a forest tree. It has been cultivated as a plantation crop for its latex, with wood as a side-product. With the increase in the price of tropical woods, rubber is starting to be cultivated as a forest tree in industrial forest plantations (HPHTI) with varieties selected for their wood production and with latex as a by-product.

STATISTICAL DATA

All statistical data should be treated with caution. Figures given by different agencies for the same event often differ markedly. For example the area of South Sumatra province used by the Department of Transmigration – and in this report – is 11 333 860 ha while BPS (1993) quote 11 298 266 ha. and the BAPPEDA Web Site, '*Sumatera Selatan dalam angka*' [South Sumatra in figures] suggests that it is 10 925 400 ha.

There is even less certainty when dealing with statistics such as populations, areas planted, areas burnt, etc. To avoid the appearance of spurious precision, these and similar data have been rounded to the nearest 100 or 1000 but must still be considered with circumspection. Boundaries and other mapped data should also be treated with considerable caution.

RINGKASAN

Kebakaran Vegetasi dan Manusia

Kebakaran vegetasi terjadi di Indonesia sejak awal peradaban tetapi pada masa 20 tahun terakhir ini telah menjadi kejadian yang biasa - bahkan disertai dengan siklus topan el Nino - telah menyebabkan kehancuran ekonomi dan lingkungan hidup di dalam negeri, negara tetangga, dan iklim secara global.

Resiko dan bahaya kebakaran vegetasi ini telah diperbesar oleh:

- Meluasnya usaha perkebunan dengan menggunakan teknik-teknik yang merusak,
- Pembukaan lahan skala besar oleh perusahaan agro-industri,
- Pembukaan lahan sebagai lokasi transmigrasi secara besar-besaran,
- Pemanfaatan lahan oleh perusahaan dan pemerintah tanpa mementingkan kepentingan penduduk asli.

Usaha perkebunan dan pembukaan lahan telah mengakibatkan kerentanan terhadap bahaya kebakaran vegetasi dan berkurangnya selimut hutan di hampir seluruh Sumatera, Kalimantan dan Indonesia bagian Timur.

Selain pembukaan lahan skala besar untuk perkebunan ini, perkebunan rakyat tetap sebagai pengguna utama lahan di daerah dataran rendah Sumatera (10 juta hektar dalam skala nasional). Perkebunan-perkebunan rakyat ini tetap menganggap perlu usaha menjaga kelestarian hutan dan perkebunan karena dengan demikian diharapkan akan menyediakan hak akan lahan mereka.

Perubahan besar dalam tata guna lahan pada awalnya bermula di Sumatera Selatan bila dibandingkan dengan daerah-daerah lain di luar Jawa. Studi di propinsi ini menunjukkan bahwa hal ini akan terjadi dimana saja apabila metode-metode dan kebijaksanaan seperti sekarang terus berlangsung.

Dari Ladang ke Hutan Karet

Penduduk di dataran rendah biasanya bertanam padi di lahan basah, pohon buah-buahan, dan mengelola *ladang*. *Ladang* adalah pembukaan dan pembakaran lahan hutan yang kemudian diikuti oleh penanaman padi di lahan kering dan tanaman lainnya selama satu sampai dua tahun. Lahan tersebut kemudian ditinggalkan menjadi hutan kembali dan lama tidak ditanami (± 20 tahun), dan untuk mengembalikan kesuburan tanahnya diperlukan pembakaran selanjutnya. Sistem ini dapat menghidupi 25 orang per km^2 . Hutan yang terbengkalai tersebut dipenuhi oleh semak-semak. Pada saat sekarang ini pengenalan mengenai kemajuan teknik di bidang wanatani dapat mendukung lebih banyak jumlah penduduk tanpa harus membahayakan kelestarian lingkungan.

Karet diperkenalkan ke Indonesia pada pergantian abad dan petani segera menanamnya di ladang mereka. Hutan yang terbengkalai digantikan oleh 'wanatani karet', sebuah campuran antara pohon karet yang sengaja ditanam, pohon-pohon hutan dan pohon buah-buahan yang

setaraf dengan hutan sekunder dalam keaneka-ragaman dan strukturnya. Setelah 30 sampai 40 tahun, pohon-pohon karet tersebut akan rusak dan diperbarui dengan sistem tebang dan bakar. Sistem ini dapat mendukung dan memiliki bahaya kabakaran vegetasi yang rendah.

Wanatani karet seluas 3-5 ha. telah membuat petani dapat mencukupi kebutuhan rumah tangganya. Kira-kira 80% dari penghasilan berasal dari penjualan lateks, dan sisanya dari usaha-usaha dan jenis tanaman lain.

Kemampuan untuk mendapatkan pendapatan yang cukup tergantung dari tersedianya lahan baru yang akan digunakan untuk mendukung penyebaran populasi. Perkebunan karet diperlakukan sebagai properti pribadi dalam perjanjian tanah adat tradisional dan petani muda meninggalkan desa mereka untuk membuat ladang baru dengan membersihkan lahan hutan milik suku mereka (*marga*). Bagaimanapun juga pada tahun 1983, kepemilikan *marga* tersebut dihapuskan dan digantikan oleh struktur administratif pemerintah.

Perubahan tersebut berarti mengurangi kontrol petani atas hak tanah mereka. Pemerintah hanya mengakui hak keluarga yang telah secara permanen ditanami. Petani kehilangan tanah-tanah mereka yang secara cepat dialokasikan kepada perusahaan perkayuan, proyek transmigrasi, atau pemilik modal industri perkebunan dan kehutanan.

Perubahan Tata Guna Lahan

Pola penggunaan lahan di Sumatera Selatan selama 15 tahun terakhir ini telah berubah secara dramatis. Departemen Transmigrasi telah mengalokasikan 850.000 ha. lahan untuk pendatang baru dari Jawa sejak tahun 1980. Pendatang-pendatang tersebut seharusnya menanam tanaman pangan, tetapi ini segera terbukti tidak menguntungkan dan tidak dapat diandalkan pada tanah yang asam di dataran rendah. Areal luas yang telah dibersihkan dengan bulldozer, diabaikan atau ditinggalkan, dan berubah menjadi padang *alang-alang* - yang beresiko kebakaran tinggi. Bagaimanapun juga transmigran-transmigran terdahulu telah diperbolehkan untuk menanam tanaman pohon dan menguntungkan pemerintah dalam membantu penanaman kelapa sawit dan karet.

Perusahaan-Perusahaan perkayuan di Sumatera Selatan berkembang secara cepat dan mengubah areal luas menjadi hutan yang penuh dengan sisa kebakaran vegetasi. Hak Pengusahaan Hutan dan Tanaman Industri (HPHTI) dimulai pada awal tahun 90-an dan menggunakan api untuk membuka lahan luas untuk bertanam *Acacia*. Perkebunan adalah beresiko bahaya kebakaran yang tinggi, karena daun-daun gugur mudah kering dan bercampur dengan *alang-alang* dan semak. Perusahaan agro-industri juga mulai membuka lahan mereka untuk menanam kelapa sawit. Perusahaan HPHTI dan perkebunan menebang dan membakar hutan seluas 40.000 ha. Setiap tahunnya biarpun sesungguhnya melanggar peraturan yang berlaku. Pembakaran dilakukan karena cara yang paling mudah dan murah meski pun kebakaran besar sulit diatasi dan sering keluar ke areal vegetasi dan perkebunan terdekat.

Seluas 4 juta ha. Lahan di Sumatera Selatan telah dialokasikan untuk proyek transmigrasi, perusahaan perkayuan dan agro-industri. Telah dibuktikan bahwa tidak mungkin untuk membatasi alokasi ini sekaligus melindungi lingkungan dan hak penduduk asli. Petani yang sebenarnya harus memiliki lahan sebagai hak tradisional mereka dan sekarang merasa tersingkir dan terasing oleh proses kemajuan ini. Hal ini mengakibatkan banyak konflik

kepentingan dimana kedua belah pihak menggunakan api untuk mengusir pihak lain atau sebagai balas dendam.

Perkebunan Rakyat

Pemerintah telah memperluas batasan bagi perkebunan rakyat supaya mereka dapat menanam tanaman karet bermutu tinggi yang dapat menggandakan penghasilan mereka sampai dengan Rp 4 juta per ha. setiap tahunnya. Hal ini menyebabkan para petani dapat mempersiapkan keperluan modal untuk penanaman berikutnya. Jenis klon tanaman karet ini beresiko kebakaran yang kecil karena tidak dapat bersaing dengan tanaman jenis lain.

Menanam jenis klon tanpa bantuan finansial adalah sangat mahal dan terlalu beresiko untuk kebanyakan petani yang memiliki luas tanaman karet kurang dari 4 ha. dan hidup secara pas-pasan. Satu-satunya jalan bagi mereka untuk menambah penghasilan adalah dengan mengusahakan kebun karet yang lain di lahan yang belum ditanami. Tetapi area ini biasanya telah berada dekat dengan hutan areal usaha perikanan, proyek transmigrasi, atau agro-industri yang semuanya beresiko kebakaran tinggi.

Perkebunan rakyat yang menjalankan sistem klon tersebut mendapatkan kesulitan dalam mengontrol tumbuhnya semak dan *alang-alang* diantara tanaman karet muda tersebut dan area ini rawan akan kebakaran vegetasi. Diperkirakan 40.000 ha. luas perkebunan rakyat (6.000 ha. jenis klon) yang terbakar di tahun 1997 dengan kerugian \$8,9 juta.

Mengurangi Bahaya Kebakaran di Masa Depan

Benar-benar sangat sulit untuk mengontrol kebakaran vegetasi di Indonesia. Pencegahan kebakaran harus diprioritaskan. Cara yang paling efisien untuk membatasi kerusakan adalah dengan mengurangi kecerobohan terjadinya kebakaran.

Penggunaan teknik tanpa sama sekali atau pembatasan jumlah pembakaran disarankan sebagai cara terbaik dalam pembukaan lahan. Hampir seluruh perusahaan dan perkebunan rakyat menganggap cara ini sangat mahal dan tidak mungkin dilakukan. Harus dilakukan suatu penelitian untuk dapat mengembangkan prosedur yang dapat diadaptasikan pada kondisi di Indonesia, dan kebijaksanaan dari pemerintah untuk keberhasilan metode tersebut.

Promosi jangka panjang dalam penggunaan kayu karet, akan mengurangi volume pembakaran biomassa. Usaha tersebut dibutuhkan di Sumatera Selatan untuk mengidentifikasi kelompok-kelompok perkebunan karet rakyat yang dapat menjual kayu pohon karet mereka kepada pabrik perabot rumah tangga di sekitar kota Palembang. Penghasilan dari penjualan ini seharusnya dapat dipergunakan - dengan bantuan teknik dari sebuah proyek - untuk mendapatkan tungkul karet bertunas yang berproduksi tinggi. Dengan demikian bahaya kebakaran seharusnya dapat dikurangi.

Cara lain untuk mengurangi resiko kebakaran dan pada saat bersamaan menambah penghasilan adalah dengan menambah bantuan keuangan kepada perkebunan rakyat yang menanam karet jenis klon tetapi mendapat kesukaran dalam merawatnya. Proyek dapat membantu pemerintah daerah dengan memberikan kredit ringan bagi perkebunan rakyat.

Satu-satunya cara permanen untuk mengurangi jumlah kebakaran vegetasi di Indonesia adalah dengan mengubah kebijaksanaan tata guna lahan. Pada tingkat lokal dibutuhkan penambahan kapasitas institusi untuk mengembangkan keahlian dalam pemetaan dan partisipasi perencanaan penggunaan lahan. Bantuan unit tata guna lahan perlu diselenggarakan dan dibantu oleh donor pada tingkat Nasional. Unit ini harus bekerja sama dengan Instansi-instansi Pemerintah, sektor pribadi, dan Lembaga Sosial Masyarakat untuk saling bertukar informasi, mendiskusikan pilihan untuk mengubah dan memperpanjang bantuan yang bersifat teknik. Hasil pekerjaan tersebut harus tersedia secara menyeluruh.

SUMMARY

Fires and man

Vegetation fires have occurred in Indonesia from the dawn of civilisation but it is only in the last twenty years have they become regular events – often coupled to the el Nino oscillation - and caused major economic and environmental damage within the country, to its neighbours and to the global climate.

Fire-risk and fire-hazard have been increased by;

- widespread logging using flawed techniques,
- large-scale land clearance by agro-industrial companies,
- land clearance for major transmigration schemes, and
- land acquisition by companies and government with little consideration for the rights of local people.

Logging and land clearance together have left a patchwork of fire-susceptible degraded forest cover over much of Sumatra, Kalimantan and eastern Indonesia.

Despite this recent large-scale land clearance to establish plantations, smallholder farming remains the main land-use in the peneplains of Sumatra (10 million hectares nationwide). These smallholders retain a direct interest in the preservation of the both forests and the plantations provided their land rights are respected.

Major changes in land-use started in South Sumatra earlier than in many other places outside Java. Study of the province thus allows insights into what may happen elsewhere if present methods and policies continue.

From ladang to jungle rubber

People of the peneplains used to grow wetland rice, plant fruit trees and practice *ladang*. *Ladang* is the felling and burning of the forest followed by the planting of dryland rice with other temporary crops for one or two years. The field is then abandoned to forest regrowth and the long fallow that follows (20 years) regenerates fertility that is made available to the next cycle through burning. The system can sustain 25 people km⁻². Above this, fallows are shortened and the areas are invaded by grasses. More recently the introduction of agroforestry techniques has supported higher populations without endangering the environment.

Rubber was introduced into Indonesia at the turn of the century and farmers soon started to plant it in their *ladang*. The forest fallow was replaced by ‘jungle rubber’, a mixture of planted rubber, forest trees and fruit trees equivalent to a secondary forest in terms of biodiversity and structure. After 30 to 40 years the rubber trees are exhausted and are replanted using slash-and-burn. The system is sustainable and is a low fire hazard after canopy closure.

Jungle rubber agroforestry has enabled farmers to support a household on 3 – 5 ha. About 80 percent of the income comes from the sale of the latex, and the rest in cash and kind from the associated species.

The ability to secure sufficient income depends on the availability of new land to support an expanding population. Rubber plantations are treated as individual property under traditional land-rights and young farmers left their villages to make new plantations by clearing common forest-land belonging to their tribe (*marga*). However in 1983 the authority of the *marga* was abolished and replaced by the present government administrative structure.

The change considerably weakened the control of farmers over their land. The government only recognises tribal rights over land that is permanently cultivated. Farmers lost their land reserves which were increasingly allocated to logging companies, transmigration projects or agro-industrial investors (plantations and industrial forestry).

Changing land-use

The pattern of land-use has changed dramatically in South Sumatra in the last fifteen years. The Department of Transmigration has allocated 850 000 ha to newcomers from Java since 1980. The settlers were supposed to grow food crops, but this soon proved unprofitable and unsustainable on the acid-leached soils of the peneplains. Large areas cleared by bulldozer were left unused or abandoned, and turned into *alang-alang* grasslands - a major fire hazard. However recent transmigrants have been allowed to plant tree crops and have become a main beneficiary of government assistance to grow oil palm and high-yielding rubber.

Logging companies in South Sumatra developed rapidly and turned large areas into forests filled with combustible waste. Industrial forestry plantations (HPHTI) started in the nineties and used fire to clear large areas to plant *Acacia* species. The plantations are a major fire hazard as the trees shed their leaves, dry easily and are mixed with *alang-alang* and bushy regrowth. Agro-industrial corporations also began to clear land for oil palm. HPHTI and agro-plantation companies now cut and burn some 40 000 ha annually despite contrary regulations. Burning is considered the easiest and cheapest way although the large fires are difficult to control and often escape to neighbouring vegetation and plantations.

Some 4 M ha of land in South Sumatra have been allocated to transmigration, logging and agro-industrial companies in less than 20 years. It has proved impossible to maintain this pace of allocation whilst protecting the environment and the rights of local people. Farmers considered much of the land as their common traditional property and now feel deprived and alienated from the development process. This has caused many conflicts in which both parties have used fire to drive the other away or as revenge.

Smallholders and change

The government has extended limited help to smallholders to enable them to plant high-yielding rubber clones that double income to Rp 4 M ha⁻¹y⁻¹. This has allowed the smallholders to re-invest in further plantations. The new clonal plantations are a low fire hazard as they are maintained weed-free - the clones being unable to compete with other vegetation.

Planting clones without financial assistance is too expensive and too risky for the majority of farmers who own less than 4 ha of rubber and live close to subsistence level. Their only way to increase income is to establish new jungle rubber in unoccupied areas. But these areas are often close to logged forests, transmigration sites or agro-industrial estates all of which are major fire hazards.

Smallholders who do invest unaided in clonal plantations find it difficult to control bushes and *alang-alang* between the young rubber and the new areas are fire-prone. An estimated 40 000 ha of smallholder plantations (6000 ha clonal) burned in 1997 at a loss of \$8.9 million.

Reducing fires in the future

It is extremely difficult to control fires throughout Indonesia. Fire prevention is the priority. The most efficient ways to limit damage are to reduce the number of deliberately set fires and to abate fire hazards.

The use of zero-burning or limited-burning techniques is sometimes suggested as a better way to clear land. Most companies and all smallholders consider such ways expensive and impractical. There is a need for applied research to develop procedures adapted to Indonesian conditions, and to work with government on a policy to encourage such methods.

In the long term promoting the use of rubber wood would reduce the volume of biomass burnt. Work is needed in South Sumatra to identify groups of smallholders able to sell their rubber wood to furniture factories in and around Palembang. The income should be used - with technical assistance from a project - to purchase budded stumps to establish high-yielding, weed-free clonal plantations. Fire hazard would consequently decrease.

Another way to reduce fire hazard and at the same time raise incomes is to extend financial assistance to smallholders who have planted clones but find it difficult to maintain them. Projects could help local government set up credit funds to defray costs.

The only permanent way to reduce the number of vegetation fires in Indonesia is to reform land-use policies. At the local level there is a need to increase the capacity of institutions to develop mapping and participatory land-use planning skills. A Sustainable Land-use Unit needs to be established and supported by donors at the national level. The Unit should collaborate with the government agencies, the private sector and NGOs to exchange information, to discuss options for reforms and to extend technical assistance. The results of the work should be made widely available.

TABLE OF CONTENTS

Foreword	i
Definitions	iii
Statistical data	iv
Ringkasan	v
Summary	ix
Table of Contents	xii
1. INTRODUCTION	1
2. FIRES AND MAN	2
Old Fires, New Problems	2
Old fires	2
The cost of the fires	3
Looking For Culprits Or Responsibilities?	4
1982-1996: smallholders as culprits	4
1997-1999: satellite imagery point to logging and agro-industrial companies	4
Inappropriate logging and land clearance	4
Land acquisition	5
Towards responsible land-use policies	5
Tree Crop Smallholders: Part Of The Problem Or The Solution?	6
The missing element	6
A tree crop based agriculture between plantations and forestry	7
Involving farmers in the preservation of tree cover and fire prevention	7
South Sumatra Province: A Prime Example	8
3. FORESTS, TREE CROPS AND PEOPLE IN SOUTH SUMATRA PROVINCE	9
The Origins Of Present Land-Use: From <i>Ladang</i> To Jungle Rubber	9
<i>Ladang</i> with slash-and-burn	9
The introduction of rubber	9
The making of an agroforestry system	10
From New Planting To Replanting: A Sustainable Land-Use System	12
Who owns the land?	12
After 1950: the first cases of replanting	13
Social equity through the development of new plantations	13
Paving The Way For Investors And Projects	14
Changes in local governance: the weakening of local communities	14

The lack of recognition of smallholders land-rights	16
<i>Izin prinsip, izin lokasi</i> : fast-track land acquisition	16
The consequences: unsustainable development and land conflicts	18
Transmigration: A Major Cause Of Fire Hazard And Fire Risk	18
South Sumatra: one million transmigrants since 1980	18
Large-scale land clearing and promotion of food crops lead to <i>alang-alang</i>	19
Independent migrants	21
Agro-Industrial Projects: Fire In Land Clearing And Conflicts	22
Smallholder Development Projects: Clonal Rubber And Oil Palm	24
Nucleus estates and smallholder schemes: monopolies and conflicts	25
The project management unit approach: a good level of success	26
The partial approach: a partial success	28
The Resulting Changes In The Smallholder Economy	29
A sense of land deprivation and alienation from development planning	29
From jungle rubber to clonal plantations	31
Fires and smallholder development	33
In summary	34
4. PROPOSED STUDIES, PROJECTS AND POLICIES	36
Fire As A Tool: Limiting The Use Of Burning To Clear Land	36
A method for large-scale land clearing with minimal burning adapted to Indonesia	36
Promoting the use of rubber wood from smallholder plantations	38
Reducing Fire Hazard Through The Improved Development Of Smallholder Rubber	43
Reducing Fire Hazard And Fire Risk Through Sound Land-Use Policies	44
From Fire Prevention To Sustainable Development	46
5. BIBLIOGRAPHY	47
6. ABBREVIATIONS	55
Appendix. TABULATED SUPPORTING DATA	57

1. INTRODUCTION

The Forest Fire Prevention and Control Project (FFPCP) is funded by the European Union and the Indonesian Government and started work in 1995 based in South Sumatra province (Map 1) under the Provincial Forestry Office (*Kanwil Kehutanan*). The project locates vegetation fires using NOAA satellite imagery and helps improve local capacity to prevent and fight fires at the district level. FFPCP includes a rural development component to study and act on the underlying causes of the fires.

Tree crops provide the main source of income for farmers in South Sumatra and their cultivation practices may increase or reduce the incidence of vegetation fires. The major farming area is on the peneplain² where most farmers grow rubber in association with annual crops, forest species and fruit trees in an agroforestry system called 'jungle rubber' (Gouyon, de Foresta and Levang, 1993). The work reported here examines cultivation practices and the relationship of the rubber-producing smallholders with forestry and agro-industrial companies.

The objectives were:

- to provide a detailed picture of the status and evolutionary trends of the smallholder rubber sector in South Sumatra,
- to analyse the influences of present and developing practices that may result in fewer or more vegetation fires,
- based on this analysis, to provide guidelines on actions to reduce the extent of vegetation fires, and
- identify areas where detailed studies are needed to further develop these guidelines.

Findings are based on field interviews with farmers, village leaders, local officials, NGOs, and managers of agro-industrial companies and wood factories in South Sumatra, and also on meetings with government and donors organisations in Jakarta and Bogor. The help given by these individuals and organisations is gratefully acknowledged as is help from Sembawa Research Institute, South Sumatra.

² Tree crop agriculture is still relatively scarce in the swamp areas of the province: and few vegetation fires occur in the more mountainous regions.

2. FIRES AND MAN

The extensive literature on vegetation fires in Indonesia published since 1982, especially following the major fires of 1997-1998 has been widely consulted. These publications include reports and articles by a number of international organisations and by Bertault (1991), Byron and Shepherd (1998), Bromley (1998), Durand (1998), Ellen and Watson (1997), Gönner (1998), Nicolas (1999), Potter and Lee (1998), Saharjo (1997), Schindler (1998), Schweithelm (1998), Sunderlin (1998), Wasson (1998) and Anderson *et al.* (1999). A fuller listing is given in the Bibliography

Old Fires, New Problems

Old fires

Vegetation fires are an integral part of the Indonesian environment and prolonged droughts linked to el Niño have always contributed to their spread. Man has lit fires to clear land since the dawn of agriculture and these fires occasionally escaped control, destroyed tree cover and caused thick haze when they entered peat deposits. Areas that burnt repeatedly turned into *alang-alang* grasslands. Since cultivation of these grasslands needs more labour than cultivation of forest, the replacement of forest cover by *alang-alang* has long been considered by farmers as one of the worst effect of fires. (Plate 1).

Fires were of limited scope and consequence until 1970 when 'development' started to increase at an unprecedented pace. Since then they have caused major changes to the landscape.

The first large fires to make the international headlines took place in 1982-83 in East Kalimantan and these were followed by further major fires in 1987, 1991, 1994 and 1997-98. Earlier fires occurred mostly in Sumatra and Kalimantan where large-scale logging and planting started in the seventies but extended in 1997 to the eastern islands of Sulawesi, Irian Jaya and Maluku following the development of extensive logging and plantation activities in these previously spared areas.

Vegetation fires take place every year in the dry season that runs from March to October in Sumatra and Kalimantan. Most fires are started in August and September after land clearance and are kept under control: any wildfires are extinguished by the first rains. However in prolonged droughts the fires run out of control and burn between 500 000 and 10 M ha³. El Niño droughts used to occur around once every five years but frequency has increased to once every three years in the last two decades and episodes have been particularly severe in the last decade. The change is cyclic but severity may be linked to global warming.

Plate 1. Bushland invaded by *alang-alang* after repeated burning.

³ There are discrepancies in the data on the extent of the areas burnt each year. For the 1997 fires, for example, the government claimed an initial figure of 627 280 ha, the WWF issued a report saying 5 million ha. Preliminary satellite assessments by the European Union and the Ministry of Forestry indicate that this figure is close to reality (State Ministry for Environment and UNDP, 1998a)



Indonesia has large peat deposits along its coastlines. Fires in peat soils may burn uncontrollably for months and send thick haze to Malaysia and Singapore. It is this trans-boundary pollution rather than the fires themselves, that has attracted the attention of the media, the anger of Indonesia's neighbours, and forced the government to react.

All attempts to control large fires have been inefficient; overwhelmed by numbers and the difficult terrain. Prevention seems the only solution.

The cost of the fires

The damage has been underestimated in official sources but it is now obvious that the environmental, economic and social costs of the fires are enormous.

The environmental cost includes the destruction of soils and forest cover - with harmful consequences for the local hydrology - and, when they occur over extensive areas, on the climate. The Indonesian lowland forests are particularly biodiverse and their destruction results in the irreversible loss of species.

The economic and social costs resulting from vegetation fires are of great importance but are difficult to translate into figures given the inaccuracy of the data on the areas burnt. Yet putting a price tag on the damage is essential to catch the attention of the Indonesian authorities, business circles and citizens who up to now have shown little concern about environmental issues.⁴

⁴ Indonesian farmers have respected their environment for centuries. Over the last decades the government placed priority on economic growth, with the underlying idea that fast development could be sustained without too much care for side effects. Many Indonesians still claim that environmental sympathy is a luxury for rich countries, who try to persuade poor countries to slow down the exploitation of their environment now that their own development is complete. The recent rapid degradation of natural resources in Indonesia and its effects on pollution, floods and fires has only recently started to change this thinking.

Socio-economic costs linked to the fires include the;

- destruction of trees of commercial value (in natural forests and plantation),
- loss of livelihood for people who depend on forests and plantations (employees of logging and agro-industrial companies, farmers and forest dwellers),
- health damage caused by the smoke haze,
- increased costs to develop areas on fire damaged soils and where forest cover has been replaced by *alang-alang*,
- disrupted transport and its consequences caused by smoke haze, and
- loss of foreign investment and tourism.

Looking For Culprits Or Responsibilities?

1982 - 1996: smallholders as culprits

Before 1997 government and international organisations blamed vegetation fires on smallholders practising slash-and-burn. A few experts insisted that farmers burn only limited areas for their own needs, that they have learnt to manage fires over centuries, and that they have a prime interest to prevent wildfires since their existence depends on the availability of forest. These ideas were not widely accepted.

1997 - 1999: satellite imagery points to logging and agro-industrial companies

A major impact of international projects to prevent and control fires has been the provision of satellite images that show fire locations (hot-spots) - and to a more limited extent, the size of the area burnt - and the matching of these with maps of land-use. This indicated that most serious and persistent fires originated in logging concessions and agro-industrial estates carrying out large-scale land clearance for oil palm or pulpwood. (Map 2). Fires on smallholders' land are often considerable in number but confined and ephemeral.

Inappropriate logging and land clearance

Many commercial companies log and plant trees using methods that increase fire hazard and fire risk.

The Indonesian system of selective logging - were it to be observed - limits the felling of trees to 8 percent of the forest biomass on 60 percent of the concession area (Durand, 1998): an acceptable theoretical limit to preserve biodiversity. But when removing high-value trees, the loggers leave behind large areas destroyed by heavy machinery and filled with dead wood and branches that burn easily (Bertault, 1991; Durand, 1998). Logging roads increase wind circulation and dry vegetation - and hence increase fire hazards - and also enable people to penetrate the area, which increases fire risk.

Logging companies are legally obliged to prevent fires in their concessions but enforcement is lax and most are only interested in protecting areas that have yet to be exploited (Nicolas and Beebe, 1999).

The use of fire to clear land has been restricted by law since 1994. Yet, agro-industrial companies continue to burn sizeable areas even during long droughts as this is considered cheaper, faster and easier (Plate 2). Fires used to clear big areas are difficult to control and often escape to surrounding degraded forests and smallholder plantations.

On the rare occasion that land is cleared mechanically, careless methods lead to the accumulation of fire prone dead wood. Contractors working for transmigration projects and agro-industrial companies often bulldoze or burn larger areas than will be immediately cultivated and planted and after the vegetation and topsoil are removed, the areas are invaded by *alang-alang* which burns readily.

Land acquisition

The acquisition of land by commercial companies has always been a contentious issue. Political openness has increased since May 1998 and more farmers, officials and plantation managers now admit that fires are used to settle land disputes between smallholders and agro-industrial companies. Farmers accuse agro-industrial companies of using fire to destroy their plots and thus reduce compensation claim. While farmers who feel cheated of their land rights are accused of retaliation by setting fire to the companies' plantations. The 1997 drought provided an easy opportunity to settle land disputes using fires which could be blamed on the climate.

Towards responsible land-use policies

Development based on logging and land clearance regardless of land laws and environmental regulations has been widespread. Where laws are not enforced, only irresponsible companies survive. Pointing out the responsibility of large agro-industrial companies will remain valueless until the legal and judicial environment is fundamentally reformed.

Responsible use of natural resources entails costs: careful logging means more work and less immediate gains; low fire hazard and fire risk clearance of land is more expensive than careless burning.

Plate 2. Large-scale land clearance using fire.



The acquisition of land by agro-industries without spoiling the livelihoods of local people and destroying fragile environments requires surveys, time-consuming negotiations and the willingness to share profits with the local communities.

In 1997 the government recognised that forestry and agro-industrial companies are the major users of fire and initiated policy changes to avoid future damage. International donors are in a good position to help sustain these efforts. In 1998 a new Minister for Environment compared the earlier situation to the, "Lawlessness of the American wild west frontier in the nineteenth century." (Schweithelm, 1998).

Tree Crop Smallholders: Part Of The Problem Or The Solution?

The missing element

Tree-crop smallholders are seldom mentioned in the debate about vegetation fires and forest management. The main actors referred to are the agro-industrial and logging companies, transmigrants, spontaneous migrants, and slash-and-burn farmers. For example, official land-use and land-planning maps used by the National Land Office (BPN) in South Sumatra indicate;

- forest areas (divided between conservation, production and conversion forests),
- nature reserves,
- transmigration areas,

- large plantations,
- industrial forest plantations,
- wetland paddy (*sawah*), and
- areas under other uses (*penggunaan lain*).

Colour-blocks are applied on the map to represent the first six categories but the ‘areas under other uses’ are left white as if they were empty. In reality, tree crop smallholders occupy most of this land but they are not explicitly ‘on the map’. Yet they cover 10^6 ha in South Sumatra of which 800 000 ha are rubber smallholdings. [10^7 ha nationwide of which 3×10^6 are rubber] (Gouyon, 1997). This lack of specific reference gives the impression that in Sumatra and Kalimantan tree-crop smallholders practise only itinerant slash-and-burn farming (*ladang berpindah-pindah*).

A tree crop based agriculture between plantations and forestry

In practice it is hard to find smallholders that practice *ladang* in the penneplains of Sumatra and Kalimantan. In its place farmers have long since planted tree crops (rubber, coffee or fruit) in former *ladang* areas, a practice that has steadily increased and led to the replacement of natural forest with man-made tree cover. The main commercial timber species are allowed to re-grow between the planted trees and such mixed agroforestry stands have a structure and a biodiversity close to a secondary forest (Gouyon, de Foresta and Levang, 1993).

A minority of smallholders plant rubber or oil palm in pure stands and there are also many intermediate systems between agroforestry and mono-crop.

Farmers have a long tradition of harvesting timber, firewood and non-timber products for their own consumption and for commercial sale from both natural forests controlled by the community and from their private agro-forests.

Thus smallholder agriculture in Sumatra and Kalimantan rests on a continuum of land-use between the forest and the mono-crop plantation. Thus the rigid dichotomy often presumed between forest and plantation is irrelevant to the understanding and management of such land-use systems. The recent changes of status of the Ministry of Forestry to become the Ministry of Forestry and Estate Crops should make it easier to apply more relevant analyses. Research staff at various institutes, in particular CIFOR and ICRAF, have developed concepts, methods and policy recommendations that take the reality into account. The European Union through its Forestry Programme, is in a strong position to support these efforts.

Involving farmers in the preservation of tree cover and fire prevention

If it is kept in mind that small farmers in Sumatra and Kalimantan are at the same time both users of the forest as well as tree planters, it is easier to imagine how they can contribute to the resolution of the fire problem. Smallholders have a direct interest in preserving their forest environment: they use the forest as a source of timber and non-timber products, and the forest is their reserve of fertility for future crops.

Of course, this applies only when farmers have a say in the present and future use of their forests, as was the case when traditional individual and community land rights were recognised under the Agrarian Law. In practice this law has been poorly implemented and government has consistently removed large areas from the control of local farmers and allocated the land to transmigration, logging interests and agro-industrial companies.

If farmers are involved in the formulation and implementation of land-use policies, they become active participants in the preservation of the local vegetation and in the prevention of vegetation fires through;

- involvement in the detection and early control of wildfires,
- reduction of fire hazard through weeding plantations, maintaining firebreaks, etc,
- having mastered methods to clear land through slash-and-burn, they know how to develop an area without destroying the surrounding vegetation, and
- a direct interest in planting tree crops and their protection from fires.

South Sumatra Province: A Prime Example

South Sumatra province contains numerous examples of the changes found in all the fire affected provinces of the island: logging in the peneplains and peat forests, development of large industrial forest plantations, and changes in smallholder tree crop cultivation systems. Because it is close to Java, South Sumatra was one of the first provinces to experience these changes, and the level of forest degradation and conversion is more advanced than in many other areas of Sumatra and in Kalimantan.

Despite this early start, exploitation and conversion of primary forest is still taking place in South Sumatra - although not for much longer. A few farmers plant rice and tree crops using *ladang* as they did at the beginning of the century, more use agroforestry. Others now cultivate high-yielding oil palm and rubber varieties using similar techniques to those employed on large estates. Sizeable areas have been assigned to transmigrants and even larger areas to agro-industrial companies to plant oil palm, rubber and pulpwood. The combination of land-uses and the fast pace of change makes South Sumatra an excellent example of what is starting elsewhere. The province thus provides insights into what is likely to happen in other provinces if the policies of the last decade were to be continued.

3. FORESTS, TREE CROPS AND PEOPLE IN SOUTH SUMATRA PROVINCE

The Origins Of Present Land-Use: From *Ladang* To Jungle Rubber

Ladang with slash-and-burn

A hundred years ago South Sumatra was sparsely inhabited (13 people km⁻²). The local Malay people lived in permanent settlements along the rivers surrounded by fruit orchards and wet paddy. They exploited the forests for timber, rattan and gums that were exported through local traders and Chinese merchants. The forests also served as the basis of the *ladang* system.

Burning in *ladang*:

- removes the vegetation to allow access,
- eliminates weed seeds and trees to reduce competition with crops, and
- converts the biomass into minerals that can be used by the crops.

Farmers have burnt land to clear it for centuries and have developed the skills to control the fires. They have an excellent knowledge of fire behaviour in their environment (Nicolas, pers. comm.). Burning is usually carried out by groups to control the fire within limited areas of 2 - 25 ha, and the fires are set over only a few days.

Decreasing fertility and increasing weed competition after one or two years of rice cultivation result in lower yields and higher labour needs. Rather than cultivate the same plot with diminishing returns per labour day, farmers prefer to clear another and allow the forest to re-grow on the abandoned fields before returning in 15 - 20 years. Given the long forest fallow and the relatively low yields, the system cannot sustain more than 25 people km⁻². If the population increases beyond this level, the rotation is shortened and the forest turns into degraded bush and grasslands. Such areas are less fertile, contain extensive *alang-alang* and require more labour for their cultivation.

However in South Sumatra the introduction of tree crops provided an alternative well before population reached the level when pure *ladang* cannot sustain families.

The introduction of rubber

Rubber (*Hevea brasiliensis*), a forest tree native to Amazonia, was initially cultivated on colonial plantations in North Sumatra and West Java and was introduced to the plains of South Sumatra between 1910 and 1920. A number of plantations were developed but with little infrastructure they remained confined to a few thousand hectares near Palembang.

Traders and Dutch administrators introduced rubber seeds to the farmers who quickly realised that the trees would grow in their *ladang* along with their fruit trees and coffee. Smallholders thus carried out the main expansion of rubber in South Sumatra, as they did in most of Indonesia.

The making of an agroforestry system

Farmers started to plant rubber systematically in association with rice after slash-and-burn (Plate 3). The home-raised - and thus cheap - rubber seedlings are planted at high density to allow for mortality (700 - 1400 per hectare) and left to grow with the forest cover. After a few years with no upkeep labour, farmers obtain a mixed forest containing 400 - 600 rubber trees per hectare and big enough to be tapped for latex (Plate 4).

Tapping took a few hours in the morning and farmers had time to plant rice and rubber on other plots. Large tracts of the Sumatra plain forest were quickly replaced with 'jungle rubber'.

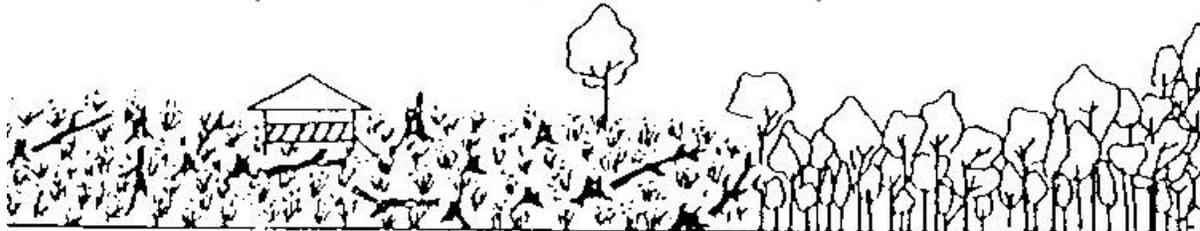
Plate 3. Rice and young rubber planted after slash and burn clearing.



Jungle rubber can be exploited for over 40 years; the smaller trees continue to develop slowly under the canopy and are then tapped in place of decaying trees. As long as land is available for new planting, smallholders do not fell old stands which age gradually with a decreasing number of rubber trees, until they become hard to distinguish from a 'natural forest'. The old plantation is cleared and replanted when no more land is available. Replanting however, raises the question of the status of the land.

Figure 1. Development of a jungle rubber agroforest. (Original figure, H. de Foresta)

Year 1: rubber planted with rice and associated crops



Year 2: rubber grows with bushes or intercrops and associated crops



Years 3-8: rubber with young secondary forest regrowth



Years 8-10: the field is partly cleaned to identify the trees before the first tapping



Years 10-30: rubber plus forest species, fruit trees



From New Planting To Replanting: A Sustainable Land-Use System

Who owns the land?

Land in South Sumatra was controlled by the local 'tribes' who followed *adat* (customary) laws. The smallest administrative unit was the *marga*; a tribe that shared remote ancestors and occupied a defined territory, although village boundaries were ill-defined when most of the area was under forest. The *marga* had authority over the village heads and the head of each village controlled land-use rights.

Plate 4. Mature jungle rubber plantation



Land planted with fruit or coffee trees was considered to be private property that belonged to a household and was inherited by its children. The same held true of land under housing and for land under permanent rice. Forest land belonged to the community. Land which was not cultivated after *ladang* returned to the *marga*, but a family having cleared a plot first could enjoy a lasting right realised by the presence of a few planted fruit trees. Part of the village land was kept as common property to harvest wood or to plant rice in emergencies. When the land reserves approached exhaustion, young people moved to other areas and opened new settlements (*talang*) which became permanent villages.

Land planted with rubber became private property and could be inherited or sold within the *marga*. (Selling land outside the *marga* needed the approval of the leaders.). Since one household planted about 1 ha y^{-1} , large tracks of common forest were steadily converted into private plantations.

After 1950: the first cases of replanting

The development of jungle rubber and the consequent conversion of community forest into privately owned agro-forests continues in relatively remote, sparsely populated areas like Pendopo and Bayung Lincir.

However in the 1950s in areas closer to Palembang, e.g. Pangkalan Balai, farmers faced a situation where no further communal land was available for new plantings. Some left the village in search of new land, others remained and started to replace their old rubber using the technique used to create the original plantation.

The sale of latex provides 80 percent of the income over the cycle, the rest comes from the sale or consumption value of rice and other annual crops grown between the young rubber (Plate 5) and from fruit trees and timber harvested in old jungle rubber plantations.⁵ The price of latex, despite several down-turns over the years, has allowed a typical South Sumatra household to sustain itself on three hectares of jungle rubber at a population density of 100 people km⁻².

Trees can be tapped for up to 40 years and fires are needed only once when replanting. Part of the wood is collected for local use, e.g. timber and fencing, prior to replanting and this reduces the amount of biomass burnt. Rubber agroforestry is thus a sustainable system based on a dense tree cover with little use of fire.

A jungle rubber agroforest is also a low fire hazard. Its structure is similar to a well-developed secondary forest with a closed canopy and high humidity. Rubber trees shed their leaves at the end of the dry season but in average years is leafless for a maximum of two months. However jungle rubber is a fire hazard during prolonged droughts when the bushy regrowth under the canopy dries out. Damage can be severe if the under-storey is dense and in young, weedy plantations.

Social equity through the development of new plantations

The introduction of jungle rubber has led to some inequalities within rural society. In a typical South Sumatra village the majority of farmers own between 2 and 4 ha of rubber. Individuals with additional land and labour can buy or establish more plantations and often come to control the local rubber trade⁶. Wealthy villagers own 10 to 30 ha, the exceptionally rich up to 100 ha.

⁵ Farmers may also supplement their income by growing wetland rice in lowlands.

⁶ These local traders act as intermediaries between farmers, larger traders in Palembang and the factories that process wet rubber into dry for export. The intermediaries are often accused of taking advantage of farmers by extending credit so that the farmers are obliged to sell their rubber to them until their debt is repaid, and to use this monopoly to impose low prices. In fact, field surveys indicate that there is strong competition between rubber traders, and that the strength of competition is linked to road access; good roads allow more traders to visit each village. Depending on access, farmers in South Sumatra receive between 70 and 85 percent of the FOB export price of dry rubber. This leaves around 10 percent for processing and export costs, and 5 to 20 percent for transport and the margin of the intermediaries.

Plate 5. Two year old smallholder rubber growing with associate fruit crops in an agroforestry plantation.



A small minority of farmers - often young - have less than 2 ha that they have inherited and are awaiting the opportunity to develop. With too little land to sustain their family they supplement their income by working as share-croppers for other farmers.⁷ Some migrate to new development areas (*talang*) to start their own plantations. This opportunity to plant new areas is essential if social differentiation within the village is to be limited. Young farmers with no or little land can always hope to become self-sustainable. Thus farmers in South Sumatra and elsewhere attach great importance to access to land reserves that represent the future livelihood of their children.

For many years land-use based on jungle rubber and associated crops was environmentally and economically sustainable. However in the eighties outside interests began the large scale exploitation of the forest land of Sumatra; a change that coincided with the start of the numerous regular vegetation fires.

Paving The Way For Investors And Projects

Changes in local governance: the weakening of local communities

⁷ Sharecroppers receive 50 – 66 percent of the harvest depending on the price of rubber, the yield of the trees, and the prevailing opportunity cost of labour.

Changes started when the government ended the official power of local community leaders. The national law of 1979 on village government was applied in South Sumatra in 1983. The *marga* were abolished and replaced by *kecamatan* (sub-districts), often with new boundaries.

The *kecamatan* are administered by heads (*camat*) appointed by the district and provincial government, itself controlled by Jakarta. Village heads (*kepala desa*) are the only elected leaders in the system, but their selection is controlled by the government.⁸

As noted by Romsan (1993) quoted in Bompard (1997), "The abolishment of the *marga* government has had a significant impact. The *marga* territory has become fragmented into small tracts under the *desa* or *dusun* (village or hamlet), but the village territories were never properly delineated, since under the *marga* system the village border was of little importance. Unused land is now controlled by the Provincial Government, and forest production, which previously belonged to the *marga*, is now under control of the Department of Forestry."

This change in local governance structure left local people powerless in front of external parties backed by central government. There have been a number of consequences.

There is now no base to recognise traditional land rights, especially common rights retained by the *marga* over forest and land reserves. It is easier for government to allocate land to external parties.

There has been a weakening of the authority to enforce traditional rules aimed at the preservation of the environment, e.g. limitations to collect forest products, to clear new land, etc. Village heads may exercise such authority but how they do so depends on their motivation and their sense of responsibility. Village heads selected by government are often preoccupied by their own interests or those of government, and have a weak real authority over the villagers.

Farmers no longer control the use and allocation of forest land. Hence they are less motivated to preserve the forest and to prevent fires.

Private untitled claims over planted land are better recognised by government than traditional rights over forest: farmers feel that it is in their interest to plant as much land as possible to retain control over it.

Farmers feel unable to control the use of their environment, and alienated from the process of 'development' which is oriented by government based on its own policies, priorities, and on interests linked to those of powerful private parties.

In theory, the Agrarian Law of 1960 recognises traditional land rights if no titled right exists and if they do not conflict with national interests. In a democratic, participatory society there is room for negotiations between local people and government to establish a compromise

⁸ Village heads are elected by the people but candidates must first pass a test at sub-district level. This provides an opportunity to eliminate candidates who are not approved by government. In some cases, village heads have been removed on political grounds such as the association of a family member with the former Indonesian Communist Party. In one instance villagers refused to vote for the government candidate and there was not enough votes cast to validate the election; the government appointed a military officer to run the village.

between national interests and local interests. In an authoritarian system the government is the sole judge.

In practice, all land that is not permanently occupied is considered by officialdom as available for development by external parties. Villagers may be allowed to keep part of their land as a reserve for their development, but this is always much more limited than the former *marga* area and subject to arbitrary decisions to allocate the land to a transmigration project or a private plantation.

The lack of recognition of smallholders land-rights

Under the Agrarian Law and the subsequent implementation decrees, only two strong long-term rights can be used when seeking to develop agricultural land:

the property right (*hak milik*) which is permanent and transferable but may only be granted to private Indonesian citizens, and the land area is limited⁹, and the exploitation right (*hak guna usaha* HGU) which is granted for 25 to 35 years with no upper limit on area and which can be extended for an additional 25 years. The HGU may be granted to an individual Indonesian citizen or to a corporation, including foreign joint-ventures.¹⁰

Farmers can in theory obtain titled *hak milik* to their plantations: land titles are obtainable at the sub-district (*kecamatan*) level on the basis of a letter from the village head. However the procedure is bureaucratic, time-consuming and costly. Most farmers consider it beyond their means. The government is now starting to issue land titles systematically and the scheme is progressing South Sumatra but the area dealt with to date is still very limited.¹¹ The difficulties encountered by farmers contrast with the rapid acquisition of land by large companies in the 1980s and 1990s.

Izin prinsip, izin lokasi: fast-track land acquisition

The granting of an HGU on areas above 200 ha is in the hands of the National Land Agency, below 200 ha with the Provincial Office. The process in theory takes into account environment conservation, regional planning and existing rights. The application is reviewed by a committee that includes the local land officials and the local authorities at sub-district (*camat*) and village (*kepala desa*) level. The application can only succeed after the committee has reviewed the land history, existing rights, and the conformity of the proposed development to land-use plans and policies (World Bank, 1991).

If the procedure were followed, time and costs become important considerations. Land survey and the checking of the history and status of each sector requires considerable practical abilities as well as the capacity to successfully discuss and negotiate with local communities – impossible unless mutual trust is established over time. The full HGU process can easily take several years.

⁹ The present limit is 22 ha per person in South Sumatra.

¹⁰ Other rights that can be used by an individual or a corporation include the right to use (*hak pakai*), but it is limited in duration and not well adapted to tree crop development.

¹¹ 789,000 ha of land is registered in the Province; including 340,000 ha of *hak milik*, and 363,000 ha of HGU.

To bypass the process, corporations and government made ample use of procedures that regulate what happens before the HGU is issued. A corporation must first apply for an *izin prinsip* (a provisional rights permit). This grants the right to survey the land and make development plans.

The *izin prinsip* is granted by the district government, and its holder can apply for a land reserve right (*pencadangan tanah*). The next step is to obtain the *izin lokasi* that enables a corporation to start planting without having necessarily met the requirements of an HGU.

As noted by Boehmer (1998), this system gives a developer the monopolistic right to purchase land. Although government regulations also stipulate rights for landowners who refuse to sell their land to such permit holders, in practice developers and local officials pressure owners to release their land at below-market prices, especially if they do not hold an official title.

The power to grant *izin lokasi* was shifted from the regional to the national government in 1993 as part of a deregulation package [*Pakto 1993*] meant to ease foreign investment. The change allowed corporations backed by central government to obtain land permits in Jakarta with little involvement of the local authorities. The system has led to many abuses: development of land despite contrary environmental regulations (e.g. planting oil palm on steep slopes without terracing), and the unfair expropriation of land from local people are now commonplace.

In many cases the land granted to a company under *izin prinsip* is much larger than the land actually developed (Table A1). Many corporations have then used their permits as collateral for bank loans spent on other projects, while retaining their monopoly right over the original land. According to a recent evaluation by the National Development Planning Bureau (BAPPENAS), of the 2.9 M ha under *izin lokasi* nationwide, only 470 000 ha (16 percent) has been developed. The total land reserved for large private plantation companies in 1997 in South Sumatra was 876 000 ha - only 180 000 ha with full HGU - of which 240 000 ha were planted (Map 3).

The *izin prinsip* / *izin lokasi* system was suspended in 1998 when the government froze the granting of new permits and started to review existing grants. The permits of a few companies that did not meet development regulations were revoked. The granting of *izin lokasi* reverted to regional governments in May 1999 in anticipation of local autonomy. Whether this will lead to a wiser use of land resources depends on the accountability of the administrators to the local citizens.

The consequences: unsustainable development and land conflicts

Well-connected corporations used the *izin* permit procedures to gain control over large areas to develop oil palm plantations. Considerable land (685 000 ha in South Sumatra of which 234 000 ha are planted) was also allocated to other companies under HPHTI - a right to plant pulp or timber species. Combined allocations to agro-industrial plantations, industrial forestry projects, logging companies and transmigration schemes from 1980 to 1998 were 3.9 M ha, 35 percent of the province.

Unsurprisingly cases of conflicting land-rights and status are manifold. The same land is frequently registered simultaneously as a transmigration area, as forest land, and as allocated to a plantation company. In numerous instances several corporations hold a permit for the same land. And many permits have been granted for common-property village-land, even where this is populated and permanently cultivated.

It would have been extremely difficult to allocate land at such a pace if the corporations and government offices involved had carried out appropriate environmental surveys and meaningful negotiations with the local communities. Instead, corporations bought the agreement of government agencies for development plans that conflicted with supposedly fixed regional plans, environment law, conservation reserves and existing land-rights.

The provinces of Sumatra and Kalimantan with the highest percentage of land under *izin lokasi* and the largest logging, transmigration and industrial forestry sectors had the worst fires in 1997.

Transmigration: A Major Cause Of Fire Hazard And Fire Risk

South Sumatra: one million transmigrants since 1980

South Sumatra was one of the first provinces to receive large number of transmigrants. The movement started before 1969 but most of the one million people have arrived from Java since 1980 (Table 1). The province is now home to 7.5 million people (67 people km⁻²)¹² (Table A2). Some 1.33 M ha (12 percent) is reserved for transmigration of which 850 000 ha have been cleared and allocated (Table 2).

There are four categories of transmigration projects:

- Swamp transmigration (*pasang surut*) in the coastal tidal swamps.
- Nuclear Estates and Smallholders Schemes (NES) See below.
HPHTI transmigrants who work for an industrial forestry company; they are given small plots to plant their food or plantation crops.
General transmigrants are given 2 ha plots to plant food crops.

¹² In 1993, the Minister of Transmigration stated that the 'ideal' population of South Sumatra is 25 million, or 230 people km⁻² (Kanwil Deprans, 1998).

Table 1. Numbers of transmigrants entering South Sumatra

Five-year Plan (<i>Repelita</i>)		No. of transmigrants	Average per year
Pre-plan		197 429	n.a.
I	1970-1974	36 736	7 347
II	1975-1979	60 373	12 075
III	1980-1984	363 273	72 655
IV	1985-1989	106 915	21 383
V	1990-1994	153 274	30 655
VI	1995-1999	75 028	18 757
Total		993 028	

Source of data: Kanwil Deptrans, 1997

Large-scale land clearing and promotion of food crops lead to alang-alang

Transmigration projects have a major impact on the population, infrastructure, vegetation and land-use. Surveys conducted between 1988 and 1991 and in 1999 (Gouyon) show that transmigration projects are a major contributor to increased fire hazard and fire risk.

Table 2. Allocation of land in South Sumatra

Category	Area (ha)	Percent of total
Area reserved for transmigration	1 333 958	12
Of which:		
Already allocated	851 437	8
Reserved for future occupants	482 521	4
Other agricultural areas	2 948 079	26
Other forest areas	5 443 542	48
Settlements and other land-use	1 608 281	14
Total	11 333 860	100

Source: Kanwil Deptrans, 1998

The method used to clear land prior to the arrival of the transmigrants increases fire hazard. Bulldozers are used and are operated by contractors who are not necessarily skilled or careful. The result is loss of topsoil and large piles of wood which are then burnt. The degraded land is rapidly colonised by *alang-alang* (Plate 6).

Transmigrants start by planting annual food and cash crops that they know (rice, peanuts, chilli, etc.) on part of their foodcrop plots. These crops bring immediate income and require no great investment. This accent on food crops is reinforced by official policies which state

that each province should be self-sufficient in rice, and that transmigrants should grow food crops to increase the local production and set an example to residents.

Local residents however prefer to grow tree not food crops for sound environmental and economic reasons. The acid-leached soils of Sumatra and Kalimantan are well suited to trees but not to annual crops: large applications of fertilisers and frequent weeding are necessary to obtain a food crop, and the net return is far below the market cost of labour.

After a few years with diminishing returns and increasing labour to weed their food crops, transmigrants have three options. They can:

Sell their land to return to Java or move to another area,
stay on their land from which they obtain a low income and supplement this with waged labour for neighbouring farmers, agro-industrial companies or industry, or
Find the necessary resources to imitate the local people and plant tree crops, even if they are not supposed to do so¹³ (In some cases, they receive help from government or corporations to develop high yielding rubber or oil palm).

The three options have a number of consequences.

Many land transactions take place in transmigration areas - often without official approval and registration - and thereby increase the risk of conflicts 'resolved' by fire. Transmigrants receive full property rights (*hak milik*) but the initial land acquisition by the government was often made without consideration of the existing traditional rights¹⁴, which leads to additional conflicts.

Sizeable areas of cleared land are not cultivated and are abandoned to *alang-alang* and bushes; a major fire hazard especially as transmigration areas are often close to logged forest and young plantations to which the fire easily spreads.

Impoverished transmigrants become a cheap source of labour for agro-industrial projects, resented by local people, and;

Transmigrants are usually the first recipients of aid to develop high-income tree-crops (clonal rubber or oil palm) as the government tries to ensure a stable income.

¹³ In the Baturanta Project, South Sumatra, farmers prospered when they changed from food crops to rubber (Levang, 1997).

¹⁴ In a recent land conflict in South Sumatra, land allocated to transmigrants was allegedly sold by them to an agro-industrial company. Soon after, local people claimed the land on the basis that it had been unfairly acquired by the transmigration authority. In another case, the head of one village had to go to Jakarta to get back village land, seized for a transmigration project.

Independent migrants

Transmigrants are usually followed by independent migrants, often from the same families or villages. Independent migrants in South Sumatra usually buy land that has already been cleared and sometimes planted by the local people, as:

They seldom dare occupy land without the permission of the local people who are liable to retaliate violently - as they have in other provinces. The right to fell the forest is the initial step to convert a plot of common land to private property; thus villagers prefer to clear it themselves. They may then choose to sell the land to migrants or share it with them against labour for the upkeep of the plantations¹⁵;

The independent migrants lack the skills to clear the forest¹⁶ and they are well aware of the resulting dangers. Letting a fire escape leads to retaliation. If they do eventually clear land, it is usually after they have settled permanently in a community and then with local help, especially when burning.

Plate 6. Land clearance by bulldozer in a transmigration area followed by burning: *alang-alang* has started to invade.



¹⁵ One way for independent migrants to acquire land is to work for a local farmer on a young plantation. With rubber, the migrant will upkeep the plantation until it reaches tapping age and will usually be given permission to plant food crops between the young rubber to help keep weeds away. The migrant receives half the land when the trees are ready to tap.

¹⁶ A local proverb says "If you want to hoe land, call a Javanese; if you want to clear forest, call a Malay".

Independent migrants in South Sumatra are well accepted by local people as a source of labour. They live either in small hamlets within a village or assimilate into the community through marriage. There is more contact between independent migrants and local people than between transmigrants and villagers. The independent migrant thus have more occasion to exchange expertise and turn to tree crops faster than transmigrants.

All migrants, who have already accepted that they must leave their home areas and who have no alternative livelihoods, remain more open than local residents to cooperation with government projects and to new technologies. They have therefore been among the first beneficiaries of smallholder tree-crop development projects. Local people view this positively as it enables them to join these projects or adopt the technologies after they have seen and judged the success of the migrants who took the initial risk. The lingering resentment against the transmigrants, however, remains.

Agro-Industrial Projects: Fires In Land Clearing And Conflicts

The agro-industry is another major acquirer and converter of land outside the control of local farmers. Up to the end of the eighties smallholder land acquisition increased rapidly but since then company land has grown much more quickly than smallholders (Table 3 and Table A3)

The area planted in HPHTI and large plantations exceeds 500 000 ha, of which 430 000 ha were established from 1991 to 1997, an average of some 70 000 ha per year (Tables 3 and 4). This led to more fires.

Areas developed by agro-industrial companies were largely logged-over forest, conversion forest and bush/*alang-alang*, all of which were cleared by fire. Fires used for such major land clearance are difficult to control during droughts and often damage surrounding vegetation and plantations.¹⁷ The use of fire was banned in 1995, although a 1997 decree authorises controlled burns under specified conditions and after a permit has been obtained. However, the great majority of plantation managers and contractors consider burning to be the cheapest, easiest and most efficient way and take advantage of droughts to clear large areas. In most instances there is no permit.

The young oil palm (or rubber) plantations are a fire hazard; they have an open canopy with underlying grasses or cover-crops that burn readily. The hazard is considerably reduced if the area is well weeded which, indeed, is often the case in large plantations. Once the tree crop closes canopy, they are no longer fire-prone.

HPHTI are planted to semi-deciduous pulp or timber species that dry quickly, have considerable bushy undergrowth, and are readily colonised by *alang-alang*. The short rotation (under 10 years) further increases the risk of grass invasion and thus the fire hazard. As HPHTI are often within logged areas, fires spread easily. HPHTI are one of the highest fire hazard land-use types in Indonesia.

¹⁷ Fires over areas larger than 100 ha create their own winds and heat column and become very hard to control (Nicolas, pers.comm.)

Table 3. The development of large plantations and smallholder areas in South Sumatra between 1991 and 1997

Category	Area planted by 1991 (ha)	Area planted by 1997 (ha)	Average percentage Growth per year, 1991-97
Smallholders	944 000	1 156 000	+4
Rubber	566 000	780 000	+6
Coffee	241 000	256 000	+1
Others	137 000	120 000	-2
Large plantations	76 400	272 000	+43
<i>Private, of which:</i>	<i>46 700</i>	<i>241 000</i>	<i>+69</i>
Oil palm	20 400	187 000	+136
Rubber	19 900	48 000	+24
<i>Public, of which:</i>	<i>29 700</i>	<i>31 000</i>	<i>+1</i>
Oil palm	9 500	11 000	+3
Rubber	6 300	7 000	+2

Data from Dinas Perkebunan, excluding Nucleus Estates and Smallholders Projects. Other crops are mainly coconut, pepper and clove in smallholdings, clove, pepper and cocoa in large private plantations, and coconut, cocoa, tea and sugar cane in State plantations.

Agro-industrial development that does not take account of the needs and rights of local communities leads to arson. Even when the investors negotiate the land acquisition with the local authorities, they seldom consult below the village head. Unfortunately many village heads in South Sumatra have been imposed by government and are not respected. Some feel free to sell land on behalf of villagers without consulting or informing them.¹⁸ The farmers are often forced to accept compensation below market value. Companies who cannot reach agreement with farmers over the acquisition of land, in particular land already planted, stand accused of setting fire to the smallholders' areas and of letting fire 'escape' their concessions during droughts.

Farmers who feel that their land has been unfairly taken or burnt sometimes resort to fire in revenge or intimidation¹⁹ (Table A4).

¹⁸ In a particularly severe conflict near PT. MHP acacia plantations, villagers accused the head of a neighbouring village of having sold their land to the company.

¹⁹ WALHI and FFPCP have listed 140 recent cases of land conflict in South Sumatra compiled from newspaper reports and information from farmers, plantations managers and government officials. These involve 60 companies, 155 villages and 125 000 ha of land. In 1997 alone, nearly 4 000 ha were reported to have burnt in these areas.

Table 4. Area (ha) under industrial forest plantations (HPHTI) in South Sumatra in June 1998

Category	Concession area (ha)	Planted area (ha)
Pulp wood (<i>Acacia mangium</i>)	393 000	213 400
Of which PT. MHP (private company)	296 400	194 400
Timber species	292 000	21 100
Of which PT. Inhutani V (State company)	270 700	6 200
Total	685 000	234 500

Source: FFPCP data from HPHTI companies and Regional Forestry Office

Smallholder Development Projects: Clonal Rubber And Oil Palm

Since the fifties, government has been concerned that productivity in smallholder rubber plantations is lower than in large plantations.

Most smallholders plant from seeds collected under old jungle rubber and there has thus been no genetic improvement since the first generation grown in Indonesia. Trees from these 'unselected seedlings' yield 500 kg ha⁻¹y⁻¹ of latex. Other individuals use 'clonal seedlings', i.e. trees grown from seeds collected in clonal plantations, and yield is increased to 750 kg ha⁻¹y⁻¹. Large plantations use bud-grafted trees (clones) selected for their quick growth, high yield, and resistance to diseases. Relatively few smallholders plant clones but those that do can collect some 1500 kg ha⁻¹y⁻¹ under South Sumatra conditions.

Improved clones have been used in large plantations since the thirties but were only introduced to smallholdings, with financial and technical assistance from government in the mid-1970s. Only since 1986, after appraising production in plantations developed by projects, have a few smallholders in South Sumatra planted clones without financial aid from government. Many are reluctant because of the high costs of planting material and maintenance. (See Table 5).

The cost to bring one hectare of clonal plantation to maturity is Rp 7.5 million. Of this, half is labour costs, much of it to control weeds. Clones grown with no maintenance and no fertiliser - as is jungle rubber - have poor growth and production and give insufficient return to match the initial investment in the planting material (Plate 7). However if the clonal plantations are maintained relatively free of weeds they are said to be at greater risk of destruction by wild pigs and tapirs.

A number of research institutes, including ICRAF and CIRAD, are testing options to grow clonal rubber with minimal maintenance in association with other tree species. The object is to reduce costs and to retain the bio-diversity and economic-diversity (fruit trees, timber, medicinal plants, rattan, etc.) found in jungle rubber. It is too early to draw conclusions but it

is recognised that such plantations would be more fire prone than those kept totally weed free. Until low cost methods are found, growing clones remains a costly and risky investment for farmers.

Aware of this, the government decided to subsidise the use of clones and has offered three packages of technical and financial assistance to farmers. (The packages have also been used to develop smallholder oil palm, which over the last 10 years has been viewed as highly profitable and an attractive alternative to rubber).

Nucleus estates and smallholder schemes: monopolies and conflicts

The first approach in the seventies was the Nucleus Estates and Smallholders Scheme (NES/PIR) which was used with local farmers and transmigrants (Table 6). The farmers received one or two hectare plots of rubber or oil palm developed by a private or public company with the property title retained by a bank as credit collateral. All produce had to be sold to the company which deducted part of the sale price as credit reimbursement.

The scheme is costly as large companies spend more to clear land and plant rubber than smallholders. Monopolies develop as the farmers are tied to the company even if it offers a low price for the latex. To try to get round this, farmers tap their trees over-intensively and sell the latex to outside buyers at a higher price. They reinvest the income in new, self-developed areas. Being over-tapped the NES plantations have a short economic life, the credit is never fully repaid and the bank does not return the land title to the farmers.

The NES rubber scheme has now been abandoned but is still used for oil palm under the name KKPA. The hope is that the monopoly will be easier to impose on farmers as the fresh fruits must be processed quickly after harvest and there is no time to 'shop around' for outside buyers. With the growing number of oil palm factories this may not be the case. In North Sumatra, Jambi and West Sumatra there are many crude palm oil factories and farmers sell their fruit to the best buyer - often not the NES.

In South Sumatra there is the opposite problem and processing capacity is too low. Many conflicts arise between oil palm mill-managers and farmers as the price paid at the mill - which had jumped during the economic crisis of 1998 - decreased sharply because of over-supply and not all farmers could sell before fruit quality fell to unacceptable levels.

Development models such as NES/PIR in which the interests of the farmers are subordinated to those of a company frequently lead to violence. In the early nineties the army is reported to have beaten farmers caught selling their rubber to outside buyers. In 1999 farmers who could not sell their palm fruits demonstrated outside plantation offices. Revenge fires are known to follow.

The project management unit approach: a good level of success

Under a Project Management Unit (PMU) approach, farmers receive credit plus technical assistance. When the trees are in production they pay back part of the credit through a bank or through the project unit itself. The Unit approach was started in the seventies by government under the names ARP and PRPTE and was later developed by the World Bank on a larger scale as SRDP and TCSDP with better management and greater success (Table 6).

Careful selection of strongly motivated farmers was the key. The project worked initially with transmigrants and independent migrants, as local farmers remained sceptical until convinced by good results.

Flexibility also promoted success: farmers were trained and convinced rather than forced to apply a given technical package. For example, in the initial SRDP farmers were free to use only part of their total credit on their plantation as long as it was growing well and spend the rest as they wished. Their cost per hectare were thus reduced.

The third advantage to farmers is that it has provided land property titles that can be used as credit collateral. Repayment was slow at the start because *Bank Rakyat Indonesia* which was supposed to collect the credit, failed to cooperate. After the PMU took over collection, repayment has been satisfactory and many farmers have already reclaimed their land title.

The Project Management Unit scheme has more than doubled participant income per hectare and has demonstrated the benefits of clones to others. Compared to jungle rubber, PMU plantations are usually well maintained and a low fire hazard. There were few fires in 1997 or 1998.

Table 5. Cost in 1999 of establishing one hectare of smallholder clonal rubber from planting to first latex production.

Year	Labour inputs	Labour (days)	Price (Rp day ⁻¹)	Cost (Rp y ⁻¹)	Cost (Rp y ⁻¹)	
1	Land preparation, fencing	140	7 500	1 050 000	1 350 000	
	Planting and upkeep	40	7 500	300 000		
2	Replacement planting, fertilizer, weeding, etc.	90	7 500	675 000	675 000	
3	Fertilizer application, weeding, etc.	80	7 500	600 000	600 000	
4	Fertilizer application, weeding, etc.	60	7 500	450 000	450 000	
5	Fertilizer application, weeding, etc.	50	7 500	375 000	375 000	
6	Fertilizer application, weeding, etc.	35	7 500	262 500	262 500	
1-6	Total labour inputs				3 712 500	
	Cost of other inputs	Quantity (Unit y ⁻¹)	Unit	Price (Rp Unit ⁻¹)	Cost (Rp y ⁻¹)	Cost (Rp)
1	Fencing material	1	Set	877 500	877 500	2 026 000
	Planting material	500	Tree	1 250	625 000	
	Phosphate (SP36) fertilizer	180	kg	700	126 000	
	Urea fertilizer	150	kg	700	105 000	
	KCl fertilizer	75	kg	1 500	112 500	
	Round-up herbicide	2	litre	40 000	80 000	
	Miscellaneous				100 000	
2	Planting material	50	tree	1 250	62 500	485 900
	Phosphate (SP36) fertilizer	75	kg	700	52 500	
	Urea fertilizer	62	kg	700	43 400	
	KCl fertilizer	25	kg	1 500	37 500	
	Round-up herbicide	6	liter	40 000	240 000	
	Miscellaneous				50 000	
3 to 6	Phosphate (SP36) fertilizer	75	kg	700	52 500	318 400
	Urea fertilizer	62	kg	700	43 400	
	KCl fertilizer	25	kg	1 500	37 500	
	Round-up herbicide	4	liter	40 000	160 000	
	Miscellaneous				25 000	
1 to 6	Total Other inputs					3 785 500
1 to 6	Total labour + other inputs					7 498 000

Source of data: Rubber Research Institute of Sembawa, E.Penot (CIRAD/ICRAF), interviews with farmers.

Plate 7. Poorly maintained four year old clonal rubber plantation at high risk of fire.



Unfortunately although agreed a success, the scheme is no longer funded. The World Bank and the Asian Development Bank are considering re-extending funds to the same or similar projects, although the economic crisis has changed priorities and slowed the process.

The partial approach: a partial success

Under ‘partial approach’ schemes, farmers receive planting material and sometimes fertilisers as a grant or at reduced prices. Assistance is limited to the first year and the schemes have been implemented without external donor assistance. In South Sumatra it is run by the Department of Plantations (*Dinas Perkebunan*) and the district governments, either with their own funds or with ‘special funds for poor villages’ (IDT). The various projects have set up nurseries in the villages to provide clonal rubber to the farmers.

The success rate varies considerably according to the quality of the implementing institution and the location. In many cases quality has been low and intended inputs did not reach farmers. There are exceptions: the district government of Muara Enim currently successfully distributes one million rubber plants per year.

However, such schemes have the in-built weakness that farmers do not have to repay the assistance. If repayment had to be made once the rubber trees were tapped, more money would become available: it would also teach farmers how to use credit to aid their own development.

The Resulting Changes In The Smallholder Economy

A sense of land deprivation and alienation from development planning

The major consequence of the changes that have taken place in South Sumatra since 1980 and especially since 1990, is a growing sense of land scarcity among smallholders.

Table 6. Smallholder tree crop development projects in South Sumatra in 1997

Scheme	Area developed (ha)
NES/PIR/KKPA (smallholders only)	
Rubber	10 900
Oil palm	72 300
PMU (ARP, PRPTE, SRDP, TCSDP)	
Rubber	60 100
Coconut	13 000
Partial approach	
P2WK (rubber)	4 800
P2WK (coconut)	2 100
District funds (rubber)	12 000

Source of data: Dinas Perkebunan.

Farmers used to consider that they had access to large reserves of forest controlled by their *marga*. With the removal of this institution, the lack of recognition of traditional land rights, and the freedom given to large investors to develop oil palm plantations and HPHTI, farmers feel deprived of land for future development.

A summary of the areas allocated to forestry, transmigration and agro-industrial projects in South Sumatra is given in Table 7. It illustrates the magnitude of the problem.

Table 7. Land allocated to transmigration, forestry and agro-industry in South Sumatra from 1979 to 1997

Sector	Land allocated (ha)	Period	Average allocation per year (ha)
Large plantations (private)	876 000	1988 - 1997	87 600
Logging concessions (HPH)	1 752 000	1979 - 1997	92 200
Industrial forests (HPHTI)	685 000	1988 - 1997	68 500
Transmigration	596 000	1979 - 1997	31 400
Total	3 909 000	1979 - 1997	205 700

Source of data: Dinas Perkebunan, Kanwil Deptrans, Kanwil Kehutanan and FFPCP.

When farmers feel that land is likely to be expropriated by an ‘investor’, they quickly plant jungle rubber or other tree crops, e.g. coffee, with minimal care to occupy as much land as possible. Farmers know that they have a better chance to obtain compensation for planted than unplanted land, even if the land is traditionally theirs. The strategy is often seen in logged forests. These are easier to slash-and-burn than primary or old secondary forest, they are easily entered along roads built by the logging company, and farmers know that logged forests are often converted to HPHTI or large plantations. The new plantations are a high fire hazard: they are poorly maintained, full of bush and *alang-alang*, and are themselves surrounded by logged forests that are a considerable fire hazard.

Another consequence of the priority given to large companies, coupled with the misuse of public funds often seen in government projects, is a profound sense of alienation from the ‘development’ process. Farmers in South Sumatra and elsewhere feel that decisions taken by the government are not made to defend their interests but in the interests of the government and private investors.

Farmers also complain about their lack of control over the design and implementation of projects: many of which supply aid that is not adapted to the farmers' needs and only partially reaches them. For example, it is difficult to persuade government institutions to give aid or credit directly in cash to farmers and let them purchase the inputs they need. Officials prefer to give fertilisers, pesticides, planting material, etc. They consider farmers as short-term minded, and fear that they would not use the cash for productive investments. Giving aid in kind also provides opportunities to collude with suppliers. Farmers are aware of these distortions and they reinforce their distrust of government interventions.

Projects such as the World Bank funded PMU treated farmers with respect and gave some freedom in the choice of inputs. They also had a relatively low level of corruption because of tight supervision and had considerable influence on surrounding farmers. They continue to shape the development of smallholder rubber in a positive direction.

From jungle rubber to clonal plantations

The use of clones in PMU projects has enabled farmers to see the advantages of increased production. When the cost of the investment and the credit is taken into account, the net income per hectare and per labour day from a clonal plantation is 50-100 percent higher than from a jungle rubber plantation. For farmers with no access to new land, this is sometimes the only way to increase income.

However, for the majority, developing clonal plantations remains risky and costly. Only those who are above subsistence level, i.e. who have more than 3 ha of jungle rubber, are able to find the resources. Farmers who do decide to invest face constraints:

lack of good quality planting material: many small private nurseries in South Sumatra sell bud-grafted plants and clonal seedlings but the quality is often low; hence the rate of growth is slow and yields disappointing. Slow growth increases fire risk in the early years.

lack of funds to finance upkeep of a plantation invaded by a bushes and *alang-alang*, and liable to burn in long drought. Interviews suggest that a weedy plantation has a 1 in 3 probability of burning before it is ready to tap. With high establishment costs, loss to fire is a major disaster for a small farmer.

In the long run, smallholder clonal plantations reduce fire hazard as at maturity they have a closed canopy with few bushes and grasses beneath.

Most government and commercial banks do not extend credit to smallholders without a land title as collateral. Some borrow from moneylenders in their villages and others from the private *Bank Perkreditan Rakyat* (owned by Tor Ganda, a plantation group from Medan) that will give credit without land title. These loans have a short maturity (one or two years at most) and high interest rates (36 – 48 percent per year). Farmers who use the loan to plant clonal rubber pay them back from other sources of income before the plantation reaches maturity. If the plantation is lost to fire, the loan still has to be repaid: again a major disaster for the family.

The fear of fire slows down the development of clonal rubber; many farmers do not want to take the risk. In Muara Enim district alone, around 1500 ha of young clonal plantations were destroyed in 1997 after they were invaded by *alang-alang*. An estimated loss of Rp 3 billion with 1500 farmers losing their investment and with it a significant part of their future livelihood.

The estimated gross annual and available income of owner farmers with different age jungle and clonal rubber plantations is shown in Table 8. The calculation is based on a minimal expenditure for subsistence (simple housing, clothes, basic food, soap, lamp oil, primary education of children, etc.) of Rp 12 000 per day for an 'average' farmers family (3 children, 2 adults) i.e. Rp 4 380 000 per year. It is clear that a smallholder with less than 4 ha of jungle rubber lives at subsistence level. On the other hand, farmers with 2 ha of clonal rubber, or 1 ha of clonal rubber plus 1 or 2 ha of jungle rubber, is able to save for future investments.

Table 8. Average incomes of farmers with jungle rubber and clonal rubber

	Annual yield of dry rubber* (kg ha ⁻¹ y ⁻¹)	Gross income** (Rp)	Costs (including amortisation of initial costs)	Net income (Rp ha ⁻¹ y ⁻¹)	Number of hectares needed to sustain a household
Old jungle rubber (above 30 years)	400	1 200 000	50 000	1 150 000	3.8
Jungle rubber	600	1 800 000	100 000	1 700 000	2.6
Clonal seedlings plantation	750	2 250 000	225 000	2 025 000	2.2
Young clonal plantation (7- 10 years)	1000	3 000 000	500 000	2 500 000	1.8
Mature clonal plantation	1500	4 500 000	500 000	4 000 000	1.1

Source of data: interviews with farmers.

**The tapped exudate is processed by farmers into thick blocks of coagulated latex (slabs), that contain 50 percent dry rubber and 50 percent water and dirt.*

***World rubber prices have fallen since the Asian economic crisis owing to currency depreciation in the three major producing countries (Thailand, Malaysia and Indonesia - 80 percent of world production). Farmers sell rubber at Rp 3000 per dry kilo. The world price in June 1999 was US 50 cents (Rp 4000) per kilo.*

Hence, three classes of farmers can be found in South Sumatra (Table 9):

Farmers (10 – 20 percent) who have benefited from PMU projects and are in a position to systematically develop new clonal plantations. Plantations are relatively weed free, close canopy quickly, and are low fire hazard. Any fires that do burn remain on the ground and cause little damage to the rubber;

Farmers (20 – 30 percent) who are above subsistence level, close to PMU plantations (i.e. in areas with good communications) and who are trying to develop clonal plantations. Often they fail to maintain their plantations which are thus at high risk of fire until they close canopy after five years.

The over 50 percent of farmers who have a low income and can not invest in clonal plantations. Their only way to increase income is to move to remote areas and plant these with low-cost, unselected seedlings. The land is frequently partly invaded by alang-alang and the plantations are slow to close canopy and are prone to accidental fires. These new developments are often near logged forests, transmigration and agro-industrial projects that clear land with fire, and this increases risk.

Table 9. Distribution of smallholder rubber: area by District and by age and planting material.

District	Total area (ha)	Immature area		Area planted or replanted (ha y ⁻¹)	Number of farmers	Area per farmer (ha)	Farmers planting clones*	Area planted with clones (ha y ⁻¹)
		Area (ha)	Percent					
OKU	77 800	29 600	38	4 200	54 224	1.4	40	1 700
OKI	80 600	30 800	38	4 400	33 600	2.4	40	1 800
Muara Enim	144 400	53 200	37	7 600	57 800	2.5	60	4 600
Lahat	44 500	1 000	2	150	14 600	3.0	30	50
Musi Rawas	205 300	41 600	20	6 000	73 700	2.8	40	2 400
Musi Banyuasin	190 500	61 000	32	8 700	66 900	2.9	60	5 200
Bangka	33 700	13 900	41	2 000	22 200	1.5	25	500
Belitung	3 100	2 400	77	350	2 100	1.5	25	100
Total	779 900	233 500	30	33 400	325 124	2.4		16 350

Source of data: Dinas Perkebunan, BPS, interviews with farmers.

*The percentage of farmers planting clones includes the beneficiaries of government projects ('partial approach') and farmers planting clones on their own initiative.

Fires and smallholder development

It is estimated that 33 000 ha of rubber (16 000 ha to clones) are planted each year in South Sumatra. Official figures at the end of October 1997 showed 13 000 ha of smallholder rubber plantations had been destroyed (Table A5). This is probably far below the true figure. Officially 2 243 ha of were lost in Muara Enim District although local officials reported 6 609 ha burnt by 22 November 1997. FFPCP interviews suggest that the total smallholder area accidentally burnt was at least 40 000 ha (i.e. 5 percent) of the smallholder plantations: of this half was old jungle rubber plus 6 000 ha of 3 - 4 year old clones and 14 000 ha of young jungle rubber. The official estimate of area burnt in large plantations was 11 300 ha: probably a more accurate figure. Estimated values lost are shown in Table 10.

Table 10. Estimated value of plantations accidentally burnt in 1997

		Area Burnt (ha)	Value (Rp ha⁻¹)	Total value (Rp)	Total value (US \$)
Smallholders	Immature clones	6 000	5 000 000	30 000 000 000	3 800 000
	Immature others	14 000	1 500 000	21 000 000 000	2 600 000
	Old jungle rubber	20 000	1 000 000	20 000 000 000	2 500 000
	Total	40 000		71 000 000 000	8 900 000
Large plantations (rubber and oil palm)		11 400	5 000 000	57 000 000 000	7 125 000
Total		51 400		128 000 000 000	16 025 000

Source of data: Dinas Perkebunan and field interviews.

Value is calculated based on development costs and is thus likely to be an underestimate. Smallholder clonal plantations were considered to have burnt at 4 years, and that their actual value was somewhat lower than the costs shown in Table 4 as they were only partly weeded. For other immature smallholder plantations, estimates are based on their costs of development over a four year period. Values for old jungle rubber are market value minus the price of the land itself. For large plantations, estimates are based on the costs over four years using an average of rubber and oil palm plantation costs.

In Summary

Three major types of fires are linked to tree crop development in South Sumatra (Table 11):

fires used as a tool by large plantations, HPHTI and smallholders to clear land, wildfires that escape during land clearing or that result from negligence. They are dangerous when they meet large areas with a high degree of fire hazard, and fires used as a weapon in land conflicts.

Table 11. Fire risk and fire hazard in man-made and natural environments (Scale: 0, low risk to 10 extreme risk)

Type of cover	Fire risk (sources of ignition)	Fire hazard (fuels that burn easily once ignited)
Primary forest	0	1
Secondary forest	0	2
Logged-over forest	1 (careless ignition by small loggers)	7
Jungle rubber agroforests Creation/ replanting 1-2 years (rice + other crops between young rubber) 3-10 years (rubber grows with forest species) 10-30/40 years (mature rubber + forest species)	5 (fire used to clear land but controlled) 2 (burning of rice straw) 0 1 (cigarette smoking when tapping)	2 5 (open canopy with bushes) 3 (rubber drops its leaves and dries during long droughts)
Smallholder clonal rubber Creation/replanting 1-2 years (same as above) 3-6 years (growth of rubber) 7-30 years (mature rubber)	5 (fire used to clear land but is controlled) 2 (as above) 1 (cigarette smoking when cleaning the plantation) 1 (as above)	1 1 if the plantation is clean 5 if invaded by bushes 8 if invaded by <i>alang-alang</i> 1 if plantation clean 3-6 if poorly maintained
Industrial rubber/oil palm plantation Creation Replanting 1-5 years 5-20/30 years	8 (large-scale land clearing with fires plus land conflicts) 2 (limited use of fires) 5 (conflicts) 1	3 (well cleaned, but covercrops may dry out and burn) 1
Industrial forest (HPHTI) Creation Replanting (1/10 years) 1-10 years	10 (large-scale land clearing with fires plus land conflicts) 2 (limited use of fire) 5 (conflicts)	8 (<i>alang-alang</i>) 8 (<i>alang-alang</i> and regrowth)
Transmigration Project Creation	5 (land clearing with fire)	9 (grasslands)

4. PROPOSED STUDIES, PROJECTS AND POLICIES

The actions and complementary studies proposed are designed to take into account the types of vegetation fires that occur in South Sumatra and that impinge on tree crop and smallholder development, i.e. fire used as a tool, accidental fires, and fires used as a weapon in land conflicts.

Fire As A Tool: Limiting The Use of Burning To Clear Land

Fire is used to clear 40 000 ha in large plantations and HPHTI, and 33 000 ha of smallholder rubber plantations each year. The larger the area burnt at any one time, the greater the risk. There is a need to reduce the use of fire in all cases.

A method for large-scale land clearing with minimal burning adapted to Indonesia

Slashing, felling and burning (or the burning of waste wood after it has been windrowed by bulldozer) is considered by many as the cheapest and easiest way to prepare land; most contractors and plantation managers feel it is the only feasible way.

Some private companies consider that the benefits of zero-burning on soil fertility outweigh the constraints and costs. London Sumatra uses a method developed in Papua New Guinea where the humid climate and dense vegetation make it difficult to use fire. The company claims that it started to adapt the method to Indonesian conditions before 1995.²⁰ The vegetation is carefully cleared with a bulldozer to avoid removing the topsoil. The timber is accumulated in windrows and cover crops (*Pueraria javanica*, *Callopogon*) planted to protect the soil and smother the windrow. The windrows can be used to contour slopes. The company has also developed a way to clear *alang-alang* with glyphosate.

The Indonesian Oil Palm Research Institute (IOPRI) recommends a method of zero-burning with costs estimated (before monetary the crisis) at Rp 920 000 ha⁻¹. Present costs would be double or more given the need to use heavy imported equipment and considerably higher than burning.

Other experts advocate controlled or minimal burning, i.e. burning limited to the smaller branches of the matted vegetation in order to avoid an accumulation of large piles of dead wood disturbing plantation operations and becoming a fire hazard.

In Malaysia a zero burning policy was introduced in 1994 but modified in 1995 to allow controlled burning under a permit when the risk of wildfire is considered low (Yew *et al.*, 1998). Recommendations on zero-burning to replant rubber specify various methods dependant on whether the trees have been uprooted or cut with a chain-saw, and on whether the vegetation is piled in the new inter-rows or beside ravines.²³

²⁰ There is a controversy over the use of fire by London Sumatra. The company claims not to use burning but reports from farmers, NGOs and satellite pictures apparently point to the contrary. The dispute has been widely reported in the local press and is not resolved.

In 1995, the Indonesian government enacted guidelines for zero-burning land clearance (PLTB):²¹

- bushes and trees of less than 10 cm. diameter to be slashed,
- trees above 10 cm diameter to be felled at a specified height (e.g. at 40 cm for trees of diameter 10 - 20 cm, at 100 cm for trees of 31 - 75 cm, etc.),
- the vegetation to be chopped into smaller pieces and planting lines marked out,
- the chopped vegetation to be piled to leave 2 m width planting corridors.

A permit requirement – based on prevailing weather and vegetation type – was specified in 1997 but is little enforced.

There are many opinions about land clearance but no definitive evaluation that compares costs and benefits has been carried out. The advantages and disadvantages of the various options are summarised in Table 12.

Conflict of opinion and a lack of information prevail. And there remains no agreement that large-scale land clearance is a major cause of the fire problem in Indonesia. A comparative and adaptive study is needed, to:

- compare the costs and benefits of zero-burning, partial burning and total burning methods to clear land on a large-scale in plantations and HPHTI;
- establish guidelines for methods to clear land that are adapted to Indonesian conditions and will minimise fire risk and hazard; and
- design policies to promote these methods through communication, information, training, incentives, cost compensation and regulations.
- Such a study could be project-aided under the umbrella of the Ministry of Forestry and Estate Crops (MoFEC) in close cooperation with an agronomic research institute such as IOPRI or the Indonesian Rubber Research Institute. A number of private companies would need to be closely involved and the trials located in their plantations to provide credibility.

The programme should have several steps:

- Carry out a literature search and consult experts, contractors and plantation managers to evaluate the perceptions, advantages and constraints of burning, reduced burning and zero-burning and methods to clear land.
- Select an advisory panel of representatives from research institutes, consulting companies, contractors and plantation managers. (The panel should be regularly consulted, involved and informed of progress.)
- Study - with the panel members - land clearance methods used in Malaysia and Papua New Guinea - countries with a history of zero-burning.
- Design trials to test methods of zero-burning and controlled burning land clearing that reduce fire risk.

²¹ Decree of the Directorate General for Plantations, Nr 38/KB-110/SK/DJ.BUN/05.95.

- Carry out a series of trials under different climatic conditions in Sumatra and Kalimantan.
- Evaluate the results of the trials from environmental, fire prevention, agronomic, economic and financial viewpoints.
- Prepare practical guidelines on land clearing methods suited to Indonesian conditions.
- Develop a programme of brochures, mail, internet, workshops, training programmes, etc. to publicise the guidelines.
- Train contractors in best-practice land clearance methods.
- Formulate a policy based on incentives (tax holidays, eco-labelling, etc.) - not on bans that are difficult to enforce – to promote best practices and give a market advantage to companies that follow it.

The expected advantages are a reduction in voluntary burning of up to 40 000 ha per year in South Sumatra and 300 000 ha per year throughout Indonesia, plus a marked reduction in wildfires that originate from large-scale land clearance.

PT. Wana Harapan Pratama is a new factory equipped to produce 90 000 m³y⁻¹ of compressed panels for the export market. The company claims many orders from Europe and Asia, but has constant difficulty in finding wood locally and is working at only 20 percent capacity.

Promoting the use of rubber wood from smallholder plantations

Zero-burning land clearance methods with their additional costs and need for heavy equipment are beyond smallholders. However, increased use of rubber wood would reduce the quantity of biomass burnt by smallholders when replanting. It would also provide additional income to farmers, and enable them to replant under favourable conditions.

Of the wood from old rubber plantations:

- most is burnt when preparing the land for the new plantation;
- part is used locally for construction or for the fencing of new plantations. (Wood for fencing comes from branches, bark or planks(Plate 8)), and
- part is sold locally and cheaply (Rp 25 000 - 50 000 m³) as firewood.

Rubber has good quality wood which when treated and processed, can be made into export quality furniture. It is a clear, pleasantly patterned wood in high demand for tables and chairs. Several companies in South Sumatra are equipped to process rubber wood and buy it occasionally. All complain of difficulties in purchasing from smallholders. One company uses 1000 - 2000 m³ per month, 90 percent bought from large plantations in North Sumatra. When treated, prices reach Rp 200 000 m³.

Table 12. Advantages and constraints of burning and zero-burning in land clearing

Effect	Burning	Zero-burning
On the environment	- Releases smoke and haze	+ No pollution
On fire risks and hazard	- May spread to surrounding vegetation	- Leaves piles of dead fuel that may burn in during subsequent droughts
On planting operations	+ Simple and easy way to prepare the field - Requires precautions to avoid fire escape - Operations are tied to the dry season	- Leaves piles of vegetation that hamper field supervision and movement - Contractors and plantation managers are not familiar with the method - Stacking of vegetation difficult on hilly terrain + Windrows can be used for contouring + More flexibility in the calendar of operations
On soil and fertility	- Deliterious effect on the soil: increases run-off and erosion, lowers pH - Over 50 percent of the nitrogen and potassium lost to the atmosphere or later leached	+ Unburned soil is a better growth media - Heavy machines compact the soil - Nutrients take more time to be released and initial growth of trees can be slow - Bulldozers must be used carefully to minimise top soil disturbance + Nutrient locked in woody material are released slowly to the feeder roots of the planted rubber or oil palm when the wood decays
On pests and diseases	- Trees that are not uprooted may spread root diseases	- Pests accumulate and multiply in the windrows (especially rats and <i>Eurycthes</i> that attack oil palms): partially controlled with cover crops and traps.
On weed control	- Growth of bushy weeds is suppressed but <i>alang-alang</i> may grow more quickly	+ Less problems with <i>alang-alang</i>
On costs and profit	+ Cheap	- More expensive: heavy machinery and special care + Reduces the use of fertilisers and improves the growth and yield of the plantation

Source of information: Ling and Mainstone (1983), IOPRI (1998), Yew et al. (1998) D. Boutin, pers comm., A.Vincent pers.comm.

There are however, a number of constraints to the use of rubber wood from smallholder plantations:

- Trees grown from unselected seedlings have a marked taper and only the lower bole can be used.
- The wood is often damaged by poor tapping; 60 – 70 percent can be processed, the rest is left in the field.
- The processed yield is only 20 – 50 percent; waste must be sold as ‘small wood’ or firewood, or left to rot behind the factory.

- Rubber wood is readily attacked by mould and insects and must be chemically treated within 72 hours of cutting, a skilled operation.
- Quantity and quality of wood from old smallholder-plantations are both unpredictable; it is difficult for a buyer to estimate yield before the trees are cut and processed. Buyers often prefer not to buy rather than risk later conflict with the farmers.
- Plantations are scattered and often difficult to access; costs of surveying, hauling and transport are high.
- Supply is highly seasonal as replanting only takes place between July and October.

Of these the major problems are the location of a steady supply of quality wood and poor roads; processing difficulties can be overcome. The variation in the value of rubber wood from one hectare in South Sumatra is shown in Table 13. Wood from old, well-tapped and maintained areas located along main road less than 50 km from Palembang can exceptionally command Rp 3 000 000 ha⁻¹. The prices obtained by a smallholder selling for furniture is more often Rp 300 000 - 500 000 ha⁻¹. The value of the wood from distant plantation in poor condition, barely pays for the transport; and if the buyer also pays for the felling of the trees – as is often the case - he risks a loss.

Rubber wood from clonal plantations has a higher value as the trees are straight, more homogenous and in better condition. The average value is Rp 3 million ha⁻¹ (maximum 10 million). New clones designed for HPHTI plantations combine good latex production, fast growth and high rubber yield. They should be tested in smallholder conditions.

An alternative use of rubber wood is to process it for pulp or particle board. This enables a much greater use of the biomass (1 ha yields 120 t of wood for particle board) but prices offered by industries are low (Rp 25 000 – 35 000 t⁻¹) and barely pay for transport. Fibre quality differs from the usual species planted in HPHTI, and a maximum of only 10 percent rubber wood can be mixed with other species. Potential sources of rubber wood are presently insufficient to build a dedicated factory.

Based on the estimate that 33 000 ha of smallholder rubber plantations are replanted each year, the theoretical amount of rubber wood that could be processed for furniture is 300 000 m³ y⁻¹. But poor access limits harvest and increases cost. The true potential is 30 000 – 60 000 m³ y⁻¹, which is below the annual capacity of a factory such as PT. WHP (compressed panels) although daily supply in the wood harvesting ‘season’ would exceed capacity. The peak daily supply would however, still be below the combined capacity of the furniture factories in Palembang.

Plate 8. Smallholder rubber plantation cleared and ready for replanting: the old wood has been gathered and stacked for fencing.



Highly restrictive regulation also deter the use of rubber wood. The government has long feared that smallholders lured by price would fell productive latex plantations and would not necessarily replant. A regulation in force since 1998 specifies that companies that use rubber wood must obtain a license to fell and buy standing plantations. The license can be withheld if the trees are considered productive. In addition, the buyer of the wood must supply the farmer with 600 budded stumps for each hectare felled.

The regulation is counter-productive as the value of the rubber wood is often less than the value of the budded stumps. This deters buyers from purchasing wood which, if sold freely, would help the farmer to buy planting material himself. Free choice also lets the farmer decide the type of planting material he needs, the supplier, and the timing. Rubber wood purchasers are tempted to supply cheaper, inferior budded stumps and may not deliver even these at the right time to plant (There are also taxes on the sale of rubber wood (Keputusan Gubernur Kepala Dati I Sumatera Selatan, Nomor 41/1998)).

There is a need to improve the utilization of rubber wood. Donor-funded technical assistance to farmer groups would provide impetus. The Rubber Research Institute at Sembawa runs a limited programme to help farmers sell their wood to furniture factories, and advises on replanting.

Table 13. Value of rubber wood from jungle rubber and clonal plantations

	Trees ha ⁻¹	Percent used	Diam (cm)	length (m)	volume (m ³ tr ⁻¹)	Volume (m ³ ha ⁻¹)	price (Rp m ⁻³)	Transport (Rp m ⁻³)	net price (Rp m ⁻³)	Net value * (Rp ha ⁻¹)
From jungle rubber										
Min	200	60	12	2	0.02	2.40	80 000	62 500	17 500	42 000
Max	400	70	18	2	0.10	28.00	125 000	25 000	100 000	2 800 000
Av*	300	65	15	3	0.05	8.78	80 000	35 000	45 000	400 000
From clonal plantations										
Min	200	70	20	3	0.09	13	125 000	62 500	62 500	825 000
Max	400	80	30	4	0.28	90	125 000	25 000	100 000	9 000 000
Av*	300	75	25	3	0.15	33	125 000	35 000	90 000	3 000 000

Source of data: Lasminingsih (1995), Departemen Kehutanan (1997), Rubber Research Institute of Sembawa, PT WHP, PT Balok Mas, PT Bumi Raya, Kanwil Kehutanan, Dinas Kehutanan, interviews with farmers

The average is not calculated based on the minima and maxima, but is the typical value found in the field. The cost of felling the trees has not been deducted as farmers have to fell to replant, even if they do not sell the rubber wood.

A donor programme run in close cooperation with the Institute would help expand benefits and would:

- identify smallholder rubber plots that need replanting and which have undamaged wood, ready access and are close to Palembang,
- identify farmers interested in selling their wood: group sales obtain higher prices,
- contact potential wood buyers in and around Palembang,
- link the farmers to the factories and assist in price negotiations,
- offer technical assistance to select high quality re-planting material,
- advise on weeding, fertilizer, etc. to obtain optimum growth,
- test clones – given free of charge - for rubber wood production (HPHTI clones) on 0.25 ha areas with volunteer farmers, and
- work to persuade the provincial government to modify the regulations to allow farmers to buy planting material themselves instead of requiring the purchaser of wood to supply the budded stumps.

The immediate direct impact on fire reduction would be limited: perhaps a 2 percent reduction in burnt biomass²⁵ that in the longer term may reach 20 percent. In Malaysia after years of promotion, the use of rubber wood, from plantations is now common.

The indirect effect on fire prevention would be immediate and sizeable. Additional income from the sale of rubber wood would allow farmers to buy herbicides and finance work to clean their plantations and thus reduce fire hazard in the initial critical years.

Reducing Fire Hazard Through The Improved Development Of Smallholder Rubber

An efficient way to prevent future vegetation fires is to promote land-use that combines low fire hazard with worthwhile benefits to farmers, i.e. smallholder clonal plantations with good control of *alang-alang* and bush regrowth (Plate 9).

If part of the money invested in large-scale HPHTI and oil palm development in South Sumatra had been allocated to smallholder development (outside monopolistic NES/KKPA models) there would be few land conflicts with their resultant fires. Areas of fire susceptible jungle rubber and bush would have been turned into low-fire-risk high-production, well-maintained clonal plantations. This has happened in the PMU/TCSDP project where smallholders make a good income and establish new clonal plantations which are imitated by their neighbours.

Donor-funded project projects are in a position to assist the development of smallholder rubber, and thus reduce fire hazard, in two ways.

1. At national level projects should consult, lobby and provide technical assistance to government agencies and international donors to promote and implement smallholder agroforestry development projects based on the successful PMU system. The model is applicable to rubber, coconut, and oil palm (Boutin and Girseng, 1998). Reduced fire hazards, fewer land conflicts and increased economic growth combine to permanently reduce fire numbers.
2. In South Sumatra province projects should assist District governments to implement smallholder development schemes with the underlying aim of reducing the incidence of fire. Work should be carried out in conjunction with the Rubber Research Institute of Sembawa which runs similar programmes and linked with work to increase the use of firewood.
 - Identify pilot Districts as national development funds are increasingly administered at this level.
 - Hold workshops and consultations to identify ways to best assist smallholders who are or who wish to develop clonal plantations to reduce fire hazard in the critical early phase. The Plantations services, District governments, the Rubber Research Institute and farmers' organisations need to be consulted. It should be emphasised that the work aims to increase farmers income by preventing wildfires.
 - Establish a credit fund - partially funded by the project and partly by local government - to finance the eradication of bushes and *alang-alang* in immature clonal smallholder plantations. The programme can be linked to other government assistance projects to supply planting material and fertilisers to farmers. The level of cash assistance offered should be related to the verified willingness of farmers to maintain their plantations. Farmers should be charged low interest until they reimburse the funds when the plantation reaches maturity. The land title is retained as collateral;
 - Establish an emergency fund available to clean plantations and establish fire breaks in el Niño years. Borrowed cash to be repaid by the farmers.
 - Such a programme has the potential to avoid the destruction of the 20 000 ha of smallholder plantations (valued at Rp 8.8 million) lost every year to fires:

Local policy should be formulated in ways that provide incentives for sound land-use and discourage those that are significant fire hazards. These policies should be part of a national,

long-term land-use policy, that minimalizes land conflicts that lead to arson and maximises motivation of people to protect the vegetation from fires.

Ongoing political changes may provide a window of opportunity and result in modified land-use policies and land allocation systems. Numerous stakeholders are now involved in the evaluation and reform of existing policies. Donor-funded assisted projects are in a strong position to provide technical assistance to these efforts which must be carried through at national and provincial levels to obtain maximum benefits.

Reducing Fire Hazard And Fire Risk Through Sound Land-Use Policies

Uncontrolled fires in the 1997 drought destroyed 40 000 ha of smallholder plantations and at least 11 000 ha in company plantations. Some fires were probably arson, most accidental. It is impossible to stop all sources of ignition that arise from daily work and from negligence. And in a severe drought, one ignition may result in a damaging fire. The only way to reduce the number of fires is to reduce the fire hazard, i.e. reduce the accumulation of easy-burning fuels to prevent fires.

A province-based project would be well-placed to establish a Sustainable Land-Use Unit to:

- Identify stakeholders and institutions working to reform land-use policies that impinge on forestry, HPHTI and plantations, (government agencies, private companies, NGOs, eco-labelling institutes and international institutions);
- Collect and correlate information on past and present studies, pilot projects and needed reforms concerned to on sustainable land-use in the forested areas of Indonesia;
- Bring together a network of individuals and institutions concerned with land-use;
- Hold regular workshops with the stakeholders to identify needed reform, on-going reforms and to assess pilot projects;
- Identify agencies and programmes to which the project could extend technical assistance; and,
- Set up a communications system to ensure that the findings of the Unit and the network are widely exchanged, publicised, and available to institutes and the public (bulletin, a library open to the public, press releases, workshops, seminars, a web site, etc).

The communication and information component is of great importance. Reliable, well-presented information is influential. All reports should be made widely available in English and Indonesian.

Plate 9. Seven-year-old clonal rubber plantation free of *alang-alang* and bush regrowth, and thus a low fire hazard.



The programme should:

In South Sumatra the project should establish a sustainable land-use programme aimed at economic development and fire prevention. The programme would:

- Hold consultations and workshops with the main stakeholders (provincial government agencies, District governments, NGOs, farmers organisations, and private companies) to identify and evaluate new land-use and development models that offer a balance between fast economic growth, social impact and environmental conservation.
- Set-up a technical assistance programme to collect and improve on land-use. Lack of transparency enables the unfair allocation of land despite environmental regulations and existing land-rights. A task force (Transmigration, Plantation, Forestry, Land Office) under the direct authority of the Governor and the Land Office, needs to collect information and make it accessible to the public.
- Provide technical assistance to two key Districts to enhance the capacity of the District government to collect and process information on land-use, and also to carry out participatory land-use planning that takes into account economic growth, social development, environment conservation and fire prevention.

- Identify private companies e.g. HPH or HPHTI, interested in starting full-participation projects with local farmers to develop wood production on part of their concession (which can include rubber wood), and also plantation companies that may wish to cooperate with farmers in a non-monopolistic way. The project would give technical assistance to the companies to design and implement the work in a way that brings direct benefits beyond the indirect ones occurring from smallholder cooperation.
- In consultation with all stakeholders, especially NGOs and farmers associations, select a number of contiguous villages for a pilot project in participatory land-use planning.

From Fire Prevention To Sustainable Development

The extensive fires of the last two decades show that fire suppression in Indonesia is extremely difficult. Prevention is the way forward. Man starts all vegetation fires by design or by accident and while it is difficult to change behaviour patterns, it is somewhat easier to reduce the potential hazard.

The rapid development of logging, transmigration and agro-industrial plantations in Sumatra and Kalimantan has completely changed land-use and vegetation cover.

The result is a degraded landscape that is a mosaic of fire-prone logged-over forests, *alang-alang*, HPHTI planted to semi-deciduous species, and young weedy plantations. Land clearing is mainly by fire. Land acquisition rarely takes local land-rights into account: revenge, is by fire.

The combination of high fire-hazard and over-use of fire results in many wildfires which damage smallholders, companies and the environment without discrimination. Projects are in good position to help reduce the damage by developing efficient methods to reduce the use of fire in land clearance, and by promoting sustainable economic development and land-use practises in which smallholders should be considered as the main participants.

22

¹ There is a controversy over the use of fire by London Sumatra. The company claims not to use burning but report from farmers, NGO's and satellite pictures apparently point to the contrary. The dispute has been widely reported in the local press and it not resolved.

² Decree of the Directorate General for Plantations, Nr 38/KB-110/SK/DJ.BUN/05.95.

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6. Abbreviations

ARP	Assisted Replanting Program
BAPPENAS	Badan Perencanaan Pembangunan Nasional (National Development Planning Bureau)
BPS	Biro Pusat Statistic (Statistical Bureau Center)
BAPPEDA	Badan Perencanaan Daerah (Regional Development Planning Agency Provincial or District Level)
BPN	Badan Pertahanan Nasional (National Land Office)
CIFOR	International Center for Forestry Research
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
Deptrans	Departemen Transmigrasi (Department of Transmigration)
EU	European Union
FFPCP	Forest Fire Prevention and Control Project
GTZ	Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation)
HGU	Hak Guna Usaha (Right of Exploitation)
HPH	Hak Pengusahaan Hutan (Right of Forest Exploitation)
HPH	Hak Pengusahaan Hutan Tanaman Industri (Right of Industrial Forest Plantation Exploitation)
HPHTI	Hutan Tanaman Industri (Industrial Forest Plantations)
IDT	Inpres Desa Tertinggal (Presidential Help for Left Behind Villages)
IFFM	Integrated Forest Fire Management Project (GTZ)
ICRAF	International Centre for Research on Agroforestry
IOPRI	Indonesian Oil Palm Research Institute
IRRI	Indonesia Rubber Research Institute
KKPA	Kredit Koperasi Primer untuk Anggota (Primary Cooperative Credit for its Members)
LIPI	Lembaga Ilmu Pengetahuan Indonesia (Indonesian Science Institute)
MoFEC	Ministry of Forestry and Estate Crops
MHP	Musi Hutan Persada
MUBA	Musi Banyuasin (one of the five FFPCP priority Districts in South Sumatra)
MURA	Musi Rawas (one of the five FFPCP Priority Districts in South Sumatra)
NES	Nucleus Estates and Smallholders
NGO	Non-Governmental Organisation
NOAA	National Oceanic and Atmospheric Administration
OKI	Ogan Komring Ilir (one of the five Districts in South Sumatra)
OKU	Ogan Komering Ulu (one of the five Districts in South Sumatra)
PIR	Perkebunan Inti Rakyat (NES)
P2WK	Proyek Pengembangan Wilayah Khusus (Special Region Development Project)
PRPTE	Proyek Rehabilitasi dan Perluasan Tanaman Ekspor (Project for the Rehabilitation and Development of Export Crops)
PT	Perseroan Terbatas (Limited Company)
PMU	Project Management Unit (UPP)
SFMP	Sustainable Forest Management Project (GTZ)
SRDP	Smallholder Rubber Development Project

TCSDP	Tree Crop Smallholder Development Project
UCNW	University College of North Wales
UNDAC	United Nations Disaster Assessment and Coordination
UNDP	United Nations Development Program
UNESCO	United Nation Education, Scientific and Cultural Organisation
UPP	Unit Pengelolaan Proyek (PMU)
WALHI	Wahana Lingkungan Hidup Indonesia (Indonesia Environmental Forum)
WWF	World Wide Fund for Nature
WWW	Wana Harapan Pratama

APPENDIX. **TABULATED SUPPORTING DATA**

Table A1. Land (hectares) allocated by District to large estates in South Sumatra as of 1997

District	Crop*	Reserved Area	Izin Prinsip	HGU	Planted Area
OKI	KA	82 600	44 900	16 000	19 900
	Oil palm	123 800	124 100	10 000	35 400
	KH,KS	100		100	100
	KH	10 000	6 000	7 600	5 000
	Other	11 800	0	0	1 200
Total		228 300	175 000	33 700	61 600
OKU	KA	10 000	7 200	100	300
	Oil palm	18 000	9 900	9 000	10 000
	TB	33 300			
	Other	11 000			3 000
Total		72 300	17 100	9 100	13 300
MUBA	KA	17 700	4 200	500	1 700
	Oil palm	95 000	258 700	5 700	14 600
	KA+KS	4 300	1 100	4 300	4 000
	KH/KNH	10 000	3 300	3 000	2 200
	KH	1 700	1 400	1 800	
	KH/CO	5 000	12 000	12 600	4 800
	KA/CO	7 000			
	Other	1 400			
Total		142 100	280 700	27 900	27 300
MURA	KA	2 200		1 500	1 400
	Oil palm	168 300	219 000	17 000	31 800
Total	Oil palm	170 500	219 000	18 500	33 200
Musi Rawas	KA		12 000	3 000	100
	Oil palm	58 700	53 500		3 900
	KA+KS	20 000	17 000	8 800	13 800
	Other	6 500			500
Total		85 200	82 500	11 792	18 227
LAHAT	Oil palm	47 200	36 800	20 900	11 100
	CO/KA	300	300		50
	KS/KA	10 000	8 000	1 700	5 500
	Other	8 700		12 700	
Total		66 200	45 100	35 300	16 650
BANGKA	KA		3 000		
	Oil palm	143 700	82 500	15 100	32 400
	KS/KA/CO	25 000	17 000	3 400	13 100
	LL	20 300			
Total		189 000	102 500	18 500	45 500
BELITUNG	KA	3 500	3 500		
	Oil palm	62 000	105 000	14 100	27 000
	LD	10 000	9 000	10 100	100
	KA/LD	5 000	4 100	4 000	3 200
	KS/KA	15 900	15 000	15 900	10 600
Total		92 900	133 100	44 010	40 900
South Sumatra		1 046 500	1 033 200	198 900	256 750

Dinas Perkebunan.MUBA = Musi Banyuasin; MURA = Musi Rawas, ME = Muara Enim

*KA= rubber; KS = Oil Palm; CO= Cacao; LD = Pepper, TB = Sugar Cane, LL = Other.

Table A2. Area (km²) and population of the Districts of South Sumatra province

District	Area (km²)	Population	Density (km⁻²)
Bangka	11 534	590 500	51
Belitung	4 548	208 500	46
Lahat	6 356	669 900	105
Muara Enim	9 575	704 000	74
Musi Banyuasin	26 099	1 178 100	45
Musi Rawas	18 650	627 300	34
OKI	21 387	926 700	43
OKU	14 679	1 124 500	77
Palembang	421	1 436 500	3 412
Pangkal Pinang	89	127 900	1 437
TOTAL	113 338	7 593 900	67

Source of data: BPS 1997

Table A3. Development of tree crops in South Sumatra

	1991		1993		1997		Growth	
	area (ha)	Percent	Area (ha)	percent	Area (ha)	Percent	Growth 1991-97	Average growth per year
Smallholders								
Rubber	566 400	60	591 300	62	779 900	67	38	6
Coffee	241 000	26	242 400	26	256 600	22	6	2
Others*	136 500	14	114 200	12	119 400	10	-13	-3
All	943 900	100	947 900	100	1 155 900	100	22	4
* Mostly coconut, pepper, clove								
Large estates, private								
Rubber	19 900	43	29 300	35	47 600	20	140	16
Oil palm	20 400	44	46 100	55	186 700	78	813	45
Others*	6 400	14	8 100	10	6 300	3	-1	-1
All	46 700	100	83 500	100	240 600	100	415	31
* clove, pepper, cocoa								
Large estates, public								
Rubber	6 400	21	6 600	21	7 300	24	15	2
Oil palm	9 500	32	11 100	35	10 600	34	11	1
Cane	12 300	41	12 400	39	11 700	38	-4	-1
Others*	1 600	5	1 500	5	1 400	5	-9	-2
All	29 800	100	31 600	100	31 000	100	4	1
*tea, coconut, cocoa								

Source of data: Dinas Perkebunan

Table A4. Reported cases of land conflicts with villagers in South Sumatra

District (Kabupaten)	Type of Activity	Number of Companies involved	Number of Villages Involved	Reported Conflict Area (ha)	Reported Burnt Area in 1997 (ha)	
Bangka	Oil palm	5	8	8 370		
Belitung	Tourism	2	2	1 106		
Lahat	Oil Palm	6	22	12 797	403	
Muara Enim	HPHTI (acacia)	1	14	14 200		
	Pulp & paper	1	5	300		
	Oil palm	8	19	10 484	663	
Musi Banyuasin	HPHTI (acacia)	2	3	4 700		
	Transmigration	<i>Government</i>	2	237		
	Oil palm	8	11	6 687	1 331	
	Cassava	1	2	750		
Musi Rawas	Logging	1	1	125		
	HPHTI (acacia)	2	4	2 450		
	Transmigration	<i>Transmigrants</i>	1	14		
	Oil palm	2	20	10 833	330	
	Mining	1	3	720		
OKI	Rubber	2	2	590		
	Housing	1	1	32		
	Animal farming	1	3	188	400	
	Oil palm	10	17	27 968	45	
	Shrimp farming	2	4	21 480		
	HPH/HPHTI	1	1	n.a.		
	Sugar cane	1	5	n.a.		
OKU	Rubber	1	1	600		
	Oil palm	5	7	1 703	723	
South Sumatra (Total per activity)	Animal farming	1	3	188	400	
	Cassava	1	2	750		
	HPHTI, Pulp	3	26	21 650		
	Logging	1	1	125		
	Oil palm	40	104	78 842	3 495	
	Rubber	3	3	1 190		
	Shrimp farming	2	4	21 480		
	Sugar	1	5	n.a.		
	Transmigration	<i>Government</i>	3	3	251	
	Non-agricultural	4	6	1 858		
Total South Sumatra, All Activities*		63	155	126 334	3 895	

Source: Newspapers, WALHI and FFPCP.

**The total number of companies and villages is lower than the total of the column as some villages and companies appear in several conflicts.*

Table A5. Area of tree crops reported as destroyed by fires in 1997: up to 4 November

	Large Plantations (ha)	Smallholders (ha)				
		Rubber	Coffee	Oil Palm	Other	Total
Bangka+ Belitung	718	2 114			378	2 492
Lahat	436	1 222	653			1 875
M.Enim	664	2 243				2 243
MUBA*	4 225	1 466			767	2 233
MURA	891	2 845				2 845
OKI	3 486	284				284
OKU	1 251	736	245	8	3	992
Total	11 371	10 910	898	8	1 148	12 964

Source of data : Dinas Perkebunan.