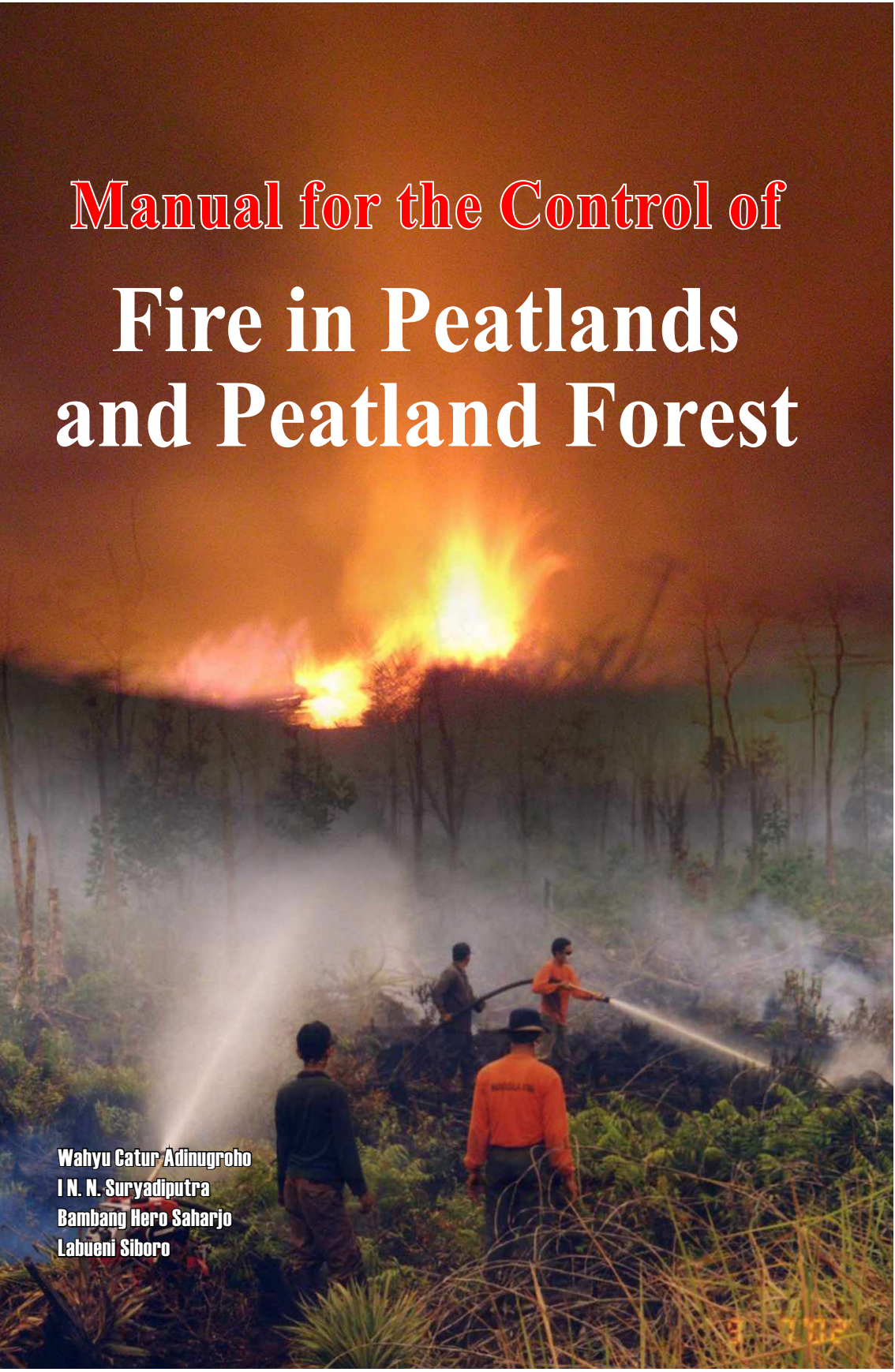
Manual for the Control of

Fire in Peatlands and Peatland Forest



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WETLANDS INTERNATIONAL
Indonesia Programme

Wildlife Habitat Canada
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Ditjen. PHKA

Bogor, December 2005

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Fire in Peatlands and Peatland Forest

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Foreword

Land and forest fire is a serious problem which Indonesia has to face in the dry season almost every year. Such fires occur not only on dry land but also on wetlands (mainly peatlands). Peatland forest fire is much more difficult to handle than fires on mineral soil or highland plains. This because the fire spreads not only through the vegetation on the surface of the peat but also through the underlying layer of peat itself, so it is difficult to determine the direction in which it is spreading. The only really effective way to extinguish peatland fires, especially when the fire has penetrated into very deep layers of peat, is from nature (i.e. heavy rain). Human fire-fighting efforts, besides requiring vast amounts of money and manpower, are not certain to extinguish the fires completely.

This Manual for the Control of Fire in Peatland and Peatland Forest contains information on : (1) fire control, (2) factors which support fire, (3) government policy on fire control, and (4) strategies and techniques for the control of land and forest fires in peatland areas. The information presented in this book, besides including a variety of concepts and practical measures for the prevention and suppression of fire already written/presented by others, also contains ideas and recent field experience of the writers in the handling of land and forest fires in peatland areas of Kalimantan and Sumatera.

The writing of this book has been funded by CIDA (*Canadian International Development Agency*) through the CCFPI project (*Climate Change, Forests and Peatlands in Indonesia*), and is produced by Wetlands International - Indonesia Programme in cooperation with Wildlife Habitat Canada.

We are aware that this Manual still has many deficiencies, and the writers would therefore welcome input in the form of criticisms and suggestions from readers, in order to improve its quality. Finally, we would like to thank all those who have helped in the production of this Manual.

Bogor, December 2005

Thank you,

The Authors

Glossary

Fuel : All organic materials, whether alive or dead, found in the earth (e.g. peat) and/or on the surface of the earth or above the earth (tree crown/canopy), which originate in the forest or land.

Beje : *Beje* is a rectangular pond constructed by the people (usually of Dayak descent) living in the peat swamp forest interior of Central Kalimantan to trap fish brought by overflowing rivers in the area.

El_Ninõ : A natural phenomenon characterised by excessive heating of sea temperatures in the equatorial region of the Pacific Ocean, which generally occurs once every 4 or 5 years.

Green House Effect : The process in which radiation from the sun enters and is then trapped within the atmosphere as a result of greenhouse gases, leading to an increase in the Earth's surface temperatures. Within certain proportions, the greenhouse effect is not bad because it results in the average ground temperature being 15^{o}C rather than -18^{o}C, thus providing the chance for life to exist on the earth's surface.

Peat : A type of soil composed of piles of organic materials originating from plant remnants which are in or have been in the process of decomposition.

Green House Gases : Gases which directly or indirectly affect the greenhouse effect, such as carbon dioxide (CO_2), methane (CH_4), dinitrogen oxide (N_2O), *Chlorofluorocarbon* (CFC), *Hydrofluorocarbon* (HFC), carbon monoxide (CO), Nitrogen Oxides (NO_x) and volatile organic non-methane gases.

Irreversible drying : A condition in which peat experiences excessive drying, causing the structure/characteristics of the peat to become damaged and change into charcoal-like material which cannot retain water nor absorb nutrients.

Illegal Logging : The uncontrolled, irresponsible, unlicensed felling of trees.

Land and forest fire : The incidence of fire, whether natural or man-made, characterised by the unhindered spread of fire consuming fuel from the forest and land through which it passes.

Ground fire : Fire which burns organic matter below the ground surface, usually organic litter/humus and dry peat. It usually begins as a surface fire which then spreads slowly to all parts below the surface layer (soil) and is extremely difficult to extinguish.

Ditch/Canal : A channel constructed by the community to link a river with peat swamp forest in order to extract logged timber. In addition, there are also authorised channels constructed by the government for irrigation purposes (e.g. in the area of the aborted Peatland Project in Central Kalimantan).

Land and Forest Fire Control : All efforts comprising activities directed at the prevention, suppression and post-fire handling of land and forest fires.

Land and Forest Fire Prevention : All efforts, actions and activities carried out to prevent or reduce the likelihood of forest fire occurring.

Land and Forest Fire Suppression : All efforts, actions and activities carried out to eradicate or extinguish fire which burns forest and land.

Community Participation : The process of community empowerment in which the community are actively involved in supporting an activity. This involvement encompasses planning, analysis and implementation of the activity.

Fuel break : This can be a natural break (such as a ravine, river, barren land, etc.) or a man-made one such as a road, reservoir, etc. which functions to separate one type of fuel from another.

Fire break : This can be a natural break (such as a ravine, river, barren land, etc.) or can be constructed by man to function (like blocked water-filled ditches) to separate, stop and control the spread of fire, or to maintain the strips of cleared land (*ilaran*) made to suppress forest fire.

Communal/Participatory fire break : A fire break, the construction of which involves the participation of the community, and which provides two benefits, i.e. (1) as a fire prevention measure and (2) to give economic benefit to the local community (for example, the blocked ditches and *beje* ponds function not only as fire breaks but also as fish ponds).

Small grant : The provision of collateral-free grants on a small scale to local community groups in order to develop a permanent business activity which does not damage the environment, in return for which grant the community group is obliged to protect the unburnt areas of peat land and forest and to rehabilitate those areas of peat land and forest which have already been degraded.

Zero Burning : A method of land clearing which does not utilise fire, but is carried out by cutting down trees in secondary forest or old plantations (e.g. oil palm), then shredding them into chips which are then piled into heaps and left to decompose naturally.

Post Fire Measures following Land and Forest Fire : All efforts, actions and activities carried out after a fire incident, to investigate the incident so as to determine its impact and discover who started it so that legal proceedings can subsequently be taken against the offender, as well as efforts to repair and rehabilitate the burnt forest and land.

List of Abbreviations

AATSR	Along Track Scanning Radiometer
ADB	Asian Development Bank
APHI	Asosiasi Pengusaha Hutan Indonesia (*Indonesian Association of Forestry Concession Companies*)
ASAR	Advanced Synthetic Aperture Radar
ASEAN	Association of Southeast Asian Nations
AVHRR	Advance Very High Resolution Radiometer
BAKORNAS PBP	Badan Koordinasi Nasional Penanggulangan Bencana dan Penanganan Pengungsi (*National Coordinating Agency for Disasters and Refugees*)
BMG	Badan Meteorologi dan Geofisika (*Meteorology and Geophysics Agency*)
BAPEDAL	Badan Pengendalian Dampak Lingkungan (*Environmental Impact Control Agency*)
BAPPENAS	Badan Perencanaan Pembangunan Nasional (*National Development Planning Agency*)
BP2HTIBT	Balai Penelitian dan Pengembangan Hutan Tanaman Indonesia Bagian Timur (*Eastern Indonesia forestry research and development agency*)
BPPT	Badan Pengkajian dan Penerapan Teknologi (*Agency for the Study and Application of Technology*)

CFFPI	Climate Change, Forest and Peatland Indonesia
CIDA	Canadian International Development Agency
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DC	Drought Code
DIRJEN	Direktur Jenderal (*Director General*)
ESA	European Space Agency
FDRS	Fire Danger Rating System
FD	Fire Danger
FFMC	Fine Fuel Moisture Code
FWI	Forest Watch Indonesia
GHG	Green House Gas
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit
GNRHL	Gerakan Nasional Rehabilitasi Hutan dan Lahan (*National Movement for Land and Forest Rehabilitation*)
HPH	Hak Pengusahaan Hutan (*Forest Concession Right*)
HPHTI	Hak Pengusahaan Hutan Tanaman Industri (*Forest Concession Right for Commercial timbers*)
IFFM	Integrated Forest Fire Management
KBDI	Keech Byram Drought Index
KKN	Korupsi, Kolusi dan Nepotisme (*Corruption, Collusion and Nepotism*)
LAPAN	Lembaga Penerbangan dan Antariksa Nasional (*National Space and Aeronautics Agency*)

LSM	Lembaga Swadaya Masyarakat (*Non Governmental Organisation*)
MERIS	Medium Resolution Imaging Spectrometer
MODIS	Moderate Resolution Imaging Spectro-Radiometer
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
OR	Organisasi Rakyat (*People/Community Organisation*)
P3K	Pertolongan Pertama Pada Kecelakaan (*First Aid*)
PBP	Penanggulangan Bencana dan Penanganan Pengungsi (*Handling of Disasters and Refugees*)
PHKA	Perlindungan Hutan dan Konservasi Alam (*Forest Protection and Nature Conservation*)
PHPA	Perlindungan Hutan dan Pelestarian Alam (*Forest Protection and Nature Conservation*)
PLG	Proyek Lahan Gambut (*Peat Land Project also known as MRP, Mega Rice Project*)
PLTB	Pembukaan Lahan Tanpa Bakar (*Zero Burning Land Clearance*)
POSKO	Pos Komando (*Comando Post*)
POSKOLAKDALKARHUTLA	Pos Komando Pelaksana Pengendalian Kebakaran Hutan dan Lahan (*Commando Post for Land and Forest Fire Control*)
PPKHL	Pencegahan dan Penanggulangan Kebakaran Hutan dan Lahan (*Prevention and Suppression of Land and Forest Fires*)
PUSDALKARHUTNAS	Pusat Pengendalian Kebakaran Hutan Nasional (*National Forest Fire Control Centre*)

PUSDALKARHUTLA
Pusat Pengendalian Kebakaran Hutan dan Lahan (*Land and Forest Fire Control Centre*)

SAR Search and Rescue

SATGAS Satuan Tugas (*Task Unit*)

SATLAK Satuan Pelaksana (*Implementation Unit*)

SATLAKDALKARHUTLA
Satuan Pelaksana Pengendalian Kebakaran Hutan dan Lahan (*Land and Forest Fire Control Implementation Unit*)

SK Surat Keputusan (*decree*)

SSFFMP South Sumatra Forest Fire Management Project

TKNKL Tim Koordinasi Nasional Kebakaran Lahan (*National Coordinating Team for Land Fires*)

TKNPKHL Tim Koordinasi Nasional Pengendalian Kebakaran Hutan dan Lahan (*National Coordinating Team for Land and Forest Fire Control*)

TNI Tentara Nasional Indonesia (*Indonesian Armed Forces*)

UPT Unit Pelaksana Teknis (*Technical Implementation Unit*)

USA United States of America

UU Undang-Undang (*Law*)

WI-IP Wetlands International - Indonesia Programme

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Chapter 1

Introduction

The general public's perception of the fires which have occurred so frequently in recent years is that they occur only in the forest, whereas in fact they can just as easily occur outside the forest. Forest and land fires should be seen together as one inseparable whole and tackled as such.

Forest fires in Indonesia at the present moment can be viewed as a regional and global disaster. This is because their impact has spread to neighbouring countries and the gases they release into the atmosphere (such as CO_2) are potential causes of global warming.

Forest fires in Indonesia occur not only on dry land but also on wetland such as peatland / peat-forest, particularly during the dry season when the wetlands dry out. Large scale clearing of peatlands with the digging of canals has further increased the risk of fire breaking out during the dry season, as the groundwater drains away through the canals leaving the peat excessively dry and easily combustible. Irreversible drying occurs and the peat changes character becoming like charcoal, as a result of which it is no longer capable of absorbing nutrients or retaining water.

Peatland fires slowly but surely eat away the underlying organic material, and the gases they emit contribute to global climate change. In 1997, peatland fires in Sumatera and Kalimantan were headline news everywhere. Malaysia and Singapore were seriously worried about the effect the smoke, which covered the region, was having on their citizens. Estimates of the extent and impact of the fires have been made by a

number of parties; although their results differ, they do show that more than 1 million hectares of Indonesia's peat swamp were burnt during 1997/1998. Tacconi (2003) estimates that the total area of peat and mangrove forest burnt in Indonesia in 1997/1998 reached 2,124,000 hectares.

Overcoming fire in peat land/forest is extremely difficult, compared with fire in areas where there is no peat. The spread of ground fire in peatland is difficult to detect because it can extend down to deeper levels or to more distant areas without being visible from the surface. On peatlands, if a fire is not quickly suppressed, or if it has already penetrated far into the peat layer, it will be difficult to extinguish. Moreover, the main obstacles to putting out the fire are the difficulty in obtaining large quantities of water nearby, and the extreme difficulty in gaining access to the site of the blaze. For these reasons, severe/extensive peatland fire can only be extinguished by natural means, i.e. by heavy rain.

Despite the many studies which have been done on forest fire, little progress has been made on ways of overcoming the problem of such fires, particularly those in peat land and forest, which continue to recur from year to year, especially in the dry season. This Manual is therefore intended to provide input and alternative choices for dealing with the problem of land and forest fire, especially that occurring in peatland areas. It is contains a variety of illustrations and diagrams which are easily comprehensible/practical and will, it is hoped, facilitate their application in the field.

Chapter 2

Importance of Controling Land and Forest Fire in Peatlands Areas

2.1 FUNCTION AND POTENTIAL OF PEAT LAND AND PEAT FOREST

Peat soil forms from the accumulation of remnants of dead prehistoric vegetation, part of which has undergone decomposition. It has a minimum organic Carbon content of 12-18% and a minimum thickness of 50cm. Taxonomically, it is termed peatland, Histosol or Organosol if it has a peat layer of e"40cm and bulk density of e"0.1g/cm3 (Widjaja Adhi, 1986). The term 'peat' has two meanings; it is used to refer to the organic material itself (peat) and also to the type of soil (peat soil). As an organic material, peat is a source of energy, a medium for seed germination, and an organic fertiliser, while as an organic soil it is used for agriculture and can be managed through a system of farming (Andriesse, 1988). Three types of organic soil have been identified based on the level of decomposition of their original plant material (Andriesse, 1988 and Wahyunto et al 2003); these are fibric, hemic and sapric. **Fibric**: this peat material has a low level of decomposition, generally with a bulk density of < 0.1 g/cm3 and fibre content e" 3/4 of its volume, while its water content when saturated ranges from 850% to 3000% of the oven dried material; it is yellowish brown, dark brown or reddish brown in colour. **Hemic**: this peat material has a medium level of decomposition, with bulk density between 0.13-0.29 g/cm3, fibre content normally < 3/4 - e" 1/4 of volume, maximum water content when saturated being 250-450%, and colour ranging from dark greyish brown to dark reddish brown. **Sapric**: this peat material has the highest level of maturity; bulk density is e"0.2 g/cm3, average fibre content < 1/4 of volume, maximum water content when saturated normally < 450%, and colour very dark grey to black.

The peat ecosystem is special in that, if it has not been disturbed, it will be inundated every year. Another special characteristic of peat is that, compared to other natural resources, it can be utilised both as "land" and also as "material" (Setiadi, 1999). Peatswamp forest has many functions, including:

Peat swamp forest (Jill Heyde - ccfpi.doc)

- ❒ as an aquifer, to store water reserves
- ❒ as an environmental/ecological buffer
- ❒ as agricultural land
- ❒ as habitat for flora (vegetation) and fauna (fish, birds, other wildlife etc.)
- ❒ as a raw material for making charcoal briquettes and growth media for plants
- ❒ as a carbon sink; peat has the capacity to store and sequester large amounts of carbon and thus restrict the emission of greenhouse gases into the atmosphere.

Box 1

Field Study, 2001
MACRO BIODIVERSITY of the BLACK WATER ECOSYSTEM in CENTRAL KALIMANTAN
by the Indonesia Center for Biodiversity and Biotechnology

1. *82 species of tree (9 protected tree species) ;*
2. *17 species of grasses and wooden shrubs;*
3. *85 species of fungi;*
4. *Average density (number/hectare): Trees : 371.74 /ha ; Pole : 984 /ha; Sapling: 3,868.89 /ha; Seedlings : 27,680.56 sm/ha*
5. *17 species of birds*
6. *16 species of fish*
7. *15 species of other wildlife*

Peatland is of little economic value but has an extremely important ecological function. Hydrologically, for example, it plays a vital role in regulating flow and storing water. Because of their enormous capacity for absorbing water, peat swamps function to prevent flooding and reduce the danger of flood.

Peat has a unique ecosystem rich in biodiversity **[box 1]**. Species of flora include: durian burung (*Durio carinatus*), ramin (*Gonystylus* sp), terentang (*Camnosperma* sp.), Gelam (*Melaleuca* sp), Gembor (*Alseodaphne umbeliflora*), Jelutung (*Dyera costulata*), Kapur naga (*Callophyllum soulatri*), Kempas *(Koompassia malacensis*), Ketiau (*Ganua motleyana*), Mentibu (*Dactyloclades stenostachys*), Nyatoh (*Palaqium scholaris*), Belangiran (Shorea belangeran), Perupuk (*Lophopetalum mutinervium*), rattan, pandan, palms and various species of liana.

Ramin

Belangeran

Jelutung

Species of fauna found in peat swamp areas include Orang-utan, deer, crocodiles, wild boar, long-tailed monkeys, reddish short-tailed monkeys, proboscis monkeys, short-tailed macaque, gibbons, monitor lizards, Bidaung (a kind of monitor), pythons, Ular tedung (cobra snake ?), Beruang madu/sun-bears, Macan pohon/*Neofelis nebulosa*, various species of fish (Tapah/ Giant malayan catfish *Wallago leeri*, Lais/Catfish *Kryptopterus spp*, Baung/River catfish *Macrones nemurus*, Seluang/ Rasbora *Rasbora* spp, Toman/Giant snakehead *Channa micropeltes*, Patin/Pangasius *Pangasius* sp, Sepat/ Three-spot gouramy *Trichogaster trichopterus*, Kalui/ Kissing gouramy *Helostoma temminckii*, Kapar/ Javan combtail *Belontia hasselt*,

Orang-utan
*(*Pongo pygmaeus*)*
(Yus R. Noor)

Papuyuk/ Climbing perch *Anabas testudineus*, Pentet/Common walking catfish *Clarias batrachus*, Biawan/Mud perch *Pristolepis groitii* and a wide variety of bird species which use the area either as a habitat or place of migration: owls/Brown boobok/Hawk-owl *Ninox scutulata*, coucal/ bubut *Cuculidae,* Tinjau/Robin/Shama *Copsychus spp*, Antang (eagle/ hawk)/Brahminy kite *Haliastur indus*, Pempuluk/Bulbul *Pycnonotidae*, Pigeons/punai/Green-pigeons *Treron spp*, Sebaruk/ egrets/herons/ bangau/Lesser adjutant *Leptoptilos javanicus*, swifts/Little swift *Apus affinis*, parakeets/Long-tailed parakeet *Psittacula longicauda,* Putar doves/ Spotted dove *Streptopelia chinensis*, mynah/Hill myna *Gracula religiosa*, woodpeckers *Picidae* and Tinggang/Rhinoceros hornbill *Buceros rhinoceros*).

Peat is also a component of fuel which is found below the surface. Peat's enormous capacity for absorbing water means that even when the soil in its upper part is dry, that lower down remains damp, even wet because it still contains water. Thus the lower fuel layer has a higher water content than the surface layer (organic litter, twigs, logs) and upper layer (canopy, moss, epiphyte). During the dry season, the surface peat soil dries out very quickly and easily catches fire. When it burns, the fire in the peat mixes with steam, resulting in copious amounts of smoke.

2.2 CAUSES OF LAND AND FOREST FIRE IN PEATLAND AREAS

In general, the cause of land and forest fires in Indonesia is 99.9% human, whether intentional or accidental, while the remaining 0.1% is due to natural causes (lightning, volcanic lava).

Human causes of fire can be categorized as follows:

a. Land conversion: conflagration resulting from the use of burning to clear land to make way for agriculture and industry, for the construction of roads, bridges, buildings, etc.

b. Burning of vegetation: conflagration resulting from the intentional burning of vegetation, where the fire gets out of control and jumps; for example, in the clearing of land on HTI and Plantation estates; farmers burning their fields in preparation for planting

c. Exploitation of natural resources: conflagration resulting from activities which take place during the exploitation of natural resources. These include the burning of undergrowth which obstructs access, and the lighting of cooking fires, by illegal loggers and fishermen in the forest. Their negligence in extinguishing these fires causes conflagration.

d. Construction of canals/channels in peatland. These canals are generally used for transporting logs or for irrigation. Channels which are not equipped with adequately functioning water control gates cause the water to drain out of the peat layer, with the result that the peat becomes dry and highly combustible.

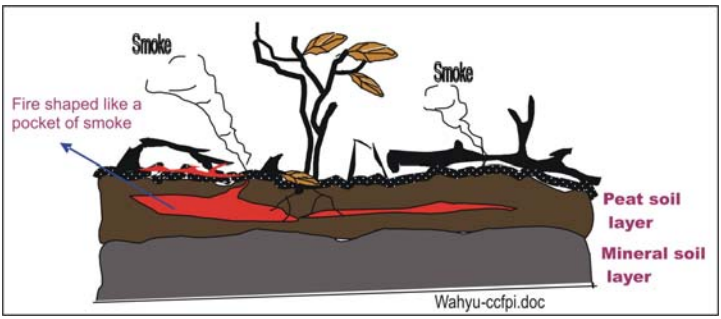
e. Land rights/ownership. Fire is often used as a tool by the local community to reclaim their rights to land or to take over 'ownerless' land in their vicinity.

Saharjo (1999) states that whether they occur in HTI areas, natural forest or shifting cultivation, 99% of forest fires in Indonesia can be ascribed to human causes, whether the fire is started intentionally or sparked off accidentally as a result of negligence during the burning of fields. Fuel and fire are important factors in preparing land for agriculture and plantations (Saharjo, 1999). In addition to being cheap and easy, burning also produces minerals which can be absorbed easily by plants.

The large quantity of fuel burned on the surface of the land will produce thick smoke and extensive environmental damage. For that reason, the use of fire and fuel in land preparation must be organized sensibly and carefully so as to minimize the negative impact on the environment. To solve this problem, the management of fire hazard control must be based on the results of research, and no longer rely solely on translations from textbooks or experience in other countries without adapting it to the land conditions prevailing in Indonesia. (Saharjo, 2000)

2.3 TYPE OF FIRE IN PEATLAND AND PEAT FOREST AREAS

Fire in peatland areas is categorized as *ground fire*. This type of fire spreads unpredictably and slowly because it is not affected by wind; smouldering beneath the surface, the organic matter burns without flame, giving rise to white smoke which is the fire's only visible sign above the surface. Ground fire does not happen of its own accord; usually the fire originates on the surface then spreads downwards burning organic matter through the pores of the peat, burning buried logs and spreading through the roots of undergrowth whose tops are burning. As it develops, the fire spreads vertically and horizontally, like a chimney of smoke. Tree roots held by the peat burn, thus losing their grip on the soil, with the result that the trees topple over. Fallen trees whose crowns are still green are a common sign of peat fires. Considering that the fire is below ground with only the smoke appearing at the surface, attempts to extinguish this type of fire are fraught with difficulties. Peatland fires can only be completely extinguished if the whole layer of burning peat is inundated with water. Obviously, to do this requires huge quantities of water, for example through the use of pump sticks, or waiting until the fire is extinguished naturally by heavy rain.



Ground Fire

2.4 IMPACT OF LAND AND FOREST FIRE IN PEATLAND AREAS

Land and forest fires in peatland areas have an obvious detrimental effect as regards degradation of the environment, human health and the socio-economic conditions of the local communities.

A. Degradation of the environment

Fire results in :

- ❒ Decline in the physical quality of the peat. (reduction in total porosity, water content and permeability).

Fire conditions (Alue dohong-ccfpi.doc)

The effect of fire on the soil's physical characteristics is not only determined by the duration and frequency of the fire and the degree of damage/ decomposition caused, but is also a result of the heating that occurs at the surface, which is affected by the availability of fuel. One tangible result of surface heating is the penetration of temperature below the surface, and this will be even worse if the fire penetrates to a deeper layer of peat. The rise in surface temperature due to fire, which can exceed 1000°C, causes the underground (peat) temperature to rise and as a result not a little of the peat also catches fire. Clearly, this burning of the peat will give rise to significant changes in its physical and chemical characteristics. A study of land belonging to local people in the village of Pelalewan in Riau (Saharjo, 2003), indicated that fire had damaged sapric peat to a thickness of 15.44 – 23.87 cm and hemic peat to a thickness of 6.0 – 12.60 cm, but none of the fibric peat appeared to have been burnt.

Table 1. Standard Criteria for Damage to Physical Characteristics of Peat due to Fire

No	Parameter	Damage	Method of Measurement
1	Soil Structure	• Damaged soil structure • Reduced infiltration of water • Plant roots do not develop • Increased rate of soil erosion	Direct observation
2	Porosity (%)	• Reduced porosity • Reduced infiltration • Increase in surface flow • Diminished supply of water and air for plants	Calculation from *bulk density* and maximum water retention capacity
3	Bulk density (g/cm^3)	• Compaction has occurred • Plant roots do not develop • Diminished supply of water and air for plants	Ring sample-gravimetry
4	Available water content (%)	• Water content is reduced • Soil's water retention capacity declines • Plants lack water	Pressure plate-gravimetry
5	Elasticity	• Soil loses its elasticity • Rate of erosion increases	COLE
6	Soil penetration (kg/cm^2)	• Soil penetration increases • Water infiltration decreases • Plant roots do not develop	Penetrometer
7	Soil consistency	• Soil loses its plasticity • Rate of erosion increases	Fill it by hand

*Source: Appendix to Government Regulation PP No 4, 2001

❒ Changes to the peat's chemical characteristics

The effect of fire on the peat's chemical characteristics is also determined by the level of decomposition and the supply of fuel on the surface, which will give rise to heating and the production of mineral rich ash. The change which occurs in the chemical characteristics of the peat, particularly immediately following the fire, will be marked by increases in pH, total-N content, Phosphorus content and total alkali content (Calcium, Magnesium, Potassium, Sodium) but a decrease in organic Carbon content. However, these changes are only temporary, because several months after the fire (usually about 3 months) further chemical changes will occur: there will be a decrease in pH, total-N content, Phosphorus content and total alkali content (Calcium, Magnesium, Potassium, Sodium).

The changes in the peat's chemical quality following fire is influenced by the supply of ash produced by the fire, drainage, the presence of damaged peat, changes in the ground cover, and micro-organism activity. These changes will subsequently affect the growth of vegetation on the soil.

Table 2. Standard Criteria for Damage to Chemical Characteristics of Peat due to Fire

No	Parameter	Damage	Method of Measurement
1	C-organic (%)	• Decrease in organic C content • Decreased soil fertility • Affects physical characteristics of soil	Walkley and Black or CHNS Elementary Analysis instrument
2	N total (%)	• Decrease in total N content • Decreased soil fertility	Kjeldahl or CHNS Elementary Analysis instrument
3	Ammonium (ppm)	• Decrease in available Ammonium content • Decreased soil fertility	Kjeldahl or specific electrode or autoanalyser
4	Nitrates (ppm)	• Increase in Nitrate content • Poisons ground water	Kjeldahl or specific electrode or autoanalyser
5	P (ppm)	• Increase in available P content • Nutrient balance is disturbed	Spectrophotometer or autoanalyser
6	pH	• pH increases or decreases • Nutrient balance is disturbed	pH-meter
7	Electrical Conductivity (m S/cm)	• Rise in electrical conductivity • Root growth is disturbed • Increase in salinity	Conductometer

* Source: PP No 4, 2001

- ❒ Disturbance to the peat soil decomposition process, due to the death of micro-organisms in the fire
- ❒ Loss/destruction of natural seedlings previously buried in the peat soil layer, with the result that succession or development in the population and composition of forest vegetation are also disturbed or altered, resulting in a decline in biodiversity
- ❒ Damage to the hydrological cycle, such as a decreased capacity for rainwater to seep into the soil, reduced transpiration from vegetation, declining soil humidity, and an increase in surface run off. Such conditions eventually

lead to sedimentation and changes in water quality in the rivers as well as a decline in fish populations and diversity in the waters. In addition, damage to peatland hydrology will cause floods in the rainy season and sea water intrusion in the dry season to extend further inland.

- ❒ Peat stores carbon reserves **[box 2]**; if it catches fire, it will emit large amounts of carbon dioxide gas which, being a greenhouse gas, will exacerbate global warming.

Land and forest fires in peatland areas will produce CO_2 and CO, leaving hydrocarbons. The CO gas results from incomplete combustion and is a major contributor to the emission of greenhouse gases which cause global warming. In addition to the CO, these fires also emit large amounts of particles detrimental to human health. These combine with the water vapour in the air, forming dense smog which has a widespread impact. According to studies by ADB, the 1997 peat fires produced carbon emissions of 156.3 million tons (75% of total carbon emissions) and 5 million tons of dust particles. However, in 2002 it became known that the total amount of carbon released during the land and forest fires in 1997/1998 was 2.6 Billion tons.

Box 2

Sequestered carbon in peat soil in Sumatera Island

The total area of peatland in the island of Sumatera in 1990 was around 7.20 million ha. By 2002, because of the effects of land utilization during the 12 preceding years, this area had shrunk by around 9.5% or 683,000 ha. Calculations of the carbon content of peat soil throughout Sumatera put the amount at around 22,283 million tons in 1990. By 2002, however, it had declined by 3,470 million tons (15.5%), leaving only 18,813 million tons in total. Calculations of the carbon content of peat soil in each province of Sumatera in 2002 showed that Riau Province had the highest amount of sequestered carbon (14,605 million tons of carbon), followed by South Sumatera (1,470 million tons), Jambi (1.413 million tons), Aceh (458 million tons), West Sumatera (422 million tons), North Sumatera (377 million tons), and the two lowest, Lampung (35 million tons) and Bengkulu (30 million tons).

Source : Wahyunto, S. et al, 2003. PETA LUAS SEBARAN LAHAN GAMBUT DAN KANDUNGAN KARBON DI PULAU SUMATERA (Map: Distribution of peatland and carbon content in Sumatra Island) 1990 - 2002. *Wetlands International – Indonesia Programme & Wildlife Habitat Canada (WHC).*

B. Danger to human health

In 1997, the smoke from the land and forest fires in Indonesia covered eleven provinces mainly in Sumatera and Kalimantan, as well as parts of neighbouring countries such as Singapore, Malaysia and the Philippines. The excessive amounts of smoke produced during these fires gave rise to a number of ailments such as respiratory diseases, asthma, bronchitis, pneumonia, skin complaints and eye irritations. As many as 23,000 cases of respiratory diseases were reported in Central Kalimantan, 35,358 in Jambi, 47,565 in West Sumatra and 22,650 in Padang city. All together, more than 20 million of Indonesia's inhabitants were affected by the smoke from the 1997 forest fires (Suratmo,1999). Moreover, the effects of smoke have to be endured every year **[Box 3]** as fires continue to occur almost every year in the dry season.

Box 3

Impact of smoke on health

According to Mr Uban, campaign coordinator for Wahana Lingkungan Hidup Indonesia (Walhi), talking on Radio Nederland, the town of Palangkaraya in Central Kalimantan was put on a level II State of Alert at the beginning of August 2003, which was shortly raised to level I Alert status on 16 August, due to the smog coming from land and forest fires in peatland areas. The smog blanketing the town restricted visibility to just a few dozen metres in the afternoon. Although it was still possible to carry on with daily activities, the smog seriously impaired the health of the people in the area. Since July 2003, thousands of inhabitants have been reported to be suffering from respiratory infections, eye diseases and coughs.

C. Change in Socio-economic values

A direct impact of fire on the community is the loss of various sources of income, particularly for those people who still depend on the forest for their livelihoods (agriculture, animal husbandry, hunting, fishing). Followings are direct impacts of the fire on several matters:

- ❒ Agriculture Production

When fields and plantations burn, all the vegetation is destroyed, including crops. For example, fires and the extended dry season of 1997/1998 in Indonesia caused 450,000 ha of paddyfields to be without water and as a result the harvest failed. Fire and drought affecting 60,000 ha of coffee, oil palm, rubber, cacao and sugar cane plantations led to a severe drop in the production of estate crops. When the subsistence and commercial activities of communities around the peatland and its forest are disturbed, the people will look for alternatives, which may in turn have secondary consequences, both social and ecological. The impact of fire on the local community is deeply felt and affects their work productivity. Land and forest fires in peatland areas have a strong impact on local earnings, because they destroy the crops which the community have planted **[Box 4]**. This loss reduces the amount of money the community will have to spend on their own primary needs. It also causes food shortages as the food-producing fields and gardens have been destroyed. Land and forest fires in peatland areas have serious social/psychological and ecological implications. The deep impact on the community, their feeling of neglect and despair, is often ignored. They feel that they have lost much and received no help nor even any acknowledgement of their loss. Such feelings constitute a socio-cultural impact which, if ignored, could lead to serious social conflict (Tacconi, 2003).

Box 4

Report by Local Inhabitants near Lake Sentarum National Park

A number of inhabitants near the Lake Sentarum National Park in West Kalimantan reported that their production of wild honey had fallen sharply, and in some areas had totally disappeared, because the honeybees had fled when their peatforest habitat was burnt.

❒ Timber Production

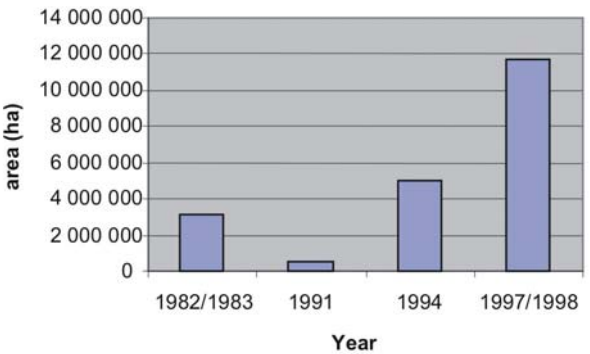
When production forest (HPH/HPHTI) is destroyed by fire, many commercial species are burnt, with the result that timber production will decline. Moreover, timber production will fall not only during

the period of the fire but also for several decades thereafter, and this will endanger the continued existence of the timber industry, such as sawmills, plywood manufacturers, papermills, etc.

❒ Transportation

One of the direct effects of smoke from land and forest fires is a reduction in visibility, thus disrupting transportation, not only in the air but also on land and by water, and leading to a sharp decrease in transportation activity. Traffic accidents occur easily, for example tanker collisions, air crashes and road accidents. During the 1997 fires, 313 flights were cancelled in Sumatera and Kalimantan, resulting in losses of around Rp.100 billion to airlines and airports.

Area of Forest and Land (including peat) burnt
(Source : Bappenas-ADB, 1999 ; FWI)



❒ Tourism

The impact of the smoke haze on the tourist industry is serious, as it disrupts travel and causes problems regarding safety. Neighbouring countries whose air is polluted by the smoke will also experience a decline in tourism and in public health. The 1997/1998 fires reduced tourist numbers to Indonesia to 3.7%. A decline in tourist numbers leads to a fall in hotel occupancy rates and in the numbers of visitors to restaurants and other tourist facilities. (Suratmo, 1999).

❒ Fire-fighting Costs

The cost of extinguishing land and forest fires is extremely expensive, especially when it involves the use of sophisticated up-to-date equipment such as aeroplanes and helicopters, and then on top of that there is the cost of rehabilitation after the fire. The fires in Indonesia in 1997/1998 mobilised not only all the employees of the forest managers but also the wider community, the military and the police.

❒ Relations with Neighbouring Countries

Protests and claims were made by neighbouring countries who felt they had suffered losses as a result of the smoke from land and forest fires in Indonesia. In modern law, transboundary haze pollution can be categorized as an international crime, so it is not impossible that the international world could impose embargos or boycotts against Indonesian forest products if Indonesia is unable to overcome land and forest fires (Saharjo,2000).

In 1982/1983, land and forest fires in Indonesia destroyed an area of 3.6 million Ha. Large scale land and forest fires occurred again in 1994 and 1997/1998 destroying 5.11 million Ha and 10 million Ha respectively.

It was the forest fires of 1997/1998 that opened the world's eyes to the fact that serious mistakes had been made in the management of Indonesia's forests. The smoke from these land and forest fires covered the Southeast Asian region, enveloping several major cities such as Kuala Lumpur and Singapore, disrupting traffic by air, sea and land, and causing serious health problems.

Chapter 3

Factors Supporting Incidence of Land and Forest Fire in Peatland Areas

The biggest tropical forest fire to occur in tropical forest was in 1982/1983 in East Kalimantan; it burnt approximately 3.6 million ha of forest, including 550,000 ha of peatland forest (KLH-UNDP, 1998). Fires occurred not only in East Kalimantan but also in other parts of Kalimantan as well as in Sumatera, especially in peatland areas. These fires have recurred year after year in the dry season like an annual plague which is difficult to cure, particularly in 1982, 1991, 1994, 1997/1998 and 2002. In 1997/1998, Indonesia experienced the world's worst land and forest fires. Over 2,000,000 ha of peatland were burnt, and are estimated to have emitted enough greenhouse gases to make a sizable contribution to global climate change. According to investigations by a number of parties, the areas of peat land and forest burnt in 1997/1998 were in Sumatera, Kalimantan and Papua **[see Table 3]**, although this does not exclude the possibility that fire may have occurred in other regions also but not been observed.

Table 3. Area of Peat Land and Forest Fires in 1997/1998 in Indonesia

LOCATION	AREA (Ha)	
SUMATERA	173,000	624,000
- South Sumatera		
KALIMANTAN		1,100,000
- Central Kalimantan	729,500	
- East Kalimantan	311,098	
PAPUA		400,000

Source: GTZ – Hoffman et al(1999) ; Forest Fire Prevention & Control Project (1999); Bappenas-ADB (1999) ; Page et al (2002) ; Tacconi (2003)

Although peatswamp is categorized as wetland, being inundated every year, nevertheless it becomes dry and susceptible to fire in the dry season. The fire danger level in peat land and forest is influenced by a number of factors, which include the following.

3.1 CLIMATE CONDITIONS

Climate conditions, especially during periods of low rainfall, are one of the factors which increase the likelihood of fire. The risk of fire breaking out in peat land and forest is highest during the dry season, when rainfall is extremely low and the intensity of sunlight extremely high. Such conditions generally occur between June and October, and sometimes from May to November. The risk increases even further when the dry season coincides with the El Ninõ phenomenon. This was one of the factors that exacerbated the devastating fires of 1997/1998, when Australia and southern Africa experienced severe drought, and caused an increase in temperatures in Asia. El Ninõ is a natural phenomenon which is characterised by an excessive rise in sea temperatures in the tropical Pacific, and occurs at intervals of 4 or 5 years.

The risk of fire will start to decrease when rain begins to fall, i.e. during certain months of the wet season when there may be several days without rain. Under these conditions, fuel can still dry out and so fires can still occur.

The risk of fire becomes low when the wet season has stabilised, with rain falling every day. Under these conditions, the peatland and forest become inundated with water and the saturated fuel is difficult to burn.

3.2 PHYSICAL CONDITIONS

The physical condition of degraded forest and land is one of the factors that can trigger fire. The degradation of peat land and forest is caused by illegal logging, and the conversion of peat land and forest for housing, ricefields, plantations and mining. Moreover, the presence of ditches/ channels constructed by the community to remove logs from the forest also degrades the forest even further. Illegal logging has opened up the forest and left an accumulation of waste which becomes a source of fuel. The conversion of peat land and forest for housing, ricefields and plantations has encouraged the use of fire in land clearing **[see box 5]**.

Box 5

PLG

Aleu-ccfpi.doc

The large scale conversion of peatland for transmigrants' housing and rice fields was a policy which the Indonesian government carried out through the 'PLG' one million hectare peatland project in 1995/1996.

This project was eventually discontinued, but it had already led to widespread environmental damage. Page et al (2002) reported that the use of fire for land clearing was the main cause of the fire and smoke pollution in Central Kalimantan in 1997. He reported that that the amount of peatland burnt in 1997 reached 0.73 million ha and was concentrated in the ex-PLG area. The construction of irrigation canals resulted in excessive drying out of peat in the dry season thus creating a fire hazard. The above picture shows one of the canals in block A of the ex-PLG which became neglected, experienced a drop in groundwater level and was burnt during the fires of 1997.

The construction of canals and ditches has caused the peat to dry out excessively during the dry season and become damaged. Irreversible drying has taken place and the peat has changed in character becoming like charcoal, as a result of which it is no longer capable of absorbing nutrients nor of retaining water.

*Canal in PLG (*Alue dohong – ccfpi.doc*)*

*Ditch on Simpang Kiri village (Sumatera) (*YRN – ccfpi.doc*)*

3.3 ECONOMIC, SOCIAL AND CULTURAL CONDITIONS

Peatland is generally swamp land which is poor in nutrients and inundated with water every year, as a result of which it is not suitable for agriculture. Thus, these conditions force the inhabitants to survive through hunting, fishing and illegal logging. At the time of writing, illegal logging had decreased slightly as, all the commercial species of tree in this area having been exhausted, the loggers now have to go deep into the forest where access is more difficult. The community have also become increasingly aware of the detrimental impact of illegal logging; this is partly a result of the awareness campaigns and advice from NGOs and government, and also because they are now experiencing the impact directly themselves.

Inhabitants of the peat ecosystem buffer zone (Alue dohong – ccfpi.doc)

The results of a survey conducted by Wetland International – Indonesia Programme in the Perian forest area of PT. ITCI, East Kalimantan in 2000 show that the peatswamp forest provides substantial direct economic benefits, to a total value of Rp.8,128,141,017/year **[see Table 4]**. The greatest of these is fish (70.2%), which are used both for commercial gain and for subsistence. The second biggest is timber (27.707%).

Table 4. Economic Benefits derived from Direct Utilisation of Forest Products from the Perian Forest Area, in 2000

No	Forest Product	Annual Economic Benefit (Rp)	%
1	Fish	5,705,703,120	70.197
2	Timber	2,251,603,018	27.701
3	Wildlife	87,835,851	1.081
4	Rattan	62,423,719	0.768
5	Medicinal plants	14,896,829	0.183
6	Bamboo	4,370,669	0.054
7	Birds	1,162,919	0.014
8	Damar resin	144,893	0.002
Total		8,128,141,017	100

Source : Survey WI-IP (2000);

Information obtained from local inhabitants indicates that there has been a reduction in the economic benefits derived from the forest, not only from fish production but also timber and all the other types of forest product. Fire and the irresponsible exploitation of forest resources have caused damage to habitats and resulted in the death of several species of animals and plants. The impact of this has been a fall in the production levels of forest resources. As these are the local people's primary source of income, the community's economic situation has deteriorated as a result

The culture of dependence on natural resources has encouraged uncontrolled, irresponsible exploitation. The local community is sometimes used by certain parties to exploit natural resources recklessly (illegal logging, trading in protected species, the use of electricity or poison to catch fish, etc.). It is this that threatens to wreck forest conservation.

That forestry and plantation entrepreneurs are still relatively unaware of the need to allocate funds for the prevention of forest fire is evident from the way that land is prepared. Even though the company director advocates that land be cleared without the use of fire, in practice inadequate funding coupled with a lack of supervision encourage the contractor to use fire because it is cheap. The fire then gets out of control and spreads.

The tendency to pass the buck and to cover up fires when they occur means that steps to put them out are delayed, while the fire continues to spread and becomes increasingly difficult to extinguish. As a result, a new firefighting budget is proposed, which in practice is in danger of being corrupted by 'KKN' ('Corruption, Collusion and Nepotism'). These issues were raised during *"A one-day National Workshop on Fires in Indonesia : Impacts, Key Issues & Policy Responses, Jakarta 16 December 2003"* held by CIFOR, where it was also reported that, even though much effort has been expended in the attempt to overcome the problem of fire, including the use of foreign aid, fire still continues to break out, especially during the dry season. What is needed right now, said Dicky Simorangkir, one of the speakers at the Workshop, is a commitment on the part of everybody to make a real effort to prevent fire. A similar sentiment was also expressed by FWI Director Togu Manurung, who stated that fire would be difficult to prevent in Indonesia so long as Corruption, Collusion and Nepotism continue to rampage.

Chapter 4

Forest Fire Control Policy in Indonesia

4.1 POLICY

Regulations and laws related to the Prevention and Suppression of Land and Forest and Fires are specified in Law No. 5 of 1990, Law No 5 of 1994, Law No. 23 of 1997, Law No 41 of 1999, and Regulation No. 4 of 2001. Steps to be taken in the suppression of forest and land fires comprise:

a. Educate the general public about measures for the prevention and suppression of fires, through coordinated information activities, for example using the printed, electronic and other media.

b. Ban the use of burning, and educate the public in ways of preparing land without the use of fire (zero burning).

c. Improve the skills and capabilities of the work force, including the employees of both the state and private sectors.

d. Provide fire-fighting equipment in accordance with specified standards.

e. Carry out technical cooperation with donor countries.

f. Improve the welfare of communities living in the vicinity of the forest.

g. Impose strict penalties on every offender who violates the current laws and regulations.

h. Improve efforts to enforce the law.

Box 6

Responsibility for Land and Forest Fire Control

Land and forest fires produce smoke which is harmful to living creatures and are the joint responsibility of us all. According to Law no 41 of 1999 and Government Regulation no 4 of 2001, it is the duty and responsibility of each and every citizen, business, provincial government, local government and central government to deal with the problem of land and forest fires throughout Indonesia.

- *Every individual is under the obligation to prevent land and forest fire*
- *The government is responsible for forest fire control in National forests*
- *Business enterprises (individually owned businesses, private/state/regional companies, cooperatives, foundations) are responsible for fire control at the site of their business operation*
- *Fire control in forest concession areas is to be carried out by the concession holder*

Box 7

Penalties for Causing Forest Fire

Strict legal penalties for persons causing fire are stipulated in Law no. 41 of 1999, article 78 clauses 3, 4 and 11, as follows :

- Intentionally setting fire to forest *: Prison sentence maximum 15 years and a maximum fine of 5 billion rupiah*
- Negligence leading to forest fire *: Prison sentence maximum 5 years and a maximum fine of 1.5 billion rupiah*
- Dumping of materials which can cause forest fire *: Prison sentence maximum 3 years and a maximum fine of 1billion rupiah*

Details of the policy on the Prevention and Suppression of Land and Forest Fires (referred to as 'PPKHL') are shown in Table 5.

Table 5. Policy on Land and Forest Fire in Indonesia*

No	Type of Regulation	Number	Content
1	*Law*	Law No.5, 1967	Main stipulations concerning forestry
2		Law No.5, 1990	Conservation of biological resources and their ecosystems
3		Law No.5, 1994	Ratification of the UN convention on biodiversity
4		Law No.6, 1994	Ratification of the UN convention on climate change
5		Law No.23, 1997	Environmental Management
6		Law No.41, 1999	Principles of Forestry (replacing Law No.5, 1967)
7	*Government Regulation*	Gov. Reg. No.28, 1985	Forest Protection
8		Gov. Reg. No.4, 2001	Control of environmental damage and/or pollution in relation to land and/or forest fires
9	*Decree of the Minister for Forestry*	No. 195/Kpts-II/1986	Instructions on Measures for Preventing and Extinguishing Forest Fires
10		No. 523/Kpts-II/1993	Guidelines on Protection in Commercial Forest Areas
11		No 188/Kpts-II/1995	Formation of the National Forest Fire Control Centre (PUS-DALKARHUTNAS)
12		No. 260/Kpts-II/1995	Instructions on Measures for Preventing and Extinguishing Fires
13		No. 365/Kpts-II/1997	National Mascot for forest fire control
14		No. 97/Kpts-II/1998	Procedures for Handling Forest Fire
15	*Decree of the Minister for the Environment*	No. KEP-18/MENLH/3/1995	Formation of the National Coordinating Agency for Land Fires
16		No. KEP-40/MENLH/09/97	Formation of the National Coordinating Team for Land and Forest Fire Control
17	*Decree of the Minister for Home Affairs*	No.364.152.233-255	Validation of Central Java Provincial Regulation Number 6, 1991 concerning Measures to Prevent and Extinguish Forest Fires in Central Java Province
18	*Decree of the Director General for Forest Protection and Nature Conservation (PHPA)*	No.243/Kpts/DJ-VI/1994	Technical Instructions for the Prevention and Suppression of Forest Fire in Commercial Forest Areas and other Utilisation Areas
19		No. 244/Kpts/DJ-VI/1994	Technical Instructions for Extinguishing Forest Fires
20		No. 245/Kpts/DJ-VI/1994	Standing Procedure for the Use of Forest Fire Fighting Equipment
21		No. 246/Kpts/DJ-VI/1994	Instructions for Making and Erecting Fire Signs
22		No. 247/Kpts-DJ-VI/1994	Instructions for the Standardisation of Facilities for the Prevention and Suppression of Forest Fires
23		No. 248/Kpts/DJ-VI/1994	Standing Procedure for the Prevention and Suppression of Forest Fire

No	Type of Regulation	Number	Content
24	*Decree of the Director General for Forest Protection and Nature Conservation (PHPA)*	No. 81/Kpts/DJ-VI/1995	Instructions for the Control of Land and Forest Fires
25		No. 46/Kpts/DJ-VI/1997	Technical Instructions for Personal Caution and Work Safety in Fighting Forest Fires
26		No. 47 /Kpts/DJ-VI/1997	Technical Instructions for Controlled Burning
27		No. 48/Kpts/DJ-VI/1997	Technical Instructions for the Commando System for Controlling Forest Fires
28		No. 152/Kpts/DJ-VI/1997	Repeal of SK Dirjen PHPA No 47/Kpts/DJ-VI/1997 concerning Technical Instructions for Controlled Burning
29	*Decree of the Director General for Forest Enterprises*	No.222/Kpts/IV-BPH/1997	Technical Instructions for the Preparation of Land for Industrial Forest Crops, without the use of Fire
30	*Decree of the Director General for Estate Crops*	No.38/KB.110/SK/Dj.Bun/05.95	Technical Instructions for the Preparation of Land for Estate Crops, without the use of fire
31	*Regional Regulations*	Perda Prop. DATI I South Sulawesi No.2, 1982	Prevention and Suppression of Forest Fires, Grazing of Animals in National Forest, and the Harvesting of Forest Products
32		Perda Prop. DATI I South Kalimantan No.10, 1984	Prevention and Suppression of Forest Fires, Grazing of Animals in National Forest, and the Harvesting of Forest Products
33		Perda Prop. DATI I South Sumatera No.2, 1987	Measures for Preventing and Extinguishing Forest Fires in South Sumatera Province
34		Perda Prop. DATI I North Sumatera No.16, 1987	Prevention and Suppression of Forest Fires, Grazing of Animals in National Forest, and the Harvesting of Forest Products
35		Perda Prop. DATI I Jambi No.6, 1988	Measures for Preventing and Extinguishing Forest Fires
36		Perda Prop. DATI I East Nusa Tenggara No.26, 1988	Measures for Preventing and Extinguishing Forest Fires
37		Perda Prop. DATI I Bengkulu No.4, 1990	Measures for Preventing and Extinguishing Forest Fires in Bengkulu Province
38		Perda Prop. DATI I Southeast Sulawesi No.5, 1990	Measures for Preventing and Extinguishing Forest Fires
39		Perda Prop. DATI I Central Java No.6, 1991	Measures for Preventing and Extinguishing Forest Fires in Central Java Province
40		Perda Prop. DATI I East Kalimantan No.7, 1992	Preventing and Extinguishing Forest Fires
41		Perda Prop. DATI I East Java No.5, 1992	Forest Protection in East Java Province
42		Perda Prop. DATI I West Nusa Tenggara No.14, 1993	Forest Fire Control
43		Perda Prop. DATI I West Nusa Tenggara No.17, 1993	Grazing of Farm Animals in the Forest, Gathering of Grass and Food
44		Perda Prop. DATI I Lampung No.6, 1998	Measures for Preventing and Extinguishing Forest Fires in Lampung Province

No	Type of Regulation	Number	Content
45	*Decree of the Governor (Head of Province)I*	Decree of the Governor of Central Java No.364/1/1987	Measures for Preventing and Extinguishing Forest Fires in Central Java Province
46		Decree of the Governor of Jambi No.36, 1993	Formation of the Forest Fire Control Centre (PUSDAL) in the Province of Jambi
47		Decree of the Governor of Maluku No. 364.05.521, 1995	Land and Forest Fire Control Centre
48		Decree of the Governor of East Nusa Tenggara No. 37 1995	Formation of a Forest Fire Control Team, an Implementation Unit, and a Provincial Forest Fire Brigade in East Nusa Tenggara
49		Decree of the Governor of West Sumatera No. SK 364.430.1995	Formation of a Forest Fire Control Team, an Implementation Unit, and a Provincial Forest Fire Brigade in West Sumatera Province
50		Decree of the Governor of Lampung No.G/457/B.VII/HK/1995	Formation of the Land and Forest Fire Control Centre in Lampung Province
51		Decree of the Governor of the Special Region of Aceh (skr Nangroe Aceh Darussalam) No.522.1/423/1995	Formation of the Provincial Forest Fire Control Centre in the Special Region of Aceh
52		Decree of the Governor of South Sumatera No.7, 1995	Control Centre (PUSDAL), Commando Post (POSKOLAK) and Implementation Unit (SATLAK) for the Prevention of Forest Fire in South Sumatera Province
53		Decree of the Governor of Jambi No.182, 1995	Formation of a Coordinating Team for the Integrated Dissemination of Information on Smoke Suppression, at the Land and Forest Fire Control Centre in Jambi Province
54		Decree of the Governor of South Kalimantan No. 035, 1995	Formation of the Land and Forest Fire Control Centre in South Kalimantan Province
55		Decree of the Governor of West Java No.364/SK.1852.Perek/1995	Land and Forest Fire Control Centre (PUSDAL) in West Java Province
56		Decree of the Governor of Central Sulawesi No.SK.188.44/4969/Dephut	Formation of a Land and Forest Fire Control Centre
57		Decree of the Governor of Southeast Sulawesi No. 63, 1996	Formation of the Land and Forest Fire Control Centre in Southeast Sulawesi
58		Decree of the Governor of Bali No. 655, 1996	Formation and Membership Structure of the Land and Forest Fire Control Centre in Bali Province
59		Decree of the Governor of Jambi No.240, 1996	Formation of the Land and Forest Fire Control Centre (PUSDALKARHUTLA) in Jambi Province
60		Decree of the Governor of West Java No. 367/Kep.1163-Binprod/2001	Formation of the Land and Forest Fire Control Centre in West Java Province
61		Decree of the Governor of Riau No.Kpts 25/V/2000	Formation of the Land and Forest Fire Control Centre in Riau Province

* *A brief description of several of these policies is given in Appendix 1*

Although there are many detailed policies concerning land and forest fire control, it can be said that these regulations are still inadequate and sectoral in nature. Most of them have been issued by the Ministry of Forestry, and have relatively little legal force because they are valid only within the working area of the Ministry, whereas fire occurs not only in forests but also on other land. Moreover, in several areas, wildfires tend to result from the use of fire by the agricultural sector, including plantation companies, and recently fires have even started to flare up in mining activities.

Legal action against those responsible for causing fire imposes maximum penalties and fines which do little to discourage the perpetrators, because under this system the perpetrators receive much lighter sentences than they should and may even get off free. **[see box 7]**

The speed at which Indonesia has been moving towards implementing a system of regional autonomy, under Law No. 22 of 1999, can also lead to increased deforestation, as local governments do not generally possess the capability nor the funds necessary to carry out effective government, so their highest priority is to increase the indigenous district income (PAD). In many areas, the exploitation of forest resources has intensified and forests have been transformed into plantations to such an extent that it is feared that this will increase activities which give rise to fire hazard conditions.

Government Regulation No. 4 of 2001 basically prescribes the division of authority and responsibility for taking measures to tackle the problem of land and forest fire. It also prohibits the use of burning, though it does not include any regulations or special provisions concerning the preparation of land without the use of fire ("*Zero burning policy*"). Neither does it give a definition of 'zero burning', nor stipulations or penalties for those who contravene the "zero burning" regulation. **[see discussion topic *zero burning* in Chapter 6]**. On peatland in particular, which is so easily combustible that if fire breaks out it will be extremely difficult to suppress, all use of fire should be banned. Realistically, however, conditions in the field show that there is very little likelihood of the *zero burning* technique being applied, particularly by small-scale traditional farmers. To overcome this obstacle, it is necessary to explore land preparation techniques which are environmentally friendly.

4.2 INSTITUTIONS

Government institutions concerned with the prevention and suppression of land and forest fires (PPKHL) are :

- ❒ The Forestry Sector, i.e.: the Ministry of Forestry
- ❒ The Agricultural Sector, i.e.: the Ministry of Agriculture
- ❒ The Environmental Sector, i.e.: State Ministry for the Environment
- ❒ The Disaster Management Sector, i.e.: Bakornas PBP
- ❒ Other sectors, i.e.: the Ministry of Home Affairs, BMG, LAPAN, BPPT

A. The Forestry Sector

A large proportion of the fires which occur in forest areas are related to forest exploitation, the use of land by the community, and other land conversion activities.

1. Ministry of Forestry

   The problem of land and forest fires in Indonesia has become increasingly important since the fires of 1997/1998. At the National level, the unit of the Ministry of Forestry which handles this problem has undergone several changes in line with the increasing threat and incidence of fire. The Directorate General for Forest Protection and Nature Conservation (PHKA) is the unit of the Ministry of Forestry which has the authority to handle the problem of forest fire. It is responsible directly to the Minister of Forestry and has a special directorate which handles the problem of forest fires, which is the Directorate for Forest Fire Suppression. This Directorate comprises 4 sub-directorates: the Sub Directorate for the

Development of Fire Control Systems, the Sub Directorate for Detection and Evaluation, the Sub Directorate for Prevention and Suppression, and the Sub Directorate for Fire Impact.

At the regional level, the problem of fire is generally tackled by the provincial and district Forestry Agencies.

2. The National Forest Fire Control Centre (PUSDALKARHUTNAS)

PUSDALKARHUTNAS is a non-structural organisation formed by the Ministry of Forestry specifically to handle the problem of fire. Through this organisation, it is hoped that the forest fire problem can be tackled in a comprehensive manner, that official coordination can be more easily facilitated among sections in the Ministry and among related institutions at provincial and district level throughout Indonesia. PUSDALKARHUTNAS is headed by the Director General for Forest Protection and Nature Conservation; members are the Secretary General and all the other director generals in the Ministry of Forestry, the Board of Directors of the State owned Forestry Company, Ministerial Technical Advisor VI and the Indonesian Association of Forest Enterpreneurs (APHI). The main duties and functions of PUSDALKARHUTNAS are :

- ❒ Formulate and give direction on operational policy concerning the prevention and suppression of forest
- ❒ Coordinate efforts to prevent and extinguish forest fires in an integrated manner at national level.
- ❒ Supervise the implementation of programmes within the framework of operational policy determined by the minister
- ❒ Plan the methods and equipment required to bring forest fires under control

Box 8

Industrial Forest and Oil Palm Plantations Catch Fire

Jambi, Kompas – As of Thursday afternoon (12/6/2003), approximately 1,000 hectares of Jelutung industrial forest (HTI) belonging to PT Diera Hutani Lestari (DHL) had been destroyed by fire. The HTI, which is owned jointly by PT DHL and PT Inhutani V, is located in Kecamatan Kumpeh Hilir, Kabupaten Muaro Jambi, in the Province of Jambi.

Despite the efforts of the fully equipped team of firefighters sent by the Land and Forest Fire Control Centre for Jambi (Pusdalkarhutla), the fire rapidly spread and raged out of control. The fire has been burning since last Monday.

In addition, fire is also raging through oil palm plantation belonging to PT Bahari Gembira Ria (BGR) in Sungaigelam, Muaro Jambi. Here also, efforts to control the fire have so far failed. A team of firefighters from Pusdalkarhutla, together with transmigrants and PT BGR's own firefighters are all working hard to bring the fire under control and extinguish it.

Forestry Minister's decree No.97/Kpts-II/1998 assigns responsibility for tackling fire to the Land and Forest Fire Control Centre (PUSDALKARHUTLA) at provincial level, to the Commando Post for Land and Forest Fire Control (POSKOLAKDALKARHUTLA) at District (Kabupaten) level, and to the Land and Forest Fire Control Implementation Unit (SATLAKDALKARHUTLA) at local (Kecamatan) level.

The General Chairman of the PUSDALKARHUTLA Fire Control Centre is the Governor, with the Head of the Provincial Forestry Office as his deputy, while the Head of the District (Kabupaten) Forestry Office is responsible for the day-to-day running of the centre, assisted by representatives from related institutions as his deputies.

The main task and function of the PUSDALKARHUTLA fire control centre is to coordinate with the Coordinating Unit (Satkorlak) for the Handling of Disasters and Refugees (PBP) and determine

policies and steps to be taken during operations to suppress land and forest fires. Meanwhile, the main task and function of the POSKOLAKDALKARHUTLA commando post is to draw up a plan of operations, conduct horizontal and vertical coordination, handle the field operations command, and report on the implementation of operations. Finally, the SATLAKDALKARHUTLA Implementation Unit has the job of carrying out fire control operations, making operation reports, and mobilising assistance from the community.

B. The Agricultural Sector

At the National level, the unit of the Ministry of Agriculture which is responsible for dealing with the problem of land fires is the Directorate for Plantation Protection. It is responsible directly to the Director General for Estate Crop Production (Bina Produksi Perkebunan). However, this directorate does not yet have a special division responsible for the handling of fire on plantations or on other agricultural land.

C. The Environmental Sector

Land and forest fires result in the degradation of the quality of the environment. In Indonesia, environmental management is the responsibility of the Minister of State for the Environment. In order to improve the effectiveness of environmental control and surveillance, the Environmental Impact Control Agency (BAPEDAL) was set up, under the coordination of the Ministry of State for the Environment but responsible directly to the President. Bapedal does not have a special unit to handle the problem of land and forest fire. In 1995, therefore, a non structural institution was formed, the National Coordinating Team for Land Fires (TKNKL), which would focus on the management of land fires. TKNKL was chaired by the Director General for Forest Protection and Nature Conservation. Subsequently, the raging fires of 1997 prompted ministerial decree No.40/ MenLH/1997 establishing the National Coordinating Team for Land and Forest Fire Control (TKNPKHL) which has a wider scope and stronger

authority. TKNPKHL comes under the leadership of the Minister of State for the Environment and its executive chairman is the Director General for Forest Protection and Nature Conservation.

D. The Disaster Management Sector

The National Coordinating Agency for Disasters and Refugees (Bakornas PBP) is a non structural coordinating body and functions only if multi-sectoral action is required during a disaster, for example land and forest fire. It is chaired by the Vice President of Indonesia and has as its members 9 Ministers, Leaders of the Armed Forces and Police, and the Governor(s) of the province(s) hit by the disaster.

E. Other Sectors

The Meteorology and Geophysics Agency (BMG), the National Space and Aeronautics Agency (LAPAN), the Agency for the Study and Application of Technology (BPPT), the Ministry of Transmigration, The National Search and Rescue Agency (SAR), the Police, and the Armed Forces are all concerned institutions which share in the responsibility for land and forest fire control management. The data and information produced by LAPAN on environmental conditions and hotspots are of utmost importance to preventive measures, particularly in providing early warning of land and forest fires. As well as assisting in fire prevention, these institutions are also involved in fire suppression and post conflagration activities.

Table 6. Important Institutions Involved in Land and Forest Fire Management at the International/Regional, National, Provincial and District (Kabupaten) / Municipal Levels

Level	Institution *						
International / Regional	ASEAN Secretariat in Jakarta						
	Forestry and Agriculture			Environment		Disaster	Notes
National	Ministry of Forestry	**Pusdalkarhutnas** National Forest Fire Control Centre	Ministry of Agriculture	**Bapedal** Environmental Impact Control Agency	**TKNPKHL** National Coordinating Team for Land and Forest Fire Control	Bakornas PBP National Coordinating Agency for Disasters and Refugees	Other related institutions: BMG, LAPAN, BPPT, Transmigration, SAR, Police, Armed Forces
Provincial	**Dinas Kehutanan** Provincial Forestry Office **UPT Kehutanan** Forestry Technical Implementation Unit	**Pusdalkarhutla** Land and Forest Fire Control Centre	*Dinas Pertanian* Provincial Agricultural Office *UPT Pertanian* Agricultural Technical Implementation Unit	*Bapedal* Environmental Impact Control Agency Regional and Provincial Office		*Satkorlak PBP*	
Kabupaten/ Municipal/ District	**Dinas Kehutanan** District Forestry Office	Poskolakdalkarhutla Commando Post for Land and Forest Fire Control	*Dinas Pertanian* District Agricultural Office			**Satlak PBP** Implementation Unit for Disasters and Refugees	
Kecamatan/ Sub-district		**Satlakdalkarhutla** Land and Forest Fire Control Implementation Unit				**Satgas PBP** Task Unit for Disasters and Refugees	

Source : (Simorangkir, D & Sumantri (2002) and others)

** Details of institutions, plus their addresses, are listed in Appendix 2*

Chapter 5

Strategy for the Control of Fire in Peatland and Peat Forest

Forest fire control (Saharjo et al., 1999) is all the activities for protecting the forest from wildfire, and using fire to achieve the purposes defined in forest management.

Forest fire control comprises three activity components:

1. To prevent forest fire from occurring
2. To extinguish forest fires rapidly while they are still small
3. To use fire only for certain purposes and on a limited scale.

Furthermore, Saharjo et al. (1999) state that for forest fire control to be successful a comprehensive control plan needs to be drawn up in advance. This plan will form a basis for carrying out prevention, suppression and use of fire in a controlled manner in the forests and surrounding areas. The forest fire control plan is an integral part of the forest management plan.

The facts from several fire incidents in Indonesia show that fire management in Indonesia is focused more on suppression than on prevention. This can be deduced from the following: (a) Most government institutions will only take action when fire has already occurred, thus resulting in projects which require larger funding than programmes aimed at prevention. (b) In activities and short-term programmes more emphasis is given to fire suppression, and (c) There is a low level of commitment or willingness to allocate funds, staff, technology, equipment, etc, to efforts aimed at preventing land and forest fires.

5.1 PREVENTION

Community based fire management will be better directed at prevention activities than at fire suppression. Prevention covers all work and activities which are aimed at stopping fires from breaking out.

Forest fire prevention is a component of forest fire control which covers all the ways of reducing or minimizing the number of wildfire incidents. It is not intended to eradicate all cases of wildfire. To completely eradicate all incidents of forest fire is extremely difficult and would be impossible to achieve. There are many fire incidents whose source is unknown or which derive from sources beyond the control capabilities of a forest fire control organisation.

Forest fire prevention can be viewed as an activity which is inseparable from fire control, but whose success should be evaluated in the context of the success or failure of fire control as a whole. Prevention and suppression are complementary activities not substitutes. Neither is complete nor perfect, and they must be bridged by presuppression and fuel management activities.

Forest fire prevention is the most important early activity in fire control and is work which must be carried out continuously. Fire prevention is the most economical way of reducing the damage and loss arising from fire, without having to use expensive equipment.

Combustion occurs because there is a source of heat (fire) for ignition, a supply of fuel and oxygen all occurring together at the same time, as shown in this fire triangle diagram:

Fire Triangle

A simple concept for preventing combustion from taking place is to remove one of the three components of the fire triangle. What can be done is to remove or at least reduce the sources of heat (fire) and remove or reduce the accumulation of fuel. Land and forest fire prevention consists of efforts to prevent or reduce fire from outside entering into the forest area or land, to prevent fire from occurring inside forest and land, and to restrict any fires which do occur from spreading further. There are several strategies which can be used as a guide in efforts to prevent fire. These include the following:

A. Fire Information System Approach

One component in the success of fire prevention measures is a system for providing information about the possibility of fire breaking out, in which the information is distributed well to all the relevant stakeholders, including those in the field. Conventionally, this information system is implemented through direct observation in the field (at locations prone to fire), the use of maps and compasses, and the use of drums in villages to warn the community that there is danger of fire breaking out. Today, with the help of modern technology (computers, telecommunication equipment, the internet, remote sensing) it is possible to develop a fire information system based on factors which affect the incidence of fire, such as fuel conditions, climate conditions and fire behaviour. A fire information system of this type has been developed in East Kalimantan under the Integrated Forest Fire Management (IFFM) project and in South Sumatera through the South Sumatra Forest Fire Management Project (SSFFMP).

1. Types of Fire Information System

Several systems have been developed to give warning of the possibility of fire. These include the following:

a) Early Warning System

The early warning system is developed using daily weather data as a basis for calculating the drought index. The drought index indicates the moisture deficiency level of the soil and land.

Daily weather data can be obtained from the BMG (Meteorology and Geophysics Agency). If the area coverage is inadequate, it will be necessary to install a number of weather stations to take periodic (daily) measurements of rainfall, temperature, air humidity and wind speed, **[Box 9]** so that these data become available for the particular area being managed (for example, peatland area).

Box 9

*To monitor weather conditions (rainfall, temperature) at the site of the project, WI-IP and Wildlife Habitat Canada have, as part of the CCFPI (*Climate Change, Forests and Peatlands in Indonesia*) project, installed rainfall and air temperature measuring instruments at Muara Puning village in Central Kalimantan.*

The instruments have been placed in the yard of the local primary school so that they can also be used as teaching aids. Readings for the two parameters are taken by the local Community Organization.

One drought index that can be used is obtained by calculating the KBDI (Keech-Byram Drought Index). This method is simple, as it applies only three variables to calculate the fire danger level. These are:

a. Average annual rainfall at the local weather station
b. Maximum temperature
c. Daily rainfall

In Indonesia (East Kalimantan), the KBDI has been applied by the IFFM-GTZ (Integrated Forest Fire Management) project, as follows:

$$KBDI = (2000-KBDI^*)x(0.9676xEXP(0.0875xT_{max} +1.552)- 8.229)x 0.001/(1+10.88*EXP(- 0.00175x Ann_{Rain}))+ 0.5$$

where : KBDI = Keech-Byram Drought Index for the day concerned Calculation of the daily KBDI begins from the moment that KBDI is zero, rainfall for the previous week is consecutively 6-8 inches (150-200 mm) or total rainfall for the week is = 239 mm

KBDI* = Keech-Byram Drought Index for the previous day

Tmax = Maximum temperature (°C)

Ann_{Rain} = Average annual rainfall (mm)

Table 7. Drought Level Interpretation

No	KBDI Value	Drought Level
1	0 - 1000	Low
2	1001 - 1500	Moderate
3	1501 - 2000	High

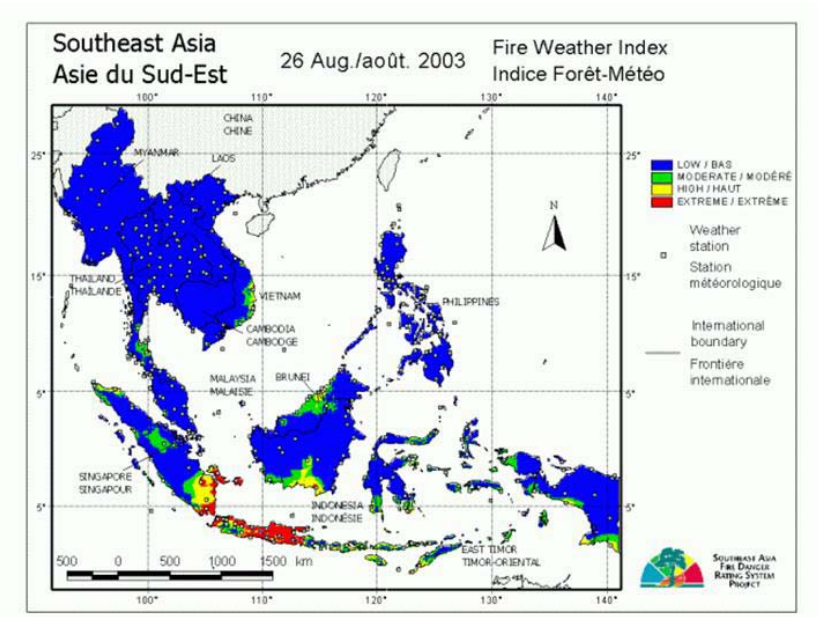
b) Fire Danger Rating System

Based on environmental factors which influence fuel (vegetation) ignitability, also control difficulty and climatological factors, the Fire Danger Rating System (FDRS) has been developed in Indonesia. This system was developed jointly by the Canadian Forest Service-CFS and BPPT, with the support of a number of relevant government institutions like the Ministry of Forestry, the office of the Minister of State for the Environment, BMG, LAPAN and several universities (IPB, UNRI, UNTAN) who received funding in the form of grants from CIDA (Canadian International Development Agency). Their output took the form of maps showing fire-prone areas, levels of fire control difficulty, and drought conditions throughout Indonesia. This information can be accessed on the internet at www.fdrs.or.id or www.haze-online.or.id. The Fire Danger Rating System is used to monitor fire probability, at both the central and regional (Province and Kabupaten) levels, primarily for the purposes of prevention and suppression of fire.

The Fire Danger Rating System is an early warning system concerning the probability of fire occurring or not. This system was developed on the basis of indicators that influence the incidence of fire, i.e. fuel moisture and drought level. As a result, we can use it to determine the fire danger level, fuel moisture and drought level in a particular area.

❒ Interpretation of Fire Danger (FD)

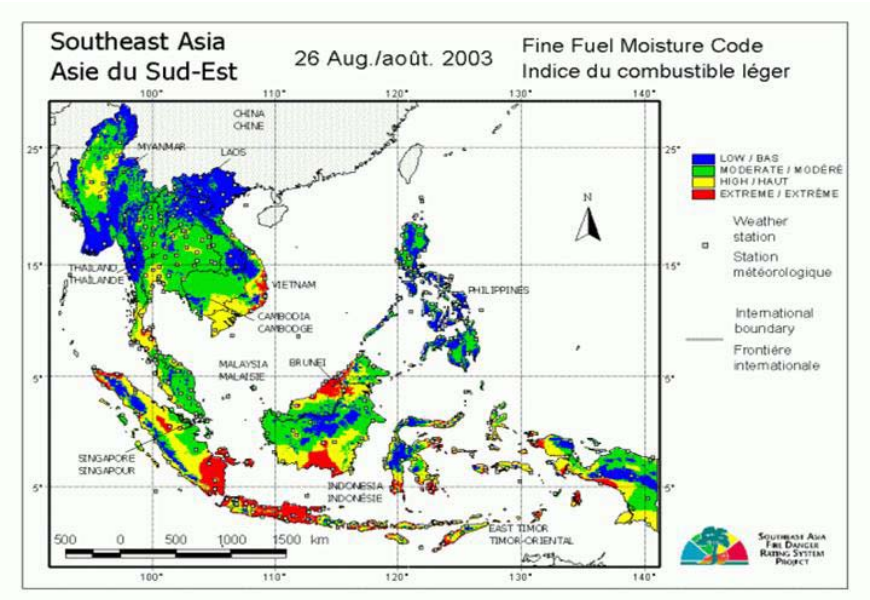
Fire Danger is a general indication drawn from all the factors which affect fire ignition, the spread of fire, the physical impact of burning, and the degree of fire control difficulty. Fire Danger Classes have been developed from Fire Weather Index values.



FIRE DANGER		
CLASS	FIRE CHARACTERISTICS	FIRE SUPPRESSION DIFFICULTY
LOW	Surface fire spreads	No problem in controlling the fire, except in cases of ground fire
MODERATE	Surface fire may spread rapidly or with moderate intensity	Fire can be controlled using simple equipment and water
HIGH	Fire spreads rapidly or is of moderate to high intensity	Fire control is with high pressure water pumps and/or construction of fire-breaks using mechanical equipment
EXTREME	Fire spreads rapidly or burns with high intensity	Fire is difficult to control. Indirect suppression from control lines can be used

❒ Interpretation of Fine Fuel Moisture Code (FFMC)

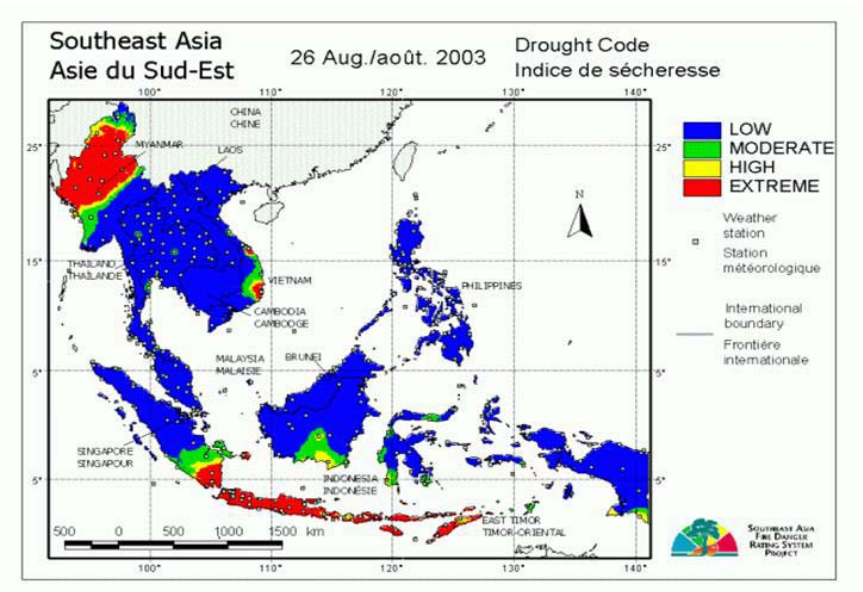
FFMC is a numerical rating of the moisture content of organic debris and other fine fuel materials. This code indicates the relative ease with which fire will start and fuel will burn. It is closely linked to fire incidents caused by human activity.



FINE FUEL MOISTURE CODE		
CLASS	FIRE CHARACTERISTICS	FIRE SUPPRESSION DIFFICULTY
LOW	Low probability of fire starts	No problem in controlling fire
MODERATE	Fire spreads on the surface	Fire can be controlled by direct attack using hand tools and water
HIGH	Fire spreads rapidly or is of moderate to high intensity	Fire control is with water pumps and/or construction of fire-breaks (using mechanical equipment, such as road construction equipment)
EXTREME	Fire spreads rapidly or burns with high intensity, depending on the fuel accumulation index	Fire is extremely difficult to control. Indirect suppression from control lines can be used

❒ Interpretation of Drought Code (DC)

DC is a numeric rating of the moisture content of the solid organic soil layer. This code is an important indicator of the impact of seasonal drought on forest fuel, and the quantity of live embers in the thick organic layer and large chunks of wood.



DROUGHT CODE		
CLASS	FIRE CHARACTERISTICS	FIRE SUPPRESSION DIFFICULTY
LOW	Low probability of surface fire on peatland	No problem in controlling fire
MODERATE	Possibility of live embers smouldering in peat	Fire is difficult to suppress or control
HIGH	Fire smoulders continuously	Fire is extremely difficult to control
EXTREME	Fire is deep and long-lasting	Fire can only be extinguished by heavy rainfall or by burning itself out (self-suppression)

c) Hot Spot Monitoring System

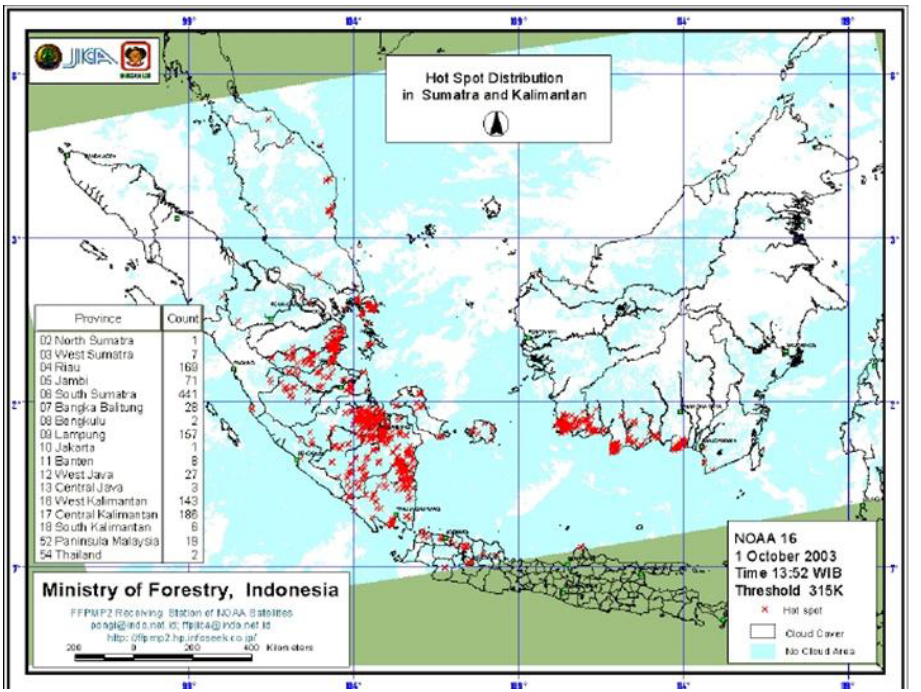
The method used to monitor hot spots is remote sensing by satellite. Hot spot data can be used as an indicator of fire probability, so it is necessary to conduct analysis, surveillance, and sometimes carry out ground truthing in the field to determine whether early fire-suppression action is needed, especially during the dry season when fire spreads extremely rapidly.

A satellite often used is the NOAA (National Oceanic and Atmospheric Administration) satellite, with the AVHRR (Advance Very High Resolution Radiometer) sensor, because this sensor can distinguish between surface temperatures on land and at sea. This satellite was constructed and launched by the National Aeronautics and Space Administration (NASA-USA). The NOAA – AVHRR has an extremely wide coverage and visits the same places 4 times a day, thus making it possible to provide data which is quite recent; its analysis time is also shorter despite the wide area it covers.

Use of the NOAA satellite is free of charge, but the hardware and software required to obtain the images (photos) from the satellite are expensive. Indonesia possesses 7 NOAA satellite receiving stations, including one belonging to the Forestry Ministry - JICA (Sipongi) and one belonging to LAPAN, both in Jakarta.

As a hot spot monitor, the NOAA satellite has a number of weaknesses. Its sensors cannot penetrate cloud, smoke or aerosol, so the number of hot spots detected during heavy burning is likely to be much fewer than it should be. The sensor's sensitivity to the earth's surface temperature, plus its low resolution, give rise to the possibility of error in estimating the number of hot spots; for example, chimneys on oil and gas fields are often identified as hot spots. For this reason, further analysis is needed, often by overlaying the hot spot data with a ground-cover map or a land-use map, using the geographical information system, and also by conducting ground surveying as a further check.

In line with technological developments, NASA has launched the MODIS (Moderate Resolution Imaging Spectro-Radiometer) satellite, which has a resolution of 250 sq. meter or 16 times more detailed than images from the NOAA satellite.



Hot Spot Distribution Map (source : JICA)

2. Fire Information Distribution

A breakdown in the channels for disseminating fire information is a constraint in current efforts to develop a fire information system. Even though fire information output is produced, sometimes its distribution is hindered by geographical conditions, inadequate communications equipment, and lack of coordination among institutions at central, provincial and regional level.

Ideally, hot spot data and output from the fire danger rating system should be distributed via the internet, e-mail and fax to the relevant

government institutions in the provinces and districts (kabupaten), such as the plantations and forestry agencies and Bapedalda (Environmental Impact Control Agency regional office). At the district level, this should immediately be followed up by mapping the information necessary for that district and then disseminating it to the authorised / relevant parties, such as the plantation/forestry companies, at sub-district (kecamatan) or even village level, in order to anticipate the possibility of fire or to extinguish any fire as early as possible.

If from the results of the hot spot monitoring hot spots are detected, and the output from the early warning system (fire danger index) at central or regional level shows indications of fire occurring, the actions/measures which need to be taken are:

- ❒ Broadcast early warnings via the local media (print, radio) so that the target groups of forest-users, politicians, community and other land managers know that there will be an extended drought season with high fire potential.
- ❒ Monitor activities around the land and forest, particularly fire-prone areas, by carrying out a daily patrol
- ❒ Broadcast a ban on burning
- ❒ Prepare, train and retrain all relevant officials and the community in fire-fighting measures
- ❒ Draw up a fire-suppression plan together with the community, NGOs and companies in the vicinity of the forest
- ❒ Ensure that fire-fighting equipment is available, ready and is all functioning properly
- ❒ Check the water sources for the fire-suppression plan
- ❒ Hold meetings and facilitate regular communication among the community, companies, NGOs and fire-fighters
- ❒ Carry out fire-suppression as early as possible whenever a fire source is found, however small it is.

B. Socio-economic Community Approach

1. Definition and Importance of Local Community Participation in the Prevention and Control of Land and Forest Fire

Participation is the mental and emotional involvement of an individual in a group, which pushes him/her to contribute willingly to the achievement of the group's goals and to accept joint responsibility for the actions taken by the group. The meaning of participation encompasses three fundamental concepts which must be present; they are:

a) The participation is truly a mental and emotional involvement, not merely a physical involvement

b) Willingness to contribute to the effort to achieve the group's goals. This means that the person helps in the group's activities voluntarily and derives pleasure from so doing

c) Responsibility is an aspect that emanates from the feeling of being a member of the group, because everybody who is involved in an organisation hopes that through the group the goals will be achieved satisfactorily. (Davis, 1962 *in* Yanuar,1998)

The motivation and stimulus to participate involve the factors of opportunity, desire, capability and guidance. If we look at the relationship between motivation and stimulus with the intensity of participation in the prevention and suppression of land and forest fire, it is evidently a strong relationship as the stronger are the motivation and stimulus to participate, the greater also is the intensity of participation. The implication of this is that if the inhabitants are given greater opportunity, their capabilities improved by giving them the chance to obtain more experience, and motivated to participate, then the intensity of their participation in preventing and controlling land and forest fire will increase. The opportunity to participate should not be given at the time of implementation only but should start from the moment of decision making and continue through planning, implementation, monitoring, evaluation and the dissemination of outcomes.

There is a close relationship between community participation and incentive. Without clear incentives the participation would change into forced action. In other words, asking the local community to participate without any incentive would be the same as turning them into a charm/token. Community participation is no longer a case of whether or not they want to participate, but more of how far their socio-economic situation will benefit from the participation.

The success of land and forest fire prevention and suppression activities is heavily dependent upon successfully stimulating the local community's emotions, feelings and enthusiasm to preserve the forest, and this requires an approach towards land and forest management which comprehends the human angle. Three fundamental assumptions that underlie community participation in the prevention and control of land and forest fire are:

a) The ratio of forest wardens to the area of forest they have to control is extremely low, so that if the local community do not participate actively in safeguarding the forest, its conservation will be threatened.

b) If the local community are aware of the forest's functions and if there are no other coercive factors, the hope that the community will actively participate in safeguarding the forest from fire danger and other types of damage will be realised.

c) The local community are one element in creating sources of fire which can cause conflagration of land and forest.

The community will unite and can be stimulated and mobilised to protect the forest from damage, if :

- ❒ They feel that they themselves are significant in the land and forest management process
- ❒ They receive an incentive

- ❒ Their emotions resonate from the self respect which grows as a result of involving themselves in land and forest management

- ❒ Their enthusiasm is aroused by something which they desire and are aware of as something which is worth fighting for, i.e. to protect the forest and land from damage.

The local people are not an inanimate target, they have feelings, emotions and enthusiasm; for that reason, their entire minds and bodies need to be involved in forest management. Self involvement as subject, respected person, active self respecting participant, will encourage success in safeguarding the forest and land from damage.

2. Measures to Increase Local Community Participation in Land and Forest Fire Prevention

Increasing local community participation in the prevention of land and forest fire is influenced by a number of factors, i.e. : Motivation and Stimulus, Incentive, Opportunity, Capability, Guidance, as illustrated below :

Factors Influencing Community Participation

These factors can be described in more detail, as follows :

a) Providing Opportunity to Work the Land

If the local people have the opportunity to work the land around the forest, they will also protect the land and forest from fire because they will be afraid of the fire spreading and destroying the land which they have worked.

b) Providing Incentives

Rattan Handicrafts

If given incentives, the people will reap benefit from their active participation in fire prevention and suppression, i.e. socio-economic improvement. Incentive can be provided in the form of developing alternative products which they can make (e.g. rattan handicrafts, charcoal briquettes and compost) and environmentally friendly economic activities (e.g. fish farming in "beje" ponds utilising the blocked canals and ditches, which at the same time function as firebreaks).

c) Stimulus and Motivation

Stimulus and motivation will increasingly arouse their emotions and desire to become involved in fire prevention and control. Such stimulus and motivation can be provided through public awareness activities, which are :

- ❒ To increase early awareness
- ❒ Measures to raise public awareness of the functions of peatland and forest
- ❒ Measures to prevent or reduce the occurrence of fire sources created by the people on peatlands
- ❒ Educate the public in controlled fire use management techniques

- ❒ Socialise and enforce current laws and policy
- ❒ Restrict public access to fire-prone areas.

These measures can be carried out using a variety of existing communication facilities, including environmental education in primary school, putting up warning signs, through storybooks, mass media, brochures, posters, stickers, calendars, video, radio, TV and also through direct communication/talks and extension activities.

Involving the public directly in a fire control activity can also make them realise the importance of early fire control in and around their area. This can be done by forming a Fire Brigade at community level, who will tackle land and forest fires in their region as early as possible. This fire brigade is formed from members of the community, with the Village Head taking responsibility, and the relevant NGOs and fire control agencies providing direction and guidance.

d) Improving the Community's Capabilities

The community's capabilities can be improved through training and extension activities, including :

- ❒ Training in the application of alternative techniques to replace or minimise the use of fire, for example : in land preparation and fishing
- ❒ Training in fire control, etc.

e) Guidance

Activities which involve the community will proceed well if there is guidance from relevant parties. Their tasks include raising public awareness, assisting the community in their efforts to prevent and control land and forest fires, monitoring and helping the local people to understand the problem.

C. Land and Forest Management Approach

Determination of appropriate land and forest management techniques (for land preparation, planting, cultivation and harvesting) will control the incidence of fire. Activities during the land preparation stage are the main cause of fire. Using the excuse that it is cheap and improves soil fertility, most of the local inhabitants and forestry/plantation companies use burning techniques to prepare their land. The fire then gets out of control, spreads and results in conflagration.

The development of mixed forest will be more profitable if seen from the viewpoint of protection in general. Mixed planting reduces the accumulation of the organic litter which acts as a source of fuel, thereby reducing the danger of fire.

In order to obtain optimum yield, it is necessary to protect crops from attack by pests or other causes of damage (fire) up until the stage of harvesting. For this purpose, units can be set up whose function is to protect the crops from damage. In addition, fire breaks must also be constructed to prevent fire.

The main problem during harvest is the piles of waste wood and other vegetation that is not utilised. When this waste material dries out it becomes a potential source of fuel which can cause fire, so appropriate harvesting techniques are required which reduce waste or utilise it as effectively as possible, thus minimising the accumulation of fuel.

Below, there follow a number of approaches that can be taken to manage land and forest in terms of fire control.

1. Community Small-holdings

In the process of land preparation, controlled burning techniques are one alternative, considering that it is unlikely that the local inhabitants will be able to apply zero burning techniques.

Nevertheless, this technique must be avoided whenever possible, or used only under the following *conditions :*

- ❒ Permission granted only to local inhabitants who are not members of a corporate body
- ❒ Land area must not exceed 1-2 ha.
- ❒ Conditions are such that zero-burning is impossible
- ❒ Burning takes place on each piece of land in turn
- ❒ Correct controlled burning techniques must be used. For example, the fire floor (in the case of peat) must be covered with a layer of mineral soil which is compacted or separated by sheets of cut up drums in order that fire does not spread into the peat soil.
- ❒ The land management system can be applied in groups, especially on pieces of land which are close together. Through these groups, farmers can share their ideas and protect their land from damage (fire) together.

2. Plantation and Forestry Companies (HPHTI/HPH)

a) Land preparation

In view of the huge areas managed by the plantation companies, burning techniques are strongly discouraged and are prohibited by the government. In a dialogue with the governors, mayors (bupati) and DPRD (Regional Parliament) leaders from the whole of Sumatera, held at Merdeka Selatan Palace in Jakarta in 2002 in anticipation of forest fires, the Vice President directly instructed the Governors and Mayors not to be reluctant to take firm action against forestry or plantation companies who try to save time and money by using fire as a shortcut.

Zero burn land preparation can be done using mechanical or chemical means.

The first stage in preparing land mechanically is to clear it using a bulldozer. Alang-alang and undergrowth are collected and piled in long mounds of maximum 2m width and at a minimum distance apart of 25m between mounds. When the land to be planted is clear of undergrowth and alang-alang it is ploughed and harrowed and made ready for planting.

Chemical land clearing (using herbicides) can be done on areas of grassland that are not too big, in order that the process can be properly controlled. Herbicide is sprayed no earlier than one month before the arrival of the rainy season, in order to avoid the danger of fire. However, the use of chemicals for land clearance still needs to be studied further, in particular how they impact on the environment, on the health of the persons spraying them, and on water quality in and around the area where they are used.

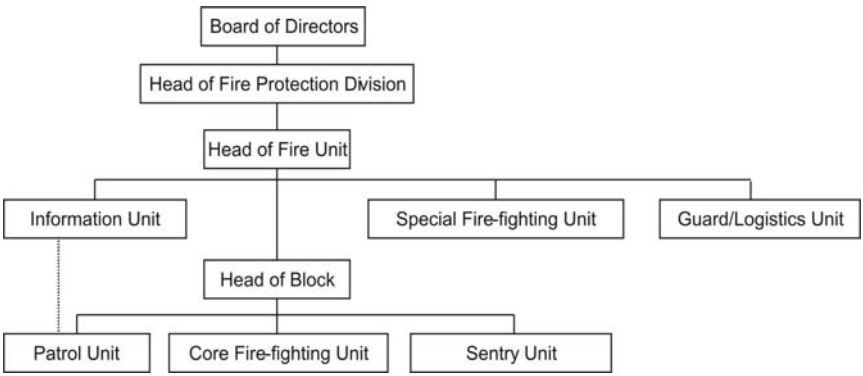
b) Effectiveness of Surveillance and Monitoring

In order for the surveillance and monitoring of forest and plantation activities to be effective, the work area needs to be broken down into smaller management units (unit, block, sub block). The leader of each unit, block and sub block is responsible for the surveillance and monitoring of his/her area as regards the danger of fire.

It is highly necessary to have an intensive network of paths around the plots in order to facilitate surveillance and security, and to enable fire-fighting personnel and equipment to reach every corner. In addition, the paths can also function as firebreaks to prevent surface fire from spreading.

c) Formation of Land and Forest Fire Suppression Units

The formation of land and forest fire suppression units is highly necessary for effective responsibility in practice. The following chart shows an organisational structure which can be developed in a company :



Flow Chart showing Organisational Structure for Fire Control in a Forestry/Plantation Company sentry

The ***Head of the Fire Protection Division*** has overall responsibility for fire danger in the company. The ***Head of Fire Unit*** is responsible and has the task of coordinating the fire suppression in the particular unit which he manages. The ***Information Unit*** plays a role in developing and managing information relating to fire danger. The ***Special Fire-fighting Unit*** backs up the core fire-fighting units of which there is one on each block. The ***Guard/Logistics Unit*** is a support unit which mobilises equipment and logistics. In each Block (headed by the ***Block Leader***) there are a core fire-fighting unit, a patrol unit who have the task of surveillance over the whole block and the sentry units who are posted in places which are especially prone to fire.

d) Harvest

During harvesting, i.e. the time when the forestry companies are felling trees, the felling should be done in a controlled manner. Trees of small diameter (< 30 cm) should be felled first, followed later by trees of large diameter (30 cm and over). After the small diameter timber has been felled and cut into lengths of at least 2 m (as raw material for the pulp and other industries), these should then be collected together in a specified place or at the roadside. Only then should the large diameter timber be felled (e.g. for the sawmill and plywood industries).

5.2 FIRE SUPPRESSION

Fire suppression action should be taken as soon as possible when a land or forest fire occurs. The following strategy can be followed in order that the fire suppression operation is effective (unhindered, rapid, safe and thorough) :

A. Human Resources Support

It is essential that various elements of the community, NGOs, institutions, relevant agencies and so on be involved in fire suppression action, in view of the fact that fire-fighting requires considerable human resources. The existence of a Fire Brigade will be extremely helpful in this. In a case of fire, it is the fire brigade which is at the front line in action to bring the fire under control, which then coordinates with the Land and Forest Fire Control Implementation Unit (Satlakdalkarhutla) and the Task Unit for Disasters and Refugees (Satgas PBP).

Box 10

During the land and forest fires in peatland areas in September 2002 in Central Kalimantan (in: Tumbang Nusa, Bukit Kamiting, Obos and Kalampangan), Wetlands International Indonesia Programme / WI-IP (coordinated in this instance by the CCFPI-WIIP Project Coordinator in Palangka Raya, Central Kalimantan) mobilised the local community to help fight the fire.

In fire suppression action at the scene of the fire, CCFPI-WIIP worked together with several local NGOs (such as: Mitra Insani, Betang Borneo, Mapala Comodo Unpar, Wamakre University Palangka Raya), the village communities of Kalampangan, Pilang and Jabiren, the fire-fighting team from the provincial Satkorlak, the fire-fighting team from the Natural Resources and Conservation Institute (BKSDA) of Central Kalimantan, the Central Kalimantan Public Works Fire Brigade, the Palangka Raya Municipal Fire Brigade, and a team from the Central Kalimantan Provincial Mines Agency. The total number of personnel helping ranged between 15-20 persons per day on average, depending on the current field requirements.

B. Identification and Mapping of Water Sources

Water sources (surface water and ground water) in fire-prone land and forest areas need to be identified and mapped. Identification should be carried out during the dry season, so that at the time when fire occurs there is a chance that the sources identified will still contain water. A report should be made and, better still, the water sources mapped (their coordinates determined) to facilitate the search for water sources during fire-fighting operations. This information must be widely disseminated to all the various parties concerned with fire suppression activity.

In tacking the land and forest fires which occurred in peatland areas in Central Kalimantan in September 2002 described above (see Box 10), WI-IP and its partners in the field came up against a number technical obstacles. To overcome such obstacles in the field in future, the following land and forest fire suppression strategy should be followed:

- ❒ It is necessary to identify sources of water (ground water and surface water) at locations where land and forest fire is likely to occur. Identification should be carried out during the dry season because if water is still found in a certain place during the dry season, this means there is a possibility that it will still be able to supply water should fire occur later in that area. These locations must be noted and the information widely disseminated to all the parties concerned.

- ❒ Trained Fire Alert Teams need to be formed in fire-prone areas. These teams should have members from and/or involve a variety of parties (including NGOs, the general public, schoolchildren, students, nature enthusiast groups, and government institutions) and should be on constant alert to anticipate fire incidents during the dry season.

- ❒ The quantity of fire-fighting equipment needs to be increased and the equipment must be well maintained so that it is always ready to use.

- ❒ An instant fund needs to be established (particularly in the run up to each long dry season) which is ready for use to mobilize fire fighters and medical personnel (doctors, etc).

- ❒ Safe, smoke free locations need to be identified, as places to which people impacted by a fire can be evacuated.

- ❒ Large scale, prominent campaigning of fire prevention measures is needed both during and in the period preceding the dry season. This must reach the general public at large, and can be carried out through schools, radio and public meeting places (mosques, churches, marketplaces, etc).

C. Funding Support

The availability of an instant fund at the appropriate times is essential to fire-fighting operations. This fund can be used to provide food and drink for fire-fighters in the field, to mobilize the community to help in the fire suppression activities, to acquire additional fire-fighting equipment and provide medical facilities for fire victims.

Box 11

The Need for Instant Funds for Fire Suppression

Minister of State for the Environment Nabiel Makarim regretted the hindrance to forest fire fighting operations caused merely because funds from regional government had not yet reached several districts in Riau and West Kalimantan.

"At the moment fire occurred, the funds had not yet arrived. This is truly ironical and I had not expected this to happen. In actual fact, the system is ready," said Makarim during a break in the Opening of Environment Week in Jakarta, Thursday (19/6/2003). (Kompas, 20-06-2003)

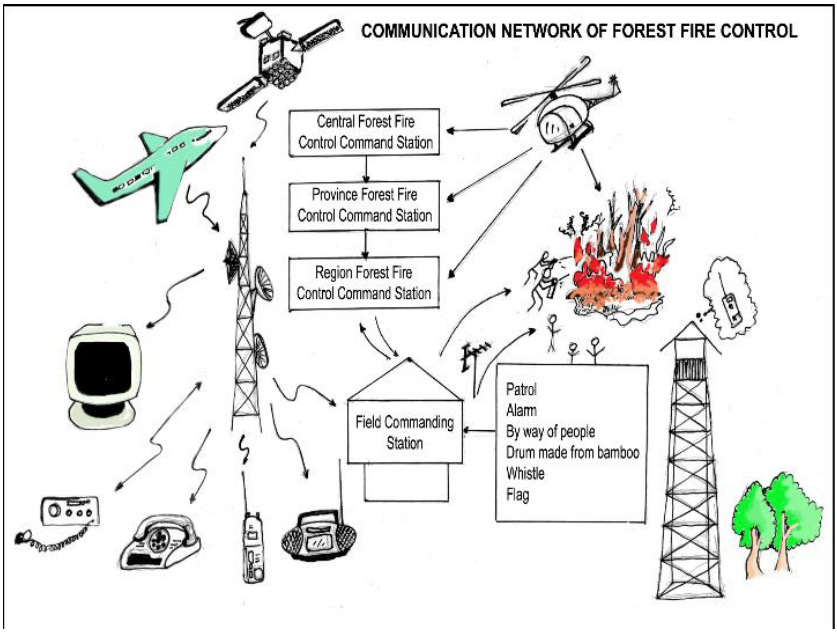
D. Supporting Facilities and Infrastructure

Fire suppression activities must be supported by adequate facilities and infrastructure (see Annex 4), including :

- ❒ Road network
- ❒ Fire towers
- ❒ Communication equipment
- ❒ Telescopes and compasses
- ❒ Transportation vehicles
- ❒ Fire engines
- ❒ Heavy equipment (bulldozers, tractors)
- ❒ Other fire-fighting equipment such as : fire beaters, axes, rakes, shovels, portable pumps
- ❒ Protective gear and equipment for fire-fighters (fireproof suits, boots, helmets, gloves, torches, machetes, drinking flasks)
- ❒ Emergency clinic, facilities for treating fire victims

Box 12

Fire Tower erected by Berbak National Park in Jambi with funding from JICA (2001). It is most regrettable that this tower is no longer manned nor properly maintained.



Communication Mechanisms in fire control (source Forestry Ministry 2001)

Table 8. One Set of Fire-fighting Equipment for Land and Forest Fire in Peatland Areas, for one team (see also Annex 4) of 15 persons*

No	Type of Equipment	Quantity	Notes
1	High pressure fire-fighting pump Robin EH 17	2 units	2 suction hoses 4 m Ø 2 Inch
2	Hose Ø 1.5 Inch	10 rolls	Length 20 m/roll
3	Hose Ø 1 Inch	4 rolls	Length 50 m/roll
4	Fog jets for surface fire	2 units	
5	Fog jets for deep fire	2 units	
6	Kopling pembagi/distribution transmission ?	2	
7	Water container 1000 litre	1	
8	Rakes (*Cangkul garu*)	2	
9	Mattocks (*cangkul*)	2	
10	Axes	2	
11	Machetes (*parang*)	4	
12	Handsaw	1	
13	Portable pumps Jufa 15 litre	3 units	
14	Handy transceivers (HT)	3 units	
15	Buckets	2	
16	Planks	2 lengths	Length 2 m

**Source : Balai Penelitian dan Pengembangan Hutan Tanaman Indonesia Bagian Timur*

Illustrations, functions and method of employment of several fire-fighting tools are given below :

MACHETE AND SICKLE

Function : Used to clear away fuel (such as thick scrub, cutting away twigs and small branches) to limit the spread of fire.

Method : With the feet placed fairly wide apart, grasp the implement firmly then swing it low and sideways

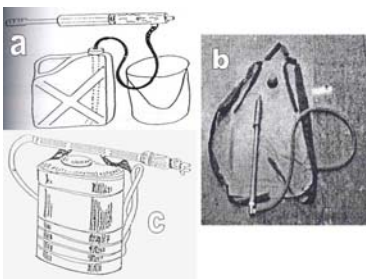
AXE

Function : Used to cut back or fell small to medium size trees

Method : A distance of ± 3m should be kept between persons using axes.

With the feet placed fairly wide apart, grasp the axe firmly then swing it downwards at a cutting angle of 45^{o}

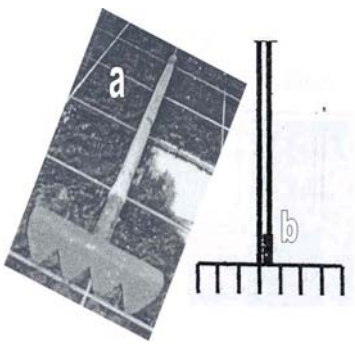
SQUIRTER (a. water tank ; b. fog jet/*jufa* ; c. portable pump)



Function : Used to squirt water early on surface fires up to a height of 2m, and effective if combined with a *beater*

Method : This implement has 3 main components: nozzle, hose and water tank. Pull the squirter lever then point the nozzle at the fire.

RAKE (a. fire rake ; b. long pronged rake)

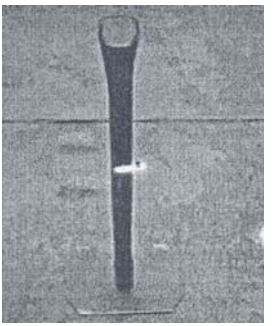


Function : The fire rake is used to clear organic litter in the construction of fire breaks.

The long pronged rake is used to clear away the cut fuel – alang-alang, ferns – when constructing fire breaks.

Method : Grasp the rake firmly, with body slightly hunched, hands at a comfortable distance apart and feet placed fairly wide apart, then pull.

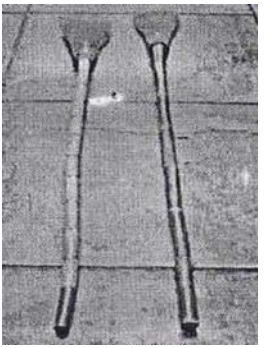
MATTOCK



Function : Used to clear the surface of the soil and to break up internal fire and wildfire in peatland

Method : Hold the mattock firmly, with hands at a comfortable distance apart and feet placed fairly wide apart, then swing downwards from a high position

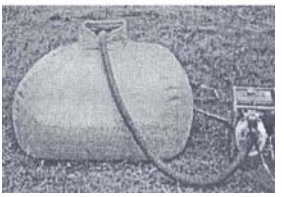
BEATERS



Function : Used to suppress surface fire burning organic litter and alang-alang up to a height of 0.5 m. It is more effective if combined with a fog jet or *jufa* so that it can extinguish fires up to a height of 2m.

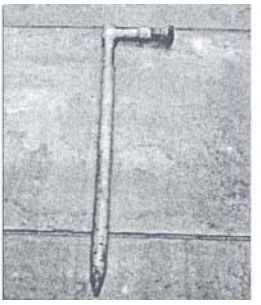
Method : Hold the implement firmly, with hands at a comfortable distance apart, feet placed fairly wide apart and back slightly bent, then bring it downwards with a strong sweeping (hitting) movement.

PORTABLE WATER TANK



Function : Used to transfer water. Can be placed in a 'pick up' vehicle as a water supply facility.

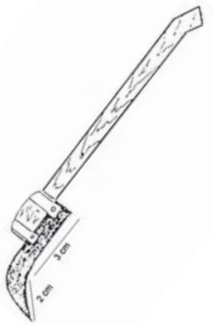
NEEDLE STICK / INJECTION



Function : Used to make fire suppression holes in peatland

Method: Hold the stick firmly, jab it into the ground then squirt water into holes which have smoke

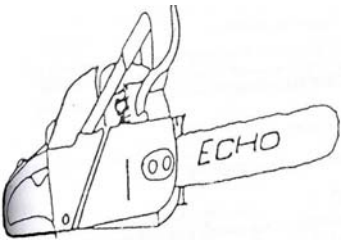
BUSH HOOK



Function : Used to clear thick bushes and undergrowth which are difficult to reach with an axe or machete

Method : With feet placed fairly wide apart, hold the implement firmly then swing it horizontally, sideways at a low position

CHAIN SAW



Function : Used to fell and saw up medium to large size trees

Method : Hold the chainsaw firmly, start the motor and direct the blade towards the tree to be felled or sawn up. Detailed instructions are given in the accompanying manual

E. Identification of Smoke Free Areas

It is necessary to identify smoke free areas to which fire victims can be evacuated, because the smoke from fires has a negative impact on health, causing upper respiratory infections, skin allergies, asthma, etc.

F. Organisation of Fire-fighting Teams for Land and Forest Fires in Peatland Areas

It is essential that fire-fighting teams have an organisational structure so that each team member understands his/her role, task and responsibility when carrying out fire-suppression activities.

Source : Balai Penelitian dan Pengembangan Hutan Tanaman Indonesia Bagian Timur

Duties and responsibilities of fire-fighting personnel :

1. Fire Commandant :

   Coordinates personnel and is responsible for all activities related to the smooth running of fire suppression operations

2. Fire Pump Team

   Have the task of operating the pump so that there is a reliable supply of water

3. Clearance Team

   to clear the area from shrub/bushes for other team member to enter burnt area

4. Well Digging Team

   Have the task of sinking wells when there is no source of water at the site of the fire or the water source is too far away, and then helping to suppress remnants of the fire using rakes and Jufa portable pumps

3. Fire Hose Team

   Have the task of attaching or reducing the number and length of hoses, and assisting the Nozzle / Fog Jet Team to suppress the fire

4. Fog Jet Team

   Have the task of squirting water on the fire source and extinguishing it

5. Food & Drink and First Aid Team

   Have the task of providing food and drink for the fire-fighters, and of administering first aid to injured/sick team members.

G. Standard Fire-fighting Procedure

Fire suppression involves the mobilization of all the available people and equipment, and can apply the following procedure :

1. Information Monitoring

   Comprehensive information on fire danger (including the location of the fire and of water sources) is received by the Land and Forest Fire Control POSKO, who then mobilize the necessary fire-fighting teams, according to the nature of the fire

2. Preparation

   Fire control preparations must be made as precisely as possible; lack of precision can lead to difficulties in the field and may even endanger the people who are trying to put out the fire.

   - ❒ Preparations before going to the fire site

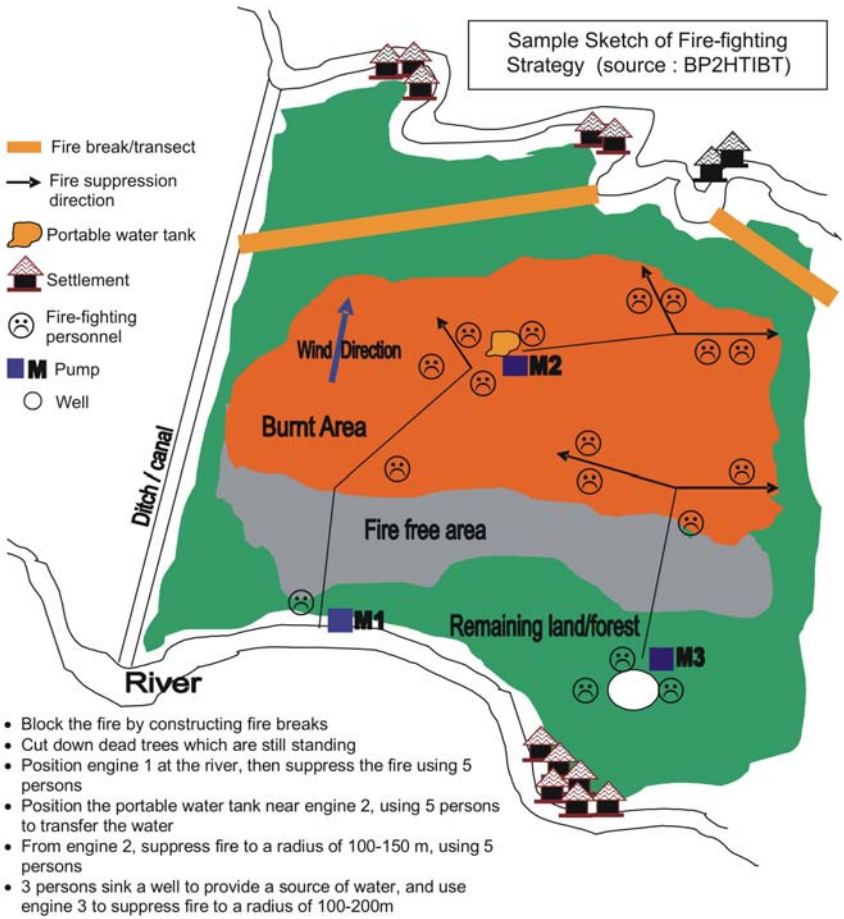
     Each fire-fighting unit's preparations should include dividing the personnel up into groups, and providing the following: transportation vehicles, fire-fighting equipment, First Aid equipment, communication instruments, and maps of the location

❒ Preparations at the site of the fire

On arrival at the site, set up tents in the vicinity of the fire, distribute the local inhabitants among all the fire control groups, brief them on the duties of each group, and provide each group with the equipment it needs (each group should be given at least 2 communication instruments) and allocate at least one person to be in charge at that location. In addition, set up a command post nearby for the provision of food, drink, transportation, and emergency medical and first aid services

- All personnel must wear individual protective gear such as fire-fighting suit, mask, helmet, glasses, boots, peples, slayer
- The fire commandant gives direction, makes a sketch of the latest fire situation, and explains the fire-fighting strategies and techniques which are to be applied
- Each team member checks the gear and quantity of equipment to be used
- All the teams assemble and pray together before starting to fight the fire
- Each team member takes up his/her position according to the fire-fighting strategy to be used, although these positions can change (differing from the strategy) if the fire conditions are different from those sketched by the commandant
- Fire suppression is carried out in line with the strategies, techniques and equipment employed, and is continued ceaselessly until the fire is brought under control and completely extinguished.
- Every development and command for each type of action is conveyed via the fire commandant.
- The fire commandant continuously monitors the development of the fire and of the personnel until the operation has been successfully completed.

- When the fire remnants have been extinguished, all the team members collect and inspect the quantity of equipment which they were carrying, and the fire commandant checks all the personnel and equipment
- After the fire has been suppressed, surveillance is continued to prevent fire from recurring
- On arrival back at the camp/POSKO all dirty equipment is cleaned and then stored in the equipment storeroom



5.3 MEASURES TAKEN AFTER LAND AND FOREST FIRE

A. Fire Impact Assessment

Fire impact assessment is carried out after a fire, in order to determine the damage to humans and the environment from a number of viewpoints, including economic, ecological, social and health.

A considerable amount of research has been done to determine fire damage, including the impact of the conflagrations of 1997/1998 which assailed Indonesia and neighbouring countries, to determine both the extent of the area burned and the losses which resulted.

An assessment of the area burned can be made utilising a remote sensing system, which uses a satellite equipped with a radar sensor that has an active signal and which can therefore penetrate cloud and smoke and function at night. One type often used in analysing the extent of fire impact is Landsat image data.

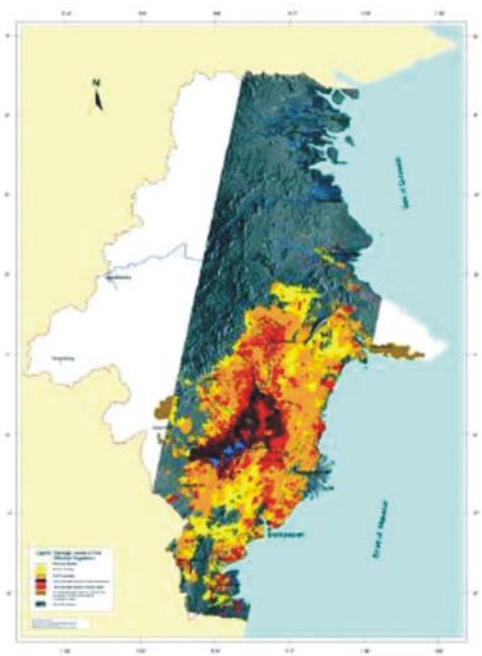


Illustration: assessment of extent of area burnt in the fires of 1997/1998 in East Kalimantan Province, using radar imaging (Hoffmann et al, 1999)

In addition to making assessments of the area burned, remote sensing can also be used to obtain measurements of the amount of carbon dioxide released into the atmosphere as a result of fire.

At present, the European Space Agency's (ESA) Envisat Satellite, which possesses Multiple sensors, has been used to monitor and analyse the impact of fires in peat land and forest which have been detected to have released millions of tons of greenhouse gases into the atmosphere. Three of the Envisat satellite's instruments were used: ASAR (Advanced Synthetic Aperture Radar) which can penetrate clouds and smoke, MERIS (Medium Resolution Imaging Spectrometer) which can detect burned areas on a large scale, and AATSR (Along Track Scanning Radiometer) which can measure surface temperature so that in peatland fires, where only the smoke is visible, hot spots can still be detected.

B. Judicial Measures

Post fire investigations must be swiftly undertaken to identify who caused the fire, how it proceeded and how much loss resulted, and then take legal action to bring the perpetrator to court. This will required close

Box 13

Forest and Land Fire Perpetrators on Trial

In 2000, fire occurred again in Riau Province causing serious damage and losses on an enormous scale. Based on the fire report and satellite analysis received by Bapedal, the province's judiciary team (police, the state prosecutor's office, Bapedal, the provincial plantation and forestry agencies) assisted by land and forest fire experts, carried out field investigations in the concession area belonging to PT. Adei Plantation and Industry. The results of this investigation proved that PT. Adei Plantation had been responsible for starting the fire. Bapedal then submitted the case to the prosecutor's office, who prepared a legal case and took the company to court.

After a long trial, the company was found guilty in October 2001 and its general manager sentenced to 2 years imprisonment and a fine of Rp. 250 million. However, when the company appealed to the Riau high court, the sentence was reduced to 8 months imprisonment and Rp. 100 million fine on 11 February 2002.

Source : Project Fire Fight South East Asia 2002.

coordinated between a number of institutions, police, civil service investigators (*ppns*), NGOs and experts. Fire, land and environmental experts can assist the investigation by collecting data and analysis findings which can reveal whether the conflagration resulted from negligent use of fire or whether it was started intentionally for certain purposes.

C. Rehabilitation

The rehabilitation of burned land is often seen as a separate activity from land and forest fire control management, whereas in fact it can reduce the likelihood of fire recurring in the future. Rehabilitation can be defined as human actions to speed up the process of succession so that land cover is rapidly restored. Succession can occur naturally but will take a long time. Therefore, rehabilitation should be a part of land and forest fire control that must be undertaken as quickly as possible after the fire, with the hope that the rehabilitation will improve the land quality, i.e. that empty land will become vegetated, and that land poor in vegetation will become rich in biodiversity.

The Indonesian Government, in this instance the Ministry of Forestry, at the beginning of 2004 initiated the GNRHL Land and Forest Rehabilitation Movement program. This is a welcome first step that must be supported by all parties. This program must be supported by human resources who possess morals and good ethics, and who distance themselves from collusion, corruption and nepotism (KKN). Wetland International-Indonesia Programme, through the CCFPI (*Climate Change, Forest and Peatland Indonesia*) programme, at one point also carries out rehabilitation activities. These are done on an area of peatland and peatforest which was degraded as a result of fire and over logging (in Kalimantan and Sumatera). The rehabilitation activities are carried out through the participation of the local communities. This participation involves incentives in the form of small grants paid by the Project to improve the community's welfare through the development of horticulture, fishery, animal husbandry and handicrafts. In return for the grants, the people are obliged to involve themselves actively in rehabilitation activities.

As part of the rehabilitation activities, it is necessary to consider silviculture measures which are appropriate to the specific conditions at the location concerned. For heavily degraded peatland, rehabilitation through

reforestation is an appropriate alternative, whereas plant enrichment measures could be applied on degraded forest which still possesses remnant stands of vegetation.

Before carrying out rehabilitation measures on burned peatland, a survey needs to be done to identify those find out what things/factors would influence their success (such as: topography, vegetation cover, inundation conditions, peat soil conditions, rejuvenation potential, plant materials and human resources potential) and explore obstacles which might occur. As a result of this survey it should be possible to determine appropriate silviculture measures.

There are several things to which attention should be given in the rehabilitation of burned peatland (Wibisono I.T.C et al*, 2004)* :

1. Choice of species

   It is recommended that local/indigenous species be used (avoid exotic species like Akasia). Species which can be used in the rehabilitation of peat swamp include : swamp Jelutung (*Dyera loowi*), Pulai (*Alstonia pneumatophora*), swamp Meranti (*Shorea sp.*), Terentang (*Campnosperma macrophyllum*), Tumih (*Combretodatus rotundatus*), Keranji (*Dialium hydnocarpoides*), Punak (*Tetramerista glabra*), Resak (*Vatica sp.*), Rengas (*Melanorrhoea wallichii*), Belangeran (*Shorea belangeran*), Ramin (*Gonystylus bancanus*), forest Durian (*Durio carinatus*), Kempas (*Koompassia malaccensis).*

2. Plant material

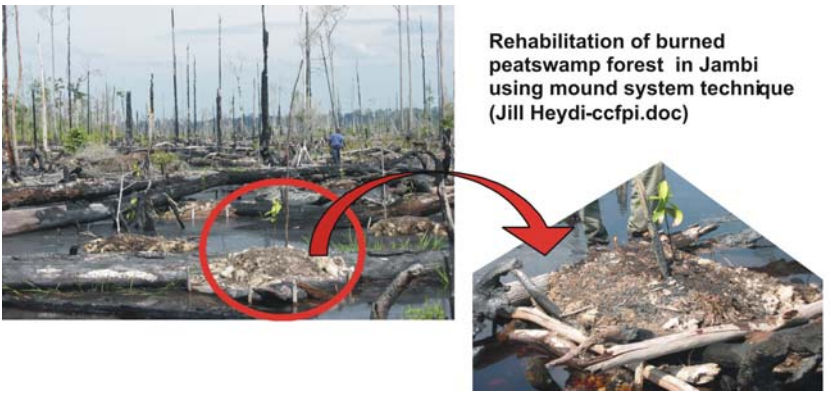
   Plant material can be in the form of seeds, wildlings found in nearby areas, and cuttings, which are then nurtured in a nursery at the nearest point to the site to be rehabilitated.

3. System of Planting

   In view of the specific characteristics of peat swamp (i.e. periods of nundation), for those species that do not tolerate inundation, such as meranti and ramin, a mound system can be applied. This is done by constructing a mound of peat soil around the point of planting and holding it in place with wood or other materials.

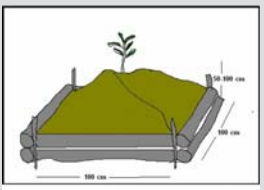
4. Community participation

Involvement of the local community is a potential human resource that can support the success of rehabilitation work, so an effort should be made to encourage the local people to become involved in rehabilitation activities.



Rehabilitation of burned peatswamp forest in Jambi using mound system technique (Jill Heydi-ccfpi.doc)

Box 14



Mound preparation

making a hole in the top of the mound

Planting the seedling

The above illustration shows the planting of seedlings of local species, using the mound system, in burned peat swamp forest in the area of Berbak National Park, Jambi. Approximately 16,000 seedlings were planted there during August – October 2003 by the CCFPI – WI-IP project, but as a result of unusually severe floods at the end of 2003 when the water reached a height of 2 meters, almost all these seedlings were submerged for around 2 months and most of them (> 90%) died. This experience demonstrates how difficult it is to rehabilitate peat swamp forest. [Photo : CCFPI - WI-IP Project Documentation].

Chapter 6

Fire Control Techniques for Land and Forest Fires in Peatland Areas

There are many methods that can be used for improving steps to control land and forest fires in peatland areas in Indonesia. These include: public awareness raising, creating alternative income sources for people living around the peatland forest, setting up fire brigades in the villages, applying environmentally friendly (zero burn) cultivation techniques or using controlled burning techniques in land clearing, and utilising blocked canals for 'beje' type fish ponds and as fire breaks.

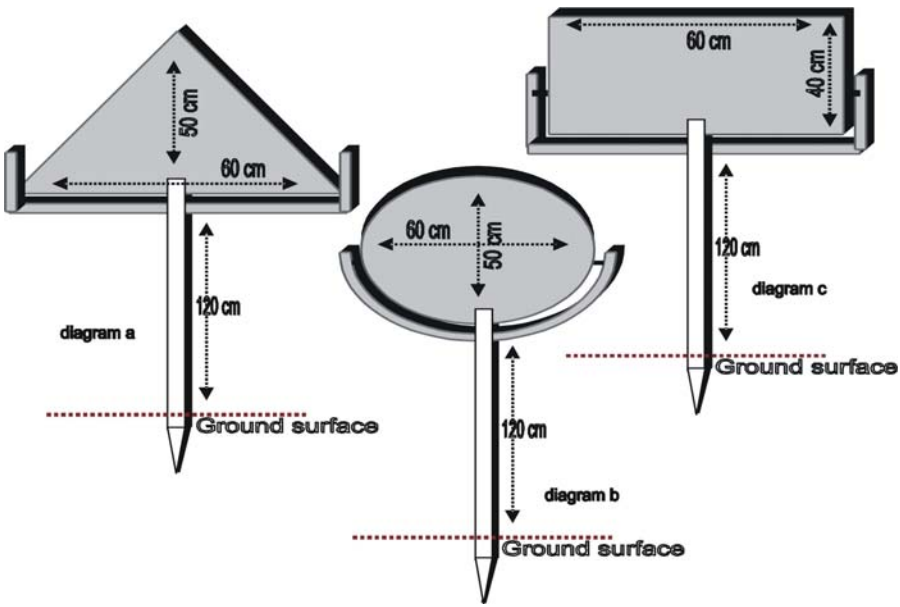
6.1 TECHNIQUES FOR PUBLIC AWARENESS RAISING

The indigenous inhabitants of peatland and peatforest areas have long been aware of the role that the peat land and forest play in their lives. Changing times and the arrival of migrants have, however, led to changes in the way of thinking about the system for managing natural resources, eventually giving rise to many types of environmental damage. To control and repair this damage, urgent efforts are needed to raise the awareness of various components of the community, in particular the local people who live around the forest and buffer zone, as well as other stakeholders. This can be accomplished through a number of techniques and media, such as :

A. Making Warning Signs

❒ Shape

Warning signs can be triangular (diagram a), circular or oval (diagram b) and rectangular (diagram c) with the following dimensions :



❒ Materials

The signs should be made from materials which are locally available, such as wooden planks, zinc or iron sheeting. They should be durable, not rust easily, not rot easily, nor fly away easily in the wind. Iron and zinc sheeting are more suitable for triangular and circular/oval signs, whereas rectangular signs can be made from wooden planks or zinc/iron sheeting.

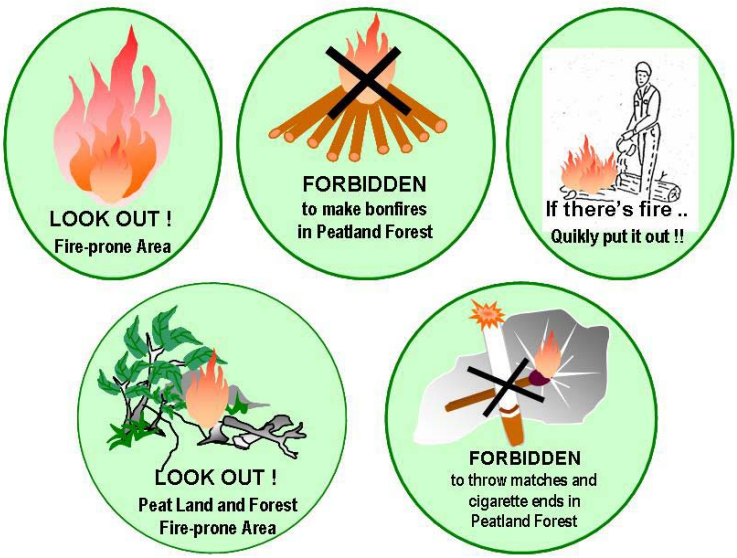
[note: to prevent people from taking the zinc signs for other uses, such as roofing, it is suggested that holes be made in the sheet, randomly but in such a way that the message the sign bears can

still be read clearly. It is hoped that people will be discouraged from taking the zinc when they see the holes, as these make it difficult to use the material for other purposes.]

❒ Location

The warning signs should be put in positions where they are clearly visible and will be read by the local people, such as: at every entrance gate to the forest and to plantations, especially those prone to fire; in settlements in the forest buffer zone; at the sides of public roads leading to or passing forest/plantation areas; along the banks of rivers which function as transportation routes. Care should be taken that roadside signs do not obscure the driver's (and other road users') view of the road. Signs put up near forest are often themselves obscured by vegetation. To avoid this, vegetation near the signs needs to be cut back at regular intervals and the signs also serviced/checked to see that they are still standing upright in their correct position.

❒ Types of warning signs



❒ Types of Warning Signs and Reminders :

Let's stop forest fire

Peat land and Forest Fire-prone area

Intentional burning of forest is against the law

If you see forest fire, report it immediately to a Forestry official or Village authorities

Entry forbidden, except for authorised persons Fire-prone area

Avoid using fire in peat land and forest areas

Put out fire in peat land and forest as early as possible

Penalties for causing fire

- **Intentional burning of forest**
  max sentence: 15 years jail and Rp 5 billion fine
- **Unintentional (Negligence)**
  max sentence: 5 years jail and Rp 1.5 billion fine
- **Causing fire by throwing objects**
  max sentence: 3 years jail and Rp 1 billion fine

B. Making Banners

Banners can be made from cloth, measuring 1-2 m in width and 4, 6 and 8 m in length. The background should be white or another easily visible colour, and the words should be in a colour that stands out. Banners can bear exhortations to prevent fire, and warnings or prohibitions related to fire incidence. The banners should be put up along public streets, with the provision that they do not disturb road users, and in certain locations in villages near the forest (such as the village hall, market).

C. Production of Brochures, Folders, Leaflets and Magazines

Brochure : 8-10 pages, cover bears picture/photo, Contents consist of foreword, introduction, the main topic and conclusion.

Folder : a sheet of paper folded in 2 or more, with coloured front cover, content is directly on the main topic and is systematic

Leaflet : a sheet of paper, coloured, content is directly on the topic and may be in the form of advice, directives, warnings and announcements.

Brochures, folders, leaflets and magazines should use simple language. They should be brief and attractively designed with pictures and photographs, and give practical information on the importance of protecting the forest ecosystem, on the threats to it, what will happen if it is damaged, and what can be done to prevent such damage, etc.

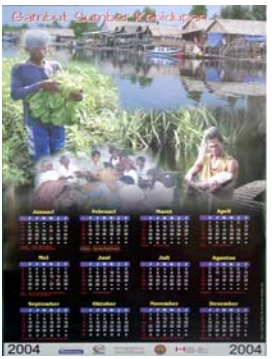
D. Production of Posters

Posters are a way of promoting awareness through the use of pictures and concise wording, printed on a sheet of paper or other material measuring no less than 45 cm x 60 cm, and posted in places where people often pass or gather together.

Procedure for making posters :

Simple but clear picture, attractive and alive (as if the picture itself is saying something), with words which are easily understandable, attractive colour composition with colours that do not fade easily.

E. Production of Fire Calendars



Short messages and reminders about the danger of fire, plus pictures of environmental damage, can be inserted into an attractively designed calendar .

Moreover, the calendar can also contain messages about land and forest fire control activities for each month, as follows:

Fire Control Activity this month: Collect data on climate and fire incidents last year, to draw up an early warning system **JANUARY 2005**	**Fire Control Activity this month:** Draw up an early warning system and distribute it. Prepare fire warning signs **FEBRUARY 2005**	**Fire Control Activity this month:** Carry out surveillance in anticipation of dry season. Start fire campaigning activities. **MARCH 2005**	**Fire Control Activity this month:** Implement consolidation and coordination among relevant institutions concerning fire control. **APRIL 2005**
Fire Control Activity this month: Map and inspect the condition of water sources; and prepare funds **MAY 2005**	**Fire Control Activity this month:** Check communication and firefighting equipment **JUNE 2005**	**Fire Control Activity this month:** Monitor and disseminate fire danger information, anticipate fire incidents, prohibit burning **JULY 2005**	**Fire Control Activity this month:** Monitor and disseminate fire danger information, anticipate fire incidents, prohibit burning **AUGUST 2005**
Fire Control Activity this month: Make preparations for mobilising human resources and fire suppression equipment. **SEPTEMBER 2005**	**Fire Control Activity this month:** Continue to monitor daily fire danger, especially during El_Nino conditions. **OCTOBER 2005**	**Fire Control Activity this month:** Evaluate fire incidents, legal action and improvements to early warning and fire danger rating systems. **NOVEMBER 2005**	**Fire Control Activity this month:** Carry out training and refresher training related to fire control **DECEMBER 2005**

Notes:

- The reminders in the boxes for each month can easily be moved to a different month depending on anticipated changes in climate conditions.
- The messages in the boxes can also be altered to match conditions and requirements in the field. For agricultural activities for example, the pages for the dry months (June – September) can carry messages concerning the danger of using fire to clear fields.
- In peat swamp forest, illegal ditches and canals are often found which can drain water away from the swamp with the result that the peat becomes dry and easily catches fire. The reminders in the calendars described above can contain messages concerning the fire danger resulting from ditches.
- The calendars should carry eye-catching photographs or pictures relevant to the messages they convey.
- These calendars with their various messages should be distributed to the communities which are the target of the awareness raising campaign, not to urban communities, who do not generally play a direct role in the occurrence of land and forest fires in peatland areas.

F. Production of Stickers

Prohibitions and pleas for preventing fire, illegal logging etc., can be printed on eye-catching stickers. These can then be stuck in places where they can be read easily, such as vehicles, work desks, work books, work equipment in the field, etc.

G. Production of Story Books

Environmental story books are a medium for introducing children to the importance of forest conservation, through the use of cartoon characters and amusing, attractive pictures which stimulate them to read the books.

H. Video Production

Technological advances have urged community education activities to make use of a variety of media which are more attractive to the public, including the playing of videos about the environment. Such videos will attract the target communities more if the actors who appear in them come from those same target communities.

I. Direct Dialogue / Communication

Direct communication and dialogue are a conventional medium for community education but a highly effective one because the message can be conveyed directly, leading to direct two-way communication through which the people feel that they are receiving special attention. Forest fire education is carried out in the run up to the dry season, and intensified during the dry season.

Target :

Communities living in and around the forests and components from other communities who are concerned about the problem of fire.

Method :

- House visits
- Indoor lectures
- Public lectures in open spaces, with unlimited numbers of participants, and using visual aids

Techniques :

- Thoroughly prepare the topic to be presented

  So that the audience can easily understand the material being presented in the lecture, there are at least 4 important things which must be conveyed, which are :

  The benefits of peatlands and peatland forests. Explain the significance of the peat ecosystem, its characteristics, and its benefits for many forms of life and the local, regional and even global environments, as well as the dangers that can arise as a result of peat fires.

The threats to peatlands and peatland forests. Describe the various human activities that threaten the conservation of peatlands and peatland forests. These include: cooking-fires, bonfires and the discarding of cigarette butts on peatland; the burning of land and forest to prepare the land for agriculture and plantations; the construction of ditches and canals in peatland, which causes uncontrolled draining away of the peat water with the result that the peat becomes dry and easy to burn; the abandonment of peatland so that it becomes covered with brush which burns easily; and the use of fire in hunting to corner wild animals, etc.

The impact of fire on the natural environment and on health. This section describes what can happen as a result of fire in peatlands and peatland forest. These impacts can be described as follows: (1) disturbances to human health (respiratory infections, disturbed vision, blood poisoning from inhaling noxious substances from the smoke, impaired water quality after the fire making the water unfit for human consumption and causing skin diseases, etc.), (2) destruction of or reduction in sources of income as a result of the damage done to natural resources, for example: the burning of economically valuable trees (*ramin, jelutung, sungkai* etc); the loss of bees' nests to fire and thus the loss of forest honey production as the bees flee to other places to escape the blaze; damage to the local hydrology thus resulting in severe flooding during the rainy season and scarcity of fresh water during the dry season; destruction to the habitats of fish in the waters and other wildlife on land damaged by fire, (3) destruction to nature in the surrounding area thus making it unsuitable for habitation, the land becoming barren, (4) the loss of a variety of important benefits previously derived from the peatland and its forests, like its functions of sequestering carbon, supporting life, biodiversity, etc.

How to control fire in peatlands and peatland forest. The information in this section places emphasis on understanding that fire prevention is more important than fire suppression (cure). Nevertheless, it is also necessary to explain how to suppress fire should it occur. Fire prevention measures include: how to repair

the damaged hydrology by blocking canals and ditches, how to cultivate farmland and plantations in peatland without using fire, and how to rehabilitate damaged peatland.

These points can be conveyed in the following ways:

- Through the use of visual and other teaching aids
- By giving the audience printed materials (brochures, leaflets, folders, etc) to help them understand the content of the lecture
- As much as possible, by getting the audience involved in discussing the problems

6.2 TECHNIQUES TO INVOLVE COMMUNITY IN LAND AND FOREST FIRE CONTROL

To get the community involved in peatland and peatforest fire control it is not enough just to campaign for awareness raising and/or give lectures in the field. Another way is by creating or providing alternative activities which are environmentally friendly (non-damaging) but sustainably profitable, i.e. that yield products which have good market prospects and can quickly generate an income in both the short and long term. In this way it is hoped that the community will desist from their old, bad habits, such as illegal logging in the forest, and instead become farmers, craftsmen or fishermen using environmentally friendly techniques.

To support such a programme of alternative business, they will need assistance with working capital in the form of loans or grants (e.g. rolling funds), as well as technical guidance from experienced agricultural extension workers who are fully dedicated to helping them. One form of such assistance is through the small grant system, in which local community groups receive grants of Rp 20-25 million without being required to provide collateral, in order to develop a permanent business which does not damage the environment. In return for the grants, the groups are obliged to protect the peatlands and peatland forest which have not

been burnt and/or rehabilitate (plant tree seedlings) those which have already been degraded **[see Box 15]**. This fund can subsequently be rolled on to other community groups who have not yet received support. This approach can arouse the community's awareness and feeling of ownership towards the peat lands and forest.

Box 15

Small Grant Funds Sumatera

*Wetland International – Indonesia Programme through the CCFPI (*Climate Change, Forest and Peatland Indonesia*) project funded by CIDA (*Canadian International Development Agency*) during 2002-2004 provided grants to several community groups for conservation activities on peatland; this was given the name* Small Grant Funds*. After a number of stages (socialisation, proposal submittal, administrative screening and verification in the field) the winning groups, which would receive the small grants, were decided upon. These included the community of Desa Jebus village (Suka Maju farmers' group) comprising 16 family heads. Desa Jebus is situated in Kecamatan Kumpe Hilir, Kabupaten Muaro Jambi which is one of the buffer villages around Berbak National Park. Most of the inhabitants live from agriculture and fishing. However, the type of land they farm is not profitable as it always floods during the rainy season and cannot be watered in the dry season. As a result, many people seek additional income from other sources, such as logging. The business this group intends to develop is free range chicken farming. In return for the grant, the group will plant and tend a number of trees in a peatland area opposite the village and play an active role in dealing with fire danger in peatland near their village.*

This small grant system is carried out through the following mechanism [with the proviso that funds are available for distribution to the community groups; the funds may come from Government funds, foreign aid/grants, foreign loans which are utilised responsibly, etc] :

1. Preparation phase

❒ Formation of a panel of judges

At the preparation stage, a panel of judges is formed, who will be responsible for selecting which community groups will receive the small grants. The panel will consist of people who are experienced, broad-sighted and independent.

The tasks of the panel are :

- to formulate assessment criteria
- to assess the feasibility of the proposals submitted
- to report the results of their assessment

❒ Announcement of the small grant system

The purpose of this step is to familiarise the public with the plans for providing small grants, particularly in appropriate target areas (for example, near peatland and forest areas where the community's socio-economic conditions are likely to give rise to activities which cause damage/fire in peat land and forest). Next, an official announcement is made concerning the holding of a small grant competition, and stating the conditions and requirements which the recipients must fulfil.

Requirements and Conditions for Grant Recipients :

- Priority will be given to a local community/NGO group
- The group should possess neglected land which is not farmed and whose status is clear
- The community/NGO group must be at least one year old, have a clear status and have formal recognition from the head of the village where it exists
- The group must submit a proposal whose contents are relevant to the aims of the competition/grant
- The group must be willing to take part in the competition and to accept the judges' decision
- The group must be willing to sign a contract, the contents of which shall be binding, between the recipients and the provider of the fund.

Proposal Format

- Cover : bears the Title, the Identity and address of the applicant
- Composition of the community/NGO group's management: describes the core management of the group
- Background : a brief description of the importance of the activity and its benefit to the group and to the environment
- Aims of the Activity : a brief description of the programme's aims and the goals the applicants want to achieve
- Type of Activity : a brief description of the type of activity which the group proposes to carry out, the parties involved, and the location of the activity
- Techniques : a brief description of the methods that will be used to carry out the activity
- Number of members/beneficiaries : gives the number of members and lists them
- Budget Plan : details of expenditures relevant to the proposed activity
- Schedule of Activities : a matrix detailing the activities and when they are to be carried out.

2. Selection phase

This section describes the time schedule given by the contest organisers to the contestants.

- ❒ Receipt of proposals from the contestants (state the closing date by which the organising committee must have received the proposals)
- ❒ Pre-screening by the panel of judges (state the length of time scheduled for pre-screening of the proposals which have been received)

- ❒ At this stage, selection is intended to assess to what extent the proposals meet the administrative requirements and conditions laid down by the committee
- ❒ Stage I selection by the panel of judges
- ❒ Here, the focus is on assessing the technical and financial feasibility of the plans described in the proposal
- ❒ Stage II selection by the panel of judges
- ❒ Field verification is carried out to find out whether the things stated in the proposal are in fact true. It is only done for some of the proposals that have passed the pre-selection and stage I selection stages.
- ❒ Selection of the winners. After verification, the judges reassess the proposals to determine which deserve to win.
- ❒ Announcement of the winners (in writing / by post)

3. Small Grant Implementation Stage

- ❒ A contract of cooperation is drawn up with the chairperson of the community group receiving the small grant (witnessed by the village head)
- ❒ Training is given (by experienced instructors) to the small grant recipients in preparation for carrying out their alternative income activity, and also in rehabilitation techniques (preparing the seedlings, planting and tending them). In fact, these rehabilitation activities are done as 'compensation' in return for the grant, under which they are obliged to plant forest species on peatland and/or participate actively in fire prevention and control in the surrounding area. So that the planting programme is successful, however, they are also equipped with knowledge of rehabilitation techniques.

- ❒ The alternative income activities and the compensation activities (rehabilitation / fire control) are carried out according to the plans in the proposal

- ❒ Counterparting is carried out to assist/guide the community in implementing the activities in the proposal. Counterparting can be provided by parties appointed by the contest organising committee (such as local NGOs which possess sufficient capabilities)

- ❒ Evaluation of activities: all activities carried out by the contestants described above need to be properly monitored by the organising committee. The results of this monitoring are then used to provide input for implementers in the field (e.g. some of the activities may not be in accordance with the proposal).

- ❒ Physical and financial reports are to be submitted quarterly and annually (Quarterly : at the end of every third month, and Annually : at the end of each year)

6.3 TECHNIQUE FOR SETTING UP A COMMUNITY FIRE BRIGADE

To set up a community level fire brigade to help in the early control of fires in peatland and peatforest in their area, requires community organisation **[see Box 16]**. The main constraints to fire suppression are the delay in information about the fire getting to the officers, and the difficulty in getting access to the location, with the result that by the time the fire-fighters arrive on the scene the fire has spread and is difficult to control. With this in mind, the primary functions of a community level fire brigade are to :

1. help prevent land and forest fires by conducting surveillance and monitoring in the area around their village

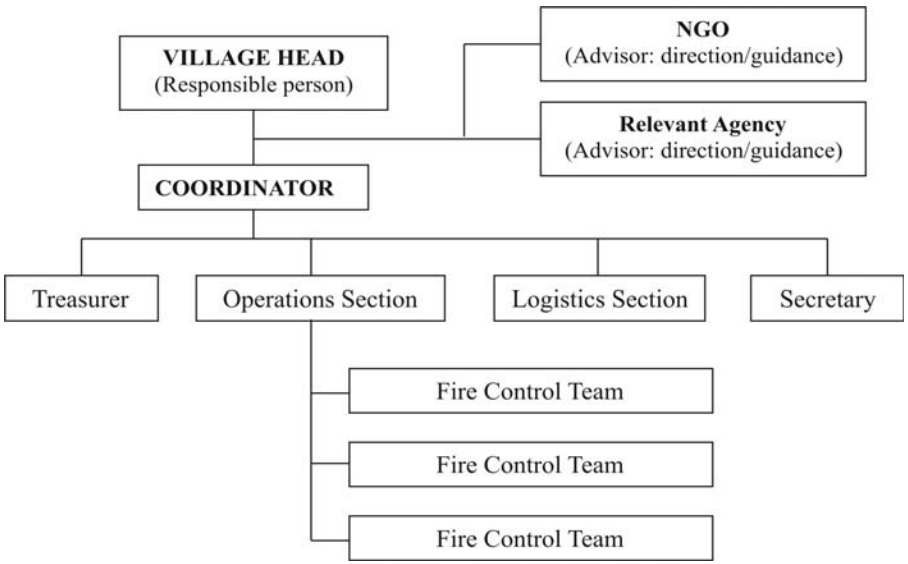
2. start fire suppression operations as quickly as possible in their area

3. support activities to deal with burned land after the fire

4. coordinate with institutions related to forest fire control concerning prevention, suppression and post-fire activities.

A fire brigade can be formed from land management groups already existing in the village. The Village Head is the responsible person while NGOs and relevant fire control agencies provide direction and guidance. To achieve optimum performance, the fire brigade needs to receive routine training to improve their knowledge and capabilities regarding fire control measures. Adequate facilities, infrastructure and fire suppression equipment are required, as well as efforts to improve the welfare of fire brigade members.

The organisational structure below could be developed in setting up a fire brigade :



Advisor's Role and Tasks :

- ❒ NGO : As a facilitator, to provide direction, guidance and training in land and forest fire control
- ❒ Relevant Agencies : to provide direction, guidance and training, as well as funds, facilities and infrastructure for the purposes of land and forest fire control

Coordinator's Role and Tasks :

- ❒ To provide leadership and take responsibility for the running of the organisation
- ❒ To draw up an annual work plan for fire control activities
- ❒ To coordinate with other parties in land and forest fire control activities
- ❒ To write a land and forest fire control evaluation report

Treasurer's Role and Tasks :

- ❒ To work with the Coordinator to seek financial support
- ❒ To regulate and manage the organisation's finances
- ❒ To keep the financial records

Secretary's Role and Tasks :

- ❒ To deputise for the coordinator when necessary
- ❒ To do the administrative tasks
- ❒ Documentation

Fire Suppression Operations Section : Role and Tasks :

- ❒ To coordinate fire prevention, suppression and post-fire activities
- ❒ To direct fire suppression activities
- ❒ To organise preparations and strategies for fire suppression

Logistics Section : Role and Tasks :

- ❒ To coordinate the provision of food, drink and accommodation for every activity
- ❒ To coordinate the provision of equipment, facilities and infrastructure in fire suppression operations

Fire Control Team : Role and Tasks:

- ❒ To support fire prevention and post-fire activities
- ❒ To conduct fire suppression operations
- ❒ To maintain fire suppression facilities and infrastructure
- ❒ To communicate the results of their activities to the relevant Fire Brigade personnel

Box 16

Fire Brigade Teluk Harimau

In April 2003, with the support and guidance of Wetland International Indonesia Programme (Project CCFPI) in cooperation with the NGO Pinse, Jambi in the village of Ds Sungai Rambut Kec. Rantau Rasau Kab. Jabung Timur Jambi, a brigade of local people was set up to fight land and forest fires. Later this brigade was given the name Fire Brigade Teluk Harimau*. The Brigade has 4 organisers: the head, deputy head, secretary and treasurer; and 24 members. Its mission is to control land and forest fires in the region, to prevent fire and carry out surveillance, fire suppression and post forest fire activities, and to coordinate with relevant institutions. It was originally established to support efforts to control land and forest fires in the region of Berbak National Park where 27,062 ha are reported to have been destroyed by fire. It has an on-going programme of refresher training for brigade members through routine training sessions and guidance, as well as efforts to improve the welfare of its members.*

6.4 THE USE OF FUEL IN LAND PREPARATION

The accumulation of fuel in a location is one of the aggravating factors causing land and forest fires. According to Bambang Hero Saharjo, a fire expert from the Faculty of Forestry at IPB (Bogor Agricultural University), steps to reduce the fire danger level through reducing the quantity of fuel can be taken by utilizing the remaining waste. Waste from land clearing, in the form of tree stumps, trunks, branches, twigs and organic litter which are used as fuel when preparing the land, can be made into charcoal briquettes which are in the end more useful and practical. In addition to briquettes, organic waste can also be used to make compost, an example of appropriate technology already applied by many people at various social levels. IPB's Forestry Faculty in cooperation with the Director General for Forest Protection and Nature Conservation have developed zero burn land preparation technology, which uses the plant waste to make compost and charcoal briquettes. A brief description of these techniques follows below.

Box 17

Zero Burning Land Preparation can reduce gas emissions

A study at the site of a demonstration plot using zero burning techniques for land preparation, found that potential fuel on the plot amounted to 44 ton/ha which, if burned, would release 3.465 ton CO_2, 0.036 ton CH_4, 0.0014 ton NO_x, 0.044 ton NH_3, 0.0367 ton O_3, 0.641 ton CO and 0.77 tons of particulate matter. This indicates that zero burn land preparation can reduce gas emissions and other environmental impacts such as smoke and degradation of peatlands.

Source : Faculty of Forestry IPB (2002)

A. Making Compost

Compost is fertiliser produced as a result of the decay of organic matter. This process should take place on a site sheltered from sun and rain. To accelerate decomposition and maturation and also to increase the nutrients, a mixture of lime and manure (chicken, cattle or goat) can be added. The source materials for the compost can be waste such as refuse or the remnants of certain plants (straw, grass, etc). Compost functions to improve soil fertility and at the same time increase the productivity of land and crops.

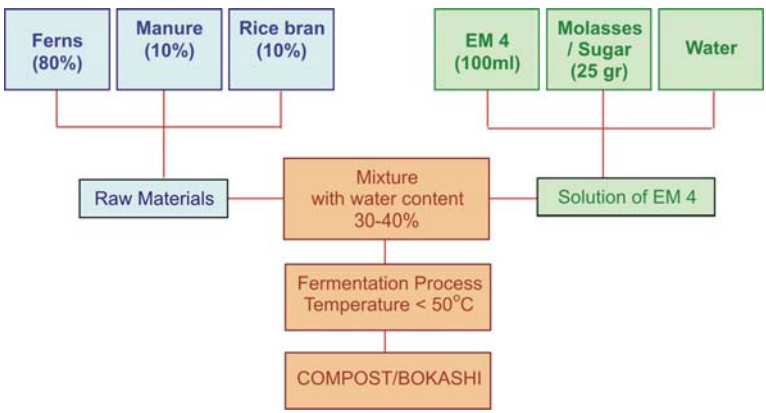
Table 9. Nutrient content of various organic fertilisers

No	Type of Fertiliser	Nutrient Content in 10 tons of material		
		N	P_2O_5	K_2O
		---------- Kg ----------		
1	Manure	24	30	27
2	Straw compost	22	4	43
3	Urban waste	40	30	50

Source: Badan Pengendali Bimas, Ministry of Agriculture, 1977

Compost is made using a technique which is simple but highly productive. Potential fuel in peatlands which is used as the main material for making compost comprises a variety of leaves, in particular various species of ferns. In outline, the stages in making compost are: preparation, heaping, monitoring the temperature and dampness of the heap, turning and watering, maturation, enrichment of the compost, packaging and storage.

The process of making a 100 kg mixture of organic materials comprising mainly ferns into compost can be seen in the flowchart below (Faculty of Forestry IPB, 2002):



Flowchart of the Process of Making Compost with Effective Micro organism (EM4) Technology, for every 100 kg of raw materials (Faculty of Forestry IPB, 2002)

An example of another method of making compost, which has been applied by farmers on peatland in South Kalimantan, is described in detail below (Lili Muslihat 2004).

Preparation

Materials :

- ❒ Vegetation remnants (harvest waste) or brush and grass/weeds. These materials should have wilted but not be too damp.
- ❒ Livestock manure (chicken, cattle, goat), which has become "mature".
- ❒ Agricultural lime.
- ❒ Water to spray the compost materials.

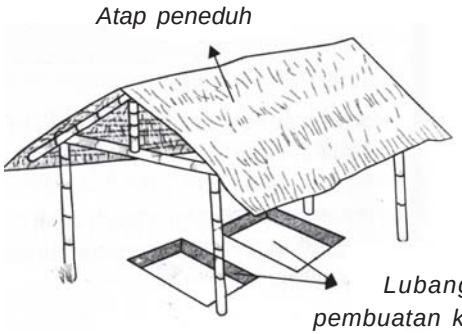
Tools :

- ❒ Mattock and shovel to stir and turn the compost.
- ❒ Large watering can or bucket to water the compost heap.
- ❒ Roof to shelter the compost materials.
- ❒ Machete or knife to cut up and separate stems from leaves.
- ❒ Sacks to store compost.

Site :

When all the materials and tools are ready, the next step is to prepare a site not far from the land where it is to be used, so that it is easy to carry and spread the compost. A roof is built over the place where the compost is to be made, to protect it from moisture, and thus hasten the composting process.

- ❒ Compost-making site measuring 2 x 2 meter.
- ❒ On large expanses of land, 3-4 compost-making sites should be prepared.



Compost-making site

Stages in making compost:

(1) Vegetation remnants (harvest waste) or brush and grass/weeds are chopped up small (25- 50 cm), to hasten the process of decay.

(2) The chopped vegetation is stacked neatly to a thickness of 30-50 cm.

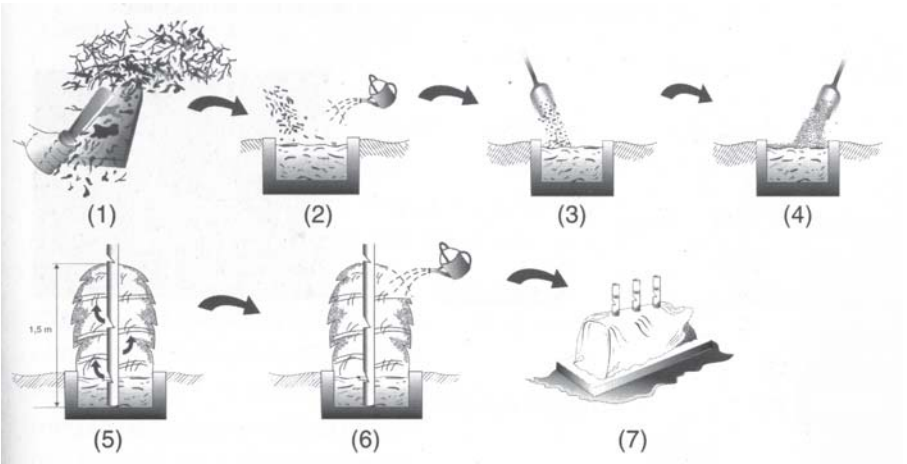
(3) An even layer of manure is then spread on top of the stacked vegetation to a thickness of 5-10 cm.

(4) Agricultural lime is sprinkled evenly over the manure.

(5) Another layer of chopped vegetation is then stacked on top of the lime, and so on until the whole heap of layers reaches a height of 1.5 metre.

(6) The heap is then sprayed with water.

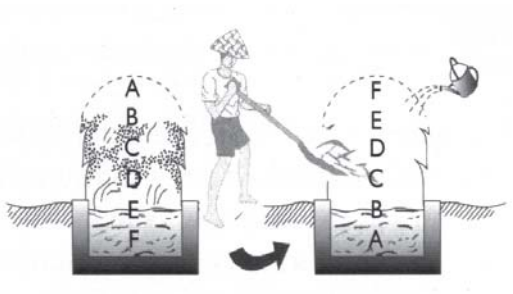
(7) To hasten the decay process, the compost heap should be covered with a sheet of plastic or tarpaulin.



Stages in making compost

Watering and Turning

The compost heap must be turned and watered every 2 - 3 days. The layer which was initially on top should be turned and put at the bottom, and so on. Each time the compost is turned it must also be watered. The purpose of this work is to ensure that the compost materials are evenly mixed with the manure and lime. It also creates a suitable environment for the micro organisms which play a role in the decomposition and thus accelerate the decomposition/composting process.

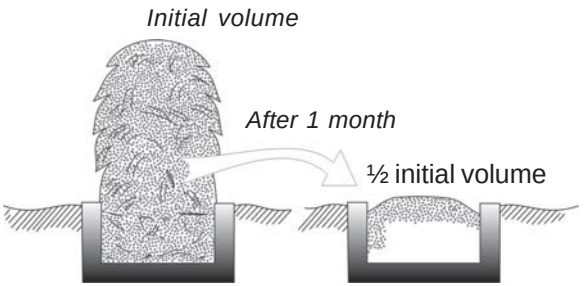


Turning the compost

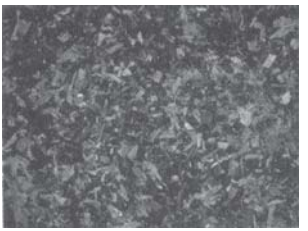
Harvest

Mature compost has the following characteristics :

- ❒ The compost no longer experiences changes in temperature (it is not warm) and does not smell rotten.
- ❒ It has a fine consistency, does not form lumps, and is blackish brown in colour (the original materials are no longer apparent)
- ❒ It has shrunk to one third of its original volume.
- ❒ The composting process is about one month old.



Kompos yang sudah jadi



Characteristics of mature compost

Various ways of making Compost

Peatlands have been used for agriculture, in particular for horticulture, by farming communities in various rural areas of Kalimantan and Sumatera. To increase crop productivity and at the same time maintain the peatland's fertility, they use a mixture of ashes and manure.

The process of making the ash-manure mixture is almost the same as that of making compost. In this case, however, the plant remnants (harvest waste) or weeds are first burned to form ashes before being made into compost [the term 'compost' here should perhaps be stated more precisely as "Modified Compost", because the raw materials / plant fragments are

burned first in order to accelerate the release of minerals so that they can be absorbed directly by the plants]. This process produces quite good compost. The 'dose' required for a plot of 2500 m2 is 20 kg of ash and 5 kg of manure, or a 1kwt mixture of the two for 1 ha (Alue Dohong, 2003). This is much lower than the dose of compost generally applied to the same area of land. [Note: care MUST be taken during ash production; burning must not be done directly on peatsoil but on a fireproof layer such as corrugated iron or sections of disused drums, see Illustration. This is essential in order to prevent peatland fire].

Illustration: Cut drum used for preparing "compost" materials through burning

In general, the dose of ash given as an ameliorant (improver) to increase soil fertility ranges from 2.5 to 30 ton/ha (Prastowo, K,. et al., 1993), although several research studies recommend the following doses:

Table 10. Dosage of ameliorant (improver) for peat soil

The use of organic waste to make compost is widespread, although some problems still exist: the composting process takes too long (1-1.5 months per ton of waste), the nutrient content/quality is low and production costs high. It takes 900 – 1,000 kg of raw waste materials to produce 300 -450 kg of compost (Budi Santoso H. 1998 and Lukman Hakin et al. 1993).

B. Manufacture of Charcoal Briquettes

The manufacture of charcoal briquettes utilises fuel found on peatland, in the form of organic litter, ferns, tree stumps and logs. The equipment comprises charcoal-making tools, i.e. drum kiln, wire sieve, pvc pipe measuring 10cm diameter x 1m length, bamboo poker, scales and machete, and briquette-making tools, i.e. briquette press, mortar, pestle, 40-mesh and 60-mesh sieves, plastic tray, kerosene stove, pan, stirrer, brush and oven.

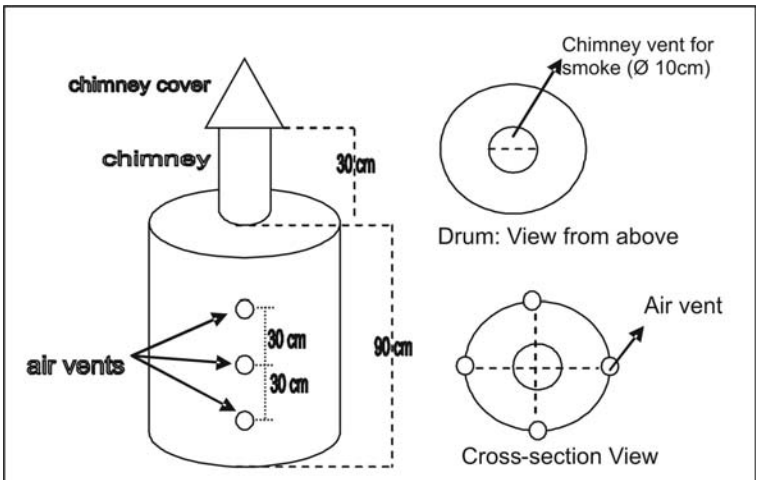


Illustration of Drum Kiln
(Faculty of Forestry IPB, 2002)

The manufacture of charcoal briquettes starts with preparation of the raw materials in the form of ferns cut down during land clearing. These materials are then dried naturally until their moisture content is much reduced. The pvc pipe is inserted straight through the centre of the drum. Next, the raw materials are loaded into the drum in stages, depending on how dry they are, until it is ¾ full, and then compressed. The pvc pipe is then withdrawn slowly so as to leave a hole through the centre of the kiln, after which the hole is filled with kindling/fire bait in the form of fabric or wood soaked in kerosene. Following this, the charring process occurs. This is started by lighting the kindling at the base of the closed drum. During combustion, the air vents at the base of the drum are opened and the others closed; when the lower part of the drum glows red, the bottom air vents are closed and the ones above them opened, and so on until the topmost air vents have been reached. The process is finished when the smoke coming out of the chimney has become thin and bluish in colour. When it has cooled down, the drum kiln is opened and the charcoal taken out.

To make briquettes, a binding agent is required which can be made from a mixture of 7.5 gr tapioca in 90 ml water. The charcoal is pounded into a powder, put through a 40 mesh sieve, and then sifted again through a 60 mesh sieve. The powder which does not escape through the 60 mesh sieve is used as the basic material for making charcoal briquettes. 150 gr of this powder is mixed with the binding agent and then cast in a press. The briquettes thus formed are subsequently dried in an oven at a temperature of 60^{o}C for 24 hours, or left in the sun until they are dry. Finally, they are packed ready for sale or for use elsewhere.

6.5 CONTROLLED BURNING TECHNIQUE

For generations, farming communities have used controlled burning to prepare their fields for planting. Within certain limits, this technique can still be used as long as the fire does not spread. In practice, however, there are still several obstacles to the success of this technique. For example, the site of the controlled burning might be near to ‘sleeping’

land that has become overgrown with scrub which could easily catch fire as a result of sparks from the controlled fire nearby. In other words, however carefully the controlled burning is done, natural factors such as gusts of wind can not be controlled, with the result that the fire may spread anywhere.

Due to the above facts, controlled burning techniques must be avoided as far as possible or only used under the following conditions :

- ❒ Permitted only for local inhabitants who do not constitute a corporate body ;
- ❒ Land area must not exceed 1-2 ha ;
- ❒ Conditions make it impossible to use zero burning techniques;
- ❒ Burning must be carried out on each field in turn ;
- ❒ Wind conditions must not be too strong ;
- ❒ If there is overgrown land nearby, fire should not be used at all.

The following stages can be used as a guide when applying controlled burning techniques on peatland (Syaufina, 2003) :

1. Selecting the Location for New Fields

   Priority should be given to scrubland with an area of 1 – 2 ha

2. Slashing

   Slashing is done to remove undergrowth, brush and young growth that can still be cut with a machete, and to facilitate drying and burning. This work can be done by groups or individuals.

3. Felling

   Felling is the next stage after slashing and is done to kill trees. It can be carried out using an axe or chainsaw.

Felling is done in the following way :

- Make an undercut and then a back cut as low down as possible (Fig. a)
- The direction of felling follows the slope of the notch (Fig. b).
- If it is windy, the felling should be stopped until the wind subsides, as wind can alter the direction in which the tree collapses (Fig. c).

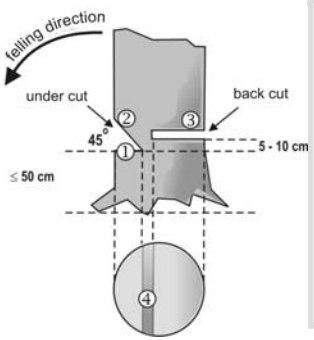


Figure a.

STAGES :

1. *Make a horizontal incision to a depth of 1/4 - 1/3 ∅ of tree*
2. *Make a second cut at an angle of 45°*
3. *Make a back cut*
4. *Leave a hinge of 1/10 – 1/6 ∅*

Figure b.

Figure c.

4. Cutting up tree trunks

Tree trunks are cut into lengths of 1-2 m to facilitate removal and drying. Tree trunks of diameter greater than 15 cm are transported away from the new field in order to reduce the accumulation of fuel.

5. Drying of Fuel

   Fuel resulting from slashing and felling is left in the sun to dry for about 2-3 weeks, depending on weather conditions.

6. Construction of Fire Breaks/Clearings

   Before the new field is burned, its perimeter is cleared of organic litter to a width of about 2-4 m. This can be done by each individual or together with the owners of nearby fields. The purpose of this activity is to prevent the fire from spreading to other people's fields.

7. Fuel Stacking

   Fuel in the form of organic litter is stacked evenly and as thinly as possible on the site of the new field which is to be burned, so as to minimise the amount of smoke produced

8. Construction of ditches and water reservoirs around the new field

   A ditch 50 cm wide and 1 m deep is dug around the field. Every 10 m along its length a water reservoir is constructed measuring 1 m x 1 m and over 1 m deep. The purpose of the ditch is to maintain the groundwater balance and to prevent the spread of fire. The purpose of the reservoirs is to store water in the wet season so that it later can be used for fire prevention in the dry season. The ditches and reservoirs can also be used for fish-farming and thus increase the farmers' incomes.

9. Burning

   During burning, attention should be paid to the following :

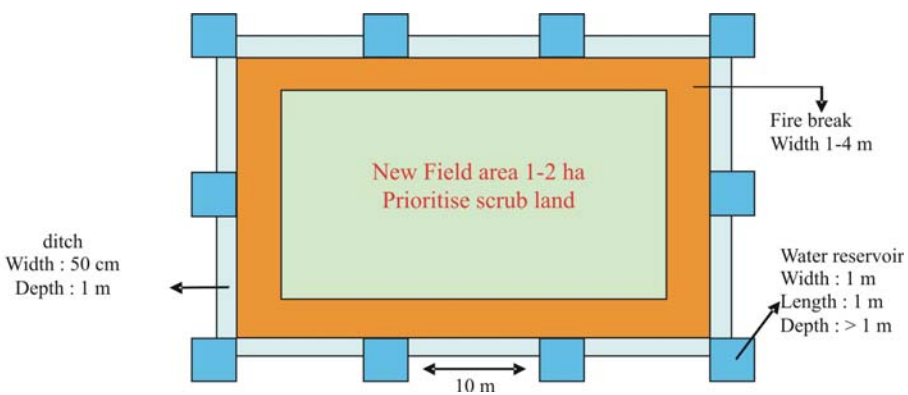
   - ❒ Personnel preparation: the personnel comprise the people who carry out the burning and those who guard the fire to prevent it from spreading.
     - ◆ burning : 4 persons
     - ◆ guards : ± 10 persons

- ❒ Materials : torches made from dried coconut leaves
- ❒ Burning Time : around 12.00 – 14.00

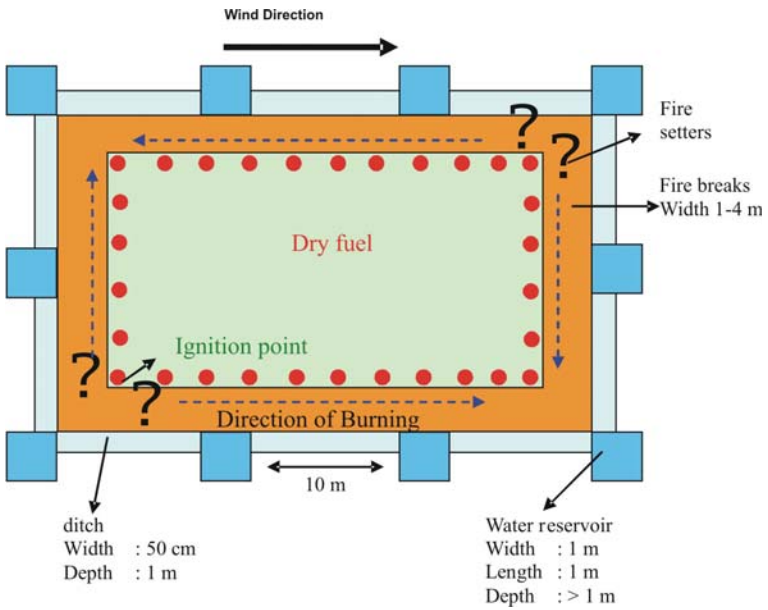
  The time for burning can vary depending on local conditions and weather. A good time is when the fuel is extremely dry and the wind is not strong, so that the fuel burns easily and the fire is easy to control.
- ❒ Burning technique : ring fire

Burning is carried out simultaneously by four persons who stand at opposite corners of the field and are under a single commando, starting from two different points (See Diagram). Each pair of fire-setters moves in the same direction, setting fire at points 1 metre apart from the initial ignition point. With this technique, the fire will spread towards the centre and the burning process will be quicker, thus reducing the risk of fire spreading outwards and downwards.

If necessary, a second stage of burning can be done in a special place outside the field. The ashes and residue from this can be sprinkled on plant beds as fertiliser.



Land Preparation Technique for Peatland (Syaufina, 2003)



Burning Technique (Syaufina, 2003)

6.6. UTILISATION OF 'BEJE' PONDS AND DITCHES AS COMMUNAL FIRE BREAKS

What is meant by 'communal' fire breaks is those fire breaks which were constructed with the participation of the community and which have two benefits: firstly for fire prevention and secondly as a means of bringing economic benefit to the surrounding community (e.g. blocked ditches and 'beje' ponds, which function both as fire breaks and as fishponds). This has been done by the community in Muara Puning village in the South Barito District, facilitated through the CCFPI Project carried out by Wetlands International-Indonesia Programme in cooperation with the Yakomsu foundation (*Yayasan Komunitas Sungai* = river community foundation), which was previously called *Sekber Buntok* (*Sekretariat Bersama Buntok* = Buntok Joint Secretariat).

A. Restrictions

The success of preventative measures in land and forest fire control depends heavily upon successfully involving the local community's emotions, feelings and enthusiasm in forest conservation, and this requires an approach to land and forest management that understands the human psychological aspect.

Communal fire breaks are those constructed through community participation, based on the local economic, social and cultural conditions. There is a strong link between community participation and incentive; without a clear incentive the participation will turn into forced labour. In other words, asking the local people to participate without any incentive is the same as treating them as unpaid labour. Community participation is no longer a case of whether or not they want to take part, but rather of how far their socio-economic standard of living will benefit from the participation.

Communal fire breaks are permanent fire breaks created by utilising 'beje' ponds and blocked ditches/canals. The community will benefit from the 'beje' ponds (Box 18) and blocked ditches/canals (Boxes 18 and 19) by using them as fishponds from which they will be able to catch fish, thus gaining an alternative source of income. These 'beje' and ditches also function as fire breaks; if fire occurs in neighbouring peatland, bodies of water such as these will be capable of limiting the fire from spreading.

B. Fire Breaks

Measures to manipulate fuel can be carried out through fuel management techniques, one of which is to cut down or reduce the quantity of fuel. The construction of fire breaks is intended to divide up the large expanses of fuel into several parts or fragments, so that if fire occurs in one part it will not spread to the fuel or vegetation in the others.

Fire breaks can be divided into: (1) natural fire breaks, such as belts of living fire resistant vegetation, gullies, rivers, etc., and (2) artificial fire breaks which are constructed intentionally, such as the planting of fire resistant species, roads, long ponds, blocked ditches, reservoirs, etc. Both types of fire break function to separate fuel and to control/prevent the spread of fire from one location to another.

Natural fire breaks. In peat swamp which has not been much disturbed by man, the presence of water in fact causes the peat land and forest to remain naturally wet, with the result that the chance of fire is very small. Recently, however, and especially since 1997/98, because human intervention has penetrated far into the peatswamp forest, the peat's natural function of retaining large quantities of water has become greatly diminished. As a result, the peat dries out and becomes easy to burn. This Manual does not say much about natural fire breaks in peatlands because the natural functions they perform have been much disturbed. Discussion will be focused more on the construction of artificial fire-breaks, as follows below.

Artificial/communal fire breaks. The characteristic condition that distinguishes peatswamp land/forest from dryland areas is the change in character from inundation during the wet season to dryness during the dry season. In peatland, the wet season inundation has its positive and negative sides. The positive side is that fire is not a danger because the peat is saturated with water; the negative side is that many plants will die as a result of being inundated with water for so long. In the dry season, however, the material (vegetation) on the surface of the peatland as well as the underlying layer (peat soil) will dry out and pose a serious fire hazard. This is why measures to create artificial fire breaks to prevent peatland fire are so important. Several types of artificial/communal partitions can be constructed on peatland, including: (1) planting certain sites with fire resistant species, (2) constructing elongated ponds/'beje', (3) blocking ditches/canals in peatland, and (4) building dykes/ embankments around the peatland, then saturating the land by directing water to it from the rivers in the area.

(1) Planting Fire Resistant Species

Where peatland s used for agriculture, fire breaks can be made by planting a variety of fire resistant species such as banana, pinang, papaya, etc. Several rows of these are planted around the perimeter of the land. As well as functioning as fire breaks, these banana, pinang and papaya trees can also provide the farmer with an extra source of income. It must be remembered, however, that the dry leaves that fall from these trees also have the potential to spread fire if blown by the wind. To prevent his from happening, the dry leaves must be cleared away and either buried in the earth or made into compost as described above.

(2) Construction of 'beje' elongated ponds

A *'beje'* is a pond constructed by the people (usually from the Dayak ethnic communities) living in the forest interior of Central Kalimantan to trap fish **[see Box 18]**. These beje ponds are normally dug during the dry season; they measure 2 - 4 m in width, 1-2 m in depth and vary in length from 5m to tens of metres if constructed communally (not individually owned). These ponds are situated not far from human settlements and are near to rivers, so that in the wet season they will be filled with rain and/or overflow from the rivers. In the rainy season, flooding will occur and the rivers will overflow, thus filling the bejes with both water and wild fish. When the dry season arrives, the floods will recede but the bejes will retain water and fish. Thus, during the dry season, the community will harvest the fish, clean the mud out of the bejes or even dig new ones. Bejes like these function not only to trap wild fish, but do apparently also function as fire breaks. This can be seen in the photograph in Box 18, where the forest around the beje is still green and unburnt.

Box 18.

Bejes in S. Puning

*These photographs show examples of the many beje ponds found in the region of the Puning river, in the South Barito district of Central Kalimantan. These bejes are in the forest, at a distance of ± 500 m from rivers and human habitation. They vary in size: 1.5-2 m wide, 1-1.5 m deep, 10-20 m long. In the rainy season they fill with water from the overflowing rivers in the area. With the river waters come a variety of fish species which are then trapped in the bejes, including snakehead (*Chana *sp.), catfish (*Clarias *sp.), betok (*Anabas testudineus*), gouramy (*Trichogaster *sp.), kissing gouramy (*Helostoma *sp.). In the dry season these bejes still contain water and are maintained (e.g. cleared of mud) by the owners so they can also function as fire breaks.*

(3) Blocking of Ditches and Canals

The hydrology of peatlands is frequently damaged as a result of poorly controlled human activities, such as the construction of ditches, canals and channels, (see Box 19), logging, land burning, etc. Of these various activities, it is the construction of open canals, ditches, and channels in peatland (without maintaining a certain water level within them) whether for transporting timber (legal or illegal) logged from the forest or for irrigating agricultural land, which is considered to have caused the water to drain out from the peatland thus leaving it dry and susceptible to fire in the dry season (see Box 20). Proof of this can be seen in several peatland locations in Central Kalimantan and Sumatera where fire has occurred in the vicinity of canals and ditches.

Box 19

This photograph shows a primary canal constructed for the defunct PLG project in Kalimantan. The total length of canals and channels in the PLG area is around 2,114 km with widths ranging from ± 5m to 30m and depths (initially) of 2 – 15 metres.

Several of these canals have been abandoned and could cause the peat to be drained of its water, thus drying out and becoming susceptible to fire. If these canals were to be blocked, it can be imagined how many beje ponds and fire breaks could be created and how many tons of fish could be harvested.

Box 20

Community Ditch in Muara Puning

Ditches have been constructed by the local inhabitants to connect the river with the forest in order to extract the timber. They were dug by cutting into the peat with a chainsaw and mattocks. The length of these ditches (in Muara Puning, South Barito, Central Kalimantan) ranges from 3 to 15 Km, width 60cm to 200cm, and depth 35 to 150cm. The photograph (left) shows a ditch belonging to the community in South Barito. Most of these ditches have fallen into disuse as logging activities have declined due to the increasing scarcity in the number of trees of commercial value remaining.

In the dry season, these ditches contain very little water and many run completely dry. The peatland in the vicinity of the ditches has already been burnt as a result of excessive drying of the peat which made it susceptible to fire. There are thought to be 19 ditches running into the Puning river, 12 of them in dusun Batilap village and 7 in Muara Puning village. Some of these have been blocked by the local inhabitants facilitated by the CCFPI WI-IP project in cooperation with the Yakomsu foundation (Yayasan Komunitas Sungai, previously called SEKBER BUNTOK).

Table: Names of Rivers and number of ditches in Ds. Batilap

River Name	No. Ditches
Kelamper	1
Tana	1
Damar Puti	1
Pamantungan	1
Maruyan	1
Bateken	7

However, if these ditches/channels are blocked (see Boxes 20 & 21), there will be multiple benefits, including: (1) the water thus retained will not only enable the ditches to act as fire breaks but will also ensure that the peat in their vicinity remains moist and difficult to burn, (2) the stretches of ditch between the blockages can be used as 'beje' ponds which trap fish when the flood season arrives, (3) because the land around the blocked ditches remains moist, plants will grow easily or, in other words, the level of rehabilitation of vegetation will be better, (4) eventually the various benefits and ecological functions of the peat will be restored, for example its support for flora and fauna, hydrology, carbon sequestration and so on. [more detailed information on ditch/canal blocking techniques is given in the book: *Panduan Penyekatan saluran dan Parit bersama Masyarakat* (A guide to blocking ditches and channels in peatlands together with the community) by I N.N. Suryadiputra *et al*. 2005. CCFPI project, Wetlands International-Wildlife Habitat Canada and PHKA].

Box 21

Ditch Blocking in S. Merang

Ditches have also been constructed illegally by inhabitants in S. Merang-Kepahiyang in the Musi Banyuasin district of South Sumatera, for the purpose of extracting logged timber during the rainy season. Along the Merang river there are about 113 ditches, of which 83 are in peatland. The ditches were dug using chainsaws, and measure 1.7 – 3 m in width, 1.5 – 2.5 m in depth and 1.5 – 5 km in length. Several of these ditches are no longer used and there are indications that they have caused erosion and excessive drying during the dry season. In order to prevent the peat in this area from drying out and catching fire, the CCFPI Wetlands International Project in cooperation with a local NGO (WBH, Wahana Bumi Hijau) in May 2004 facilitated the blocking of 4 ditches by their owners [six more are to be blocked in September 2004]. In each ditch, 4 to 5 blockages were constructed.

Box 22.

These photographs show the condition of a ditch in Muara Puning village, South Barito, Central Kalimantan after being blocked by its owner in September 2003 (photo taken in June 2004) through the facilitation of the CFPI-WI-IP Project working together with Yakomsu. The impact of this blocking has indeed been positive; not only is the surrounding peatland still wet but the ditches are also filled with a good number of swamp fish (no fewer than 16 species of fish were found at this site, i.e.: gabus *(snakehead),* kihung, mehaw, sepat rawa *(swamp gouramy),* seluang ekor merah *(redtailed rasbora),* seluang ekor putih, kakapar, biawan *(kissing gouramy),* papuyuh hijau, papauyuh kuning, lele pendek *(short catfish),* pentet/lele panjang *(long catfish),* julung-julung *(forest half beak or needle fish),* lais *(glass catfish),* kelatau took *and* tombok bander. *Surface changes in the groundwater around the ditch and also changes in the level of water in the ditches are monitored routinely by the Muara Puning community under the direction of Yakomsu and WI-IP.*

There are several steps that must be taken to obtain optimum benefit from the *beje* and blocked ditches as fire breaks :

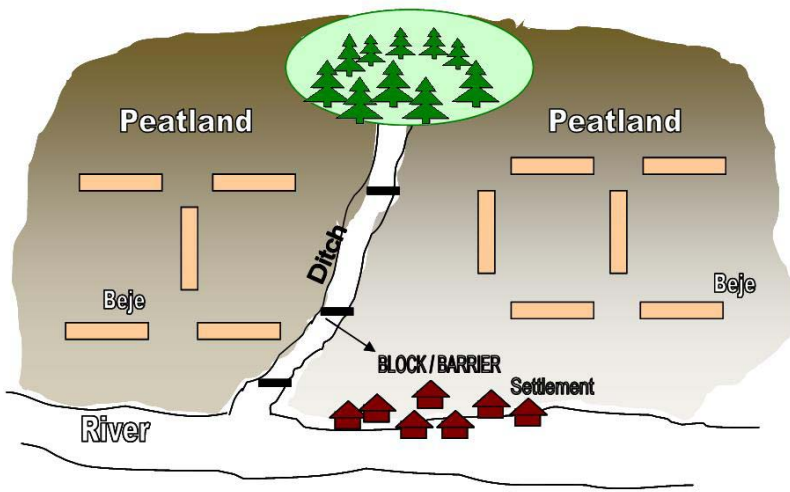
1. The beje and ditches must be cleared of mud, waste wood and other waste so that they contain the optimum amount of water and provide habitat conditions suitable for fish, and also to maintain their function as fire breaks.

2. Roots growing into the beje should be cut off and vegetation around the beje cleared away (to a radius of ± 50 cm).

3. To function optimally as fire breaks, the new bejes are dug around the perimeter of fields and should measure: 2m width, 2m maximum depth, 10-20m or longer in length. These measurements can be adapted as appropriate to suit field conditions.

4. If the land surrounding the beje/ditch is in a degraded condition (little or no vegetation cover) then succession needs to be accelerated through rehabilitation in the vicinity of the beje. The subsequent presence of vegetation is expected to accelerate recovery of the peatland's hydrology.

5. The management of bejes and ditches which function as fire breaks can be handled by community groups who, at the same time, are also members of the fire brigade. The members of the group are responsible for patrolling and surveillance of the area around their beje(s), including adjacent forest. If they discover a source of fire or activities which could lead to fire, the group leader reports this immediately to the fire control POSKO.



Sketch showing the benefits of blocking beje and ditches to form fire breaks

(4) Embankments in peatlands

Another way of preventing water from draining away from peatland, so that the peat does not catch fire, is to build dykes or embankments around it. These should not be far from a river and should be built (heaped) from mineral earth taken from the river. To maintain water levels in the peatland, particularly during the dry season, water can be pumped from the river or other reservoir (e.g. lake or swamp) into the peatland which we intend to protect from fire. The water level in the peatland can be controlled by constructing a small drainage channel (a small ditch or pvc pipe) and direct it toward other, lower-lying land.

Materials required for the construction of a dam using a pumping system of this sort are: Pump and PVC pipes.

Besides the pumping system described above, water can also be retained in a simple way, that is by collecting water on an expanse of peatland throughout the rainy season and keeping it there during the dry. The water can be collected by constructing a number of long dykes or embankments around an area of peatland which is likely to dry out and become a fire hazard. The advantage of this method is that no pumps are required, the system simply takes advantage of climate conditions, and the land does not need to be near a river. The difficulty, however, lies in obtaining the mineral soil to build the embankments.

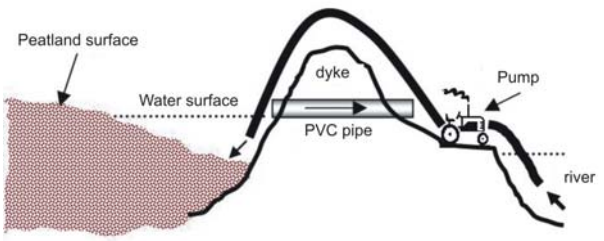


Illustration: Saturation of peatland by pumping, to prevent fire
(adapted from Stoneman & Brooks, 1997)

6.7 ZERO BURNING ON PEATLAND

Zero burning is a policy adopted by the member countries of ASEAN to overcome the problem of transboundary haze pollution due to fire. For this purpose, ASEAN has prepared a manual to serve as a guide to implementing the zero burning policy.

Several important points regarding the techniques for preparing land without burning are quoted from this manual and given below (ASEAN, 2003) :

A. Definition

"Z*ero burning* is a method of clearing land by cutting down trees in secondary forest or old plantations such as oil palm, then shredding them into fragments which are then gathered into heaps and left on site to decompose naturally."

B. Benefits of Zero Burning

1. It is an environmentally friendly approach which does not cause air pollution
2. It reduces emissions of greenhouse gases (GHG), in particular CO_2
3. Waste biomass (organic matter) can decompose thus increasing water absorption and soil fertility, thereby decreasing the need for anorganic fertilisers and reducing the risk of water pollution resulting from the surface leaching of nutrients.
4. Direct planting of seedlings on the heaps of organic waste will increase agronomic benefits (having higher levels of total nitrogen, exchanged potassium, calcium and magnesium and slower loss of nutrients)
5. Its implementation is not dependent on weather conditions

6. The period during which the land is without cover is shorter thus minimising the impact of surface run-off which can cause a fall in the water table as well as subsidence and pollution

7. The implementation of *zero burning* techniques in the replanting of oil palm will have the additional advantage that harvesting can continue uninterrupted until the moment that the trees are felled.

C. Obstacles to the Implementation of Zero Burning

1. The pest *Oryctes rhinocerous* (a kind of insect) and the disease *Ganoderma boninense* (a kind of mould) can attack cultivated crops unless intensive preventative measures are taken prior to and during the implementation of *zero burning*

2. In secondary forest and peat swamp, the implementation of *zero burning* can make the area susceptible to attack from termites (*Captotermes curvinaathus*, *Macrotermes gilvus*)

3. Piles of wood or biomass can become a breeding ground for rats

4. In general, *zero burning* is more expensive to carry out, especially on land with high volumes of biomass. This technique also requires the use of heavy machinery which smallholders could not possibly provide

5. During the dry season, piles of biomass could dry out and themselves become a fire hazard.

D. Zero Burning for Replanting on Peatland

A large Malaysian plantation company (Golden Hope Plantation) has adopted *zero burning* into its system of land preparation. The steps they follow are :

1. Planning

   - ❒ Create a design which takes into consideration the scope of work, the availability of the equipment and machinery required, the implementation time and budget
   - ❒ Provide training or field trips for the implementing personnel or contractors who do not sufficiently understand the *zero burning* technique
   - ❒ Replan the roads and drainage system
   - ❒ If the area has a history of *Ganoderma* attacks, replanting will be tighter (closer together)

2. Handling of *Ganoderma*

   - ❒ A detailed census is taken of those trees attacked by *Ganoderma;* they are marked and a record noted
   - ❒ The diseased trees are cut down prior to planting and are then shredded and placed between rows using an excavator

3. Boundary Determination

   - ❒ Boundaries are set by making new planting rows, roads, harvesting tracks and drainage channels

4. Construction of roads and channels

   - ❒ Secondary channels can be constructed before or as soon as possible after felling.
   - ❒ If the condition of the old drainage channels is not appropriate to the new layout, they must be filled in with earth and new drainage channels quickly dug. However, if the old channels can still be used, they should be cleared of mud until they are of the same depth as the new channels.

- ❒ On flat land, a secondary drainage channel should be constructed at each fourth or eighth planting row
- ❒ New drainage channels are constructed using a double rotary ditcher
- ❒ A bulldozer or excavator is used to construct new roads, which should be built quite high so that they will not be muddy or wet.

5. Felling and Shredding

- ❒ Old trees are felled directly using an excavator's hydraulic boom
- ❒ For effective shredding, the blade should be made from high tensile carbon steel
- ❒ Tree trunks are sawn up. This is normally done starting at the bottom of the trunk.

Felling
(Photo by Golden Hope Plantation Berhard)

Shredding
(Photo by Golden Hope Plantation Berhard)

6. Mounds

Mound
(Photo by United Plantation Berhard)

- In areas where 4 rows of trees are planted between 2 secondary drainage channels, the shredded materials are heaped into mounds along the centre between the 4 rows of trees between two secondary channels (illustration a).

- In areas where 8 rows of trees are planted between 2 secondary drainage channels, the shredded materials are heaped into mounds between alternate rows of trees between the drainage channels (illustration b).

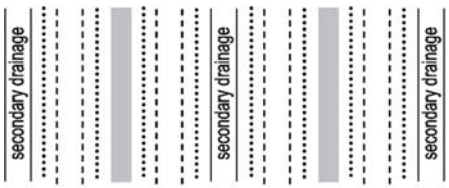
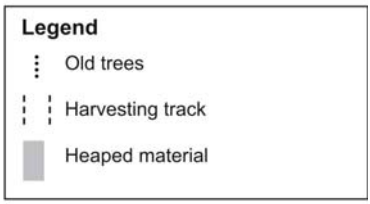


Illustration a. Heaping, with
1 drainage channel per 4 rows of trees

Illustration b. Heaping, with
1 drainage channel per 8 rows of trees



7. Ploughing and harrowing

When the felling, shredding and heaping are completed, the land along the new planting rows can be ploughed and harrowed in preparation for planting.

8. Planting legumes as ground cover

- Legumes should be planted immediately land preparation is completed to ensure close ground cover and accelerate the decomposition of the biomass. The legumes that cover the wood will reduce the risk of fire, reduce the proliferation of the insect *Oryctes* and the growth of grass. In addition, legumes will improve the soil's physical and chemical condition, especially as nitrogen fixers.

- Legumes frequently used are the bean plants *Pueraria javanica*, *Calopogonium mucinoides* and *Calopogonium caeruleum*

Legumes as ground cover
(Photo by United Plantation Berhard)

9. Digging of planting holes, and Planting

Holes can be dug and planting carried out as soon as land preparation is complete. The holes can be dug mechanically using a hole digger

10. Pulverization

- The need for pulverization depends on the risk of attack from the insect pest *Oryctes*. On land prone to *Oryctes* attacks, especially near the coast, pulverization must be carried out two to six months after felling and shredding in order to accelerate decomposition.

EnviroMulcher
(Photo by Applied Agricultural Research Sdn Bhd)

- Pulverization can be done using a modified heavy-duty rotary slasher or mulcher attached to a 80-100 HP tractor

11. Post Planting Management

After planting, top priority should be given to :

- management of pests and diseases.
- routine surveillance for damage by rats and, if possible, extermination through the use of rodenticides.

6.8 TECHNIQUES FOR SUPPRESSION OF LAND AND FOREST FIRE IN PEATLAND AREAS

Technically, fire suppression is a series of steps taken to extinguish a fire according to its type, and to prepare the necessary equipment for this purpose. Fire suppression steps which can be carried out in peatland and peatland forest areas comprise the following :

- Determine the direction in which the fire is spreading (this can be done by observation from a higher point or by climbing a tree)

- Before initiating fire suppression, a water-saturated transect is made to slow down the spread of the fire, acting as a non-permanent fire break.

Fire break from the 1997 fires in Central Kalimantan (TSA CIMTROP UNPAR)

- To prevent fire from jumping across, it is necessary to cut down dead trees which are still standing upright (snags). This is because in strong winds, if fire has reached the apex of a dead tree, its embers or even flaming branches can fly over 200 metres away

- If there is no water source in the area, then boreholes must be sunk. If there is a water source but it is far from the fire, a water supply is obtained through a relay (using several water pumps). If a borehole well is made, its coordinates need to be recorded so that it is easy to find again in case of future fires.

Sinking wells along the length of the fire break as sources of water for fire suppression (TSA CIMTROP UNPAR)

- Direct fire suppression should be done from the tail (back) or from the right and left sides of the fire. Do not attempt to fight the fire from the front (fire head) because this is extremely dangerous. The flame height and length are always changing and it is difficult to predict both the direction and speed at which the fire will spread; moreover, the smoke is so hot and profuse that the water sprayed against the fire is ineffective as it does not directly reach the actual fire.

- Indirect fire suppression can be done using the '*backing fire*' technique, which is to burn in the opposite direction to that in which the fire is spreading, in combination with the construction of artificial fire breaks.

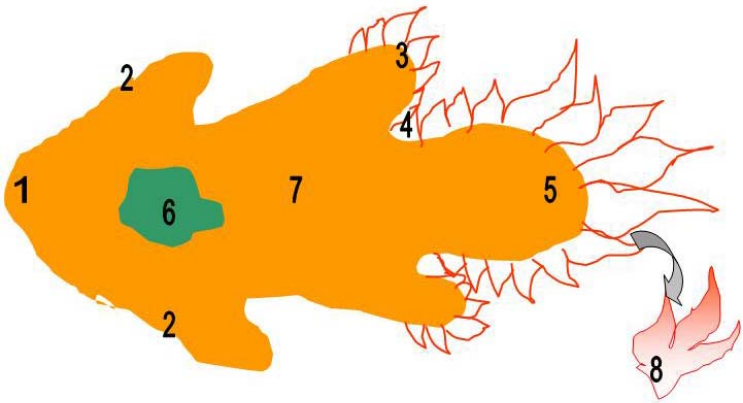


Illustration of fire parts

EXPLANATION

1. Back	:	area which has been burned by the fire
2. Sides	:	edges of the blazing area
3. Fingers	:	parts of the fire which spread in different directions from that of the main blaze and thus form a finger-like pattern
4. Bay	:	area between a finger and the main body of the fire
5. Head	:	the head of the main fire
6. Island	:	an unburnt area in the middle of a fire
7. burned area	:	area which has been burned and where the fire is out
8. jumping fire	:	fire occurring as a result of fire leaping from the burning area

- Fire suppression should be carried out using the correct techniques and in a coordinated manner, as in using fire engines in combination with manual equipment

- In burnt areas, mopping up operations must first be carried out to clear the area of embers and ensure that the fire is well and truly out. It is done by spraying water on the surface of the burnt land. This is essential in order to prevent fire from recurring

- ❒ Fire-fighters must walk with great care, using ±2m long planks, to prevent them from sinking into holes left by the fire and also to guard against flames that might flare up

- ❒ Surface fire suppression is carried out by accurately directing a jet of water at the source of the blaze, using a pump. This must hit the target and be effective, so that the very limited supply of water can be used to maximum advantage. To achieve this, tree stumps/ trunks are chopped up with machetes until the fire is completely extinguished.

- ❒ If the fire is in the tree crowns, direct suppression can be carried out with the help of heavy equipment such as aircraft, tractors, bulldozers; alternatively, indirect suppression methods can be used such as *backing fire,* i.e. burning in the reverse direction (in the opposite direction to that in which the blaze is spreading). The use of such equipment to suppress this kind of fire does not require large numbers of personnel; however, it is recommended that such methods are not used for peatland fires because it is extremely difficult to predict the direction in which peatland fires will spread.

- ❒ In cases of ground fire, especially in peatlands during the dry season, suppression is done using a needle stick which has a hole at the end. The stick's nozzle is jabbed into the smoking ground until the peat fuel takes on the appearance of porridge – a sign that it is saturated with water. This ground piercing is continued until the fire has been extinguished.

- ❒ It is essential also to extinguish all remnants of the fire, considering that such remnants, concealed beneath stumps and charred debris on peatlands, are often overlooked. This can be done by digging them up with mattocks and harrows then respraying with water until the fire is completely extinguished and there is no longer any smoke being given off. If left, such remnants can flare up again should they come into contact with the dry peat/material below.

- ❒ The area of the fire should be inspected approximately one hour after the fire remnants have been extinguished, with the purpose of ensuring that the area is truly free from fire.

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APPENDIX 1. A BRIEF DESCRIPTION OF SEVERAL REGULATIONS PERTAINING TO POLICY ON LAND AND FOREST FIRE CONTROL IN INDONESIA

1. Law no.5, 1967

   This law was policy issued by the government to regulate forestry management in Indonesia at the beginning of the New Order period. In general, it is known as the *Undang-undang Pokok Kehutanan*, consisting of 8 chapters and 22 articles. Policy on land and forest fire control is given in chapter V articles 15-18 concerning forest conservation. It states that forest fire prevention is part of forest conservation, in the implementation of which the community must be involved, and that further stipulations relating to this would be issued as government regulations.

2. Law no.5, 1990

   This law concerns regulations for the Conservation of Biological Resources and their Ecosystems. It contains basic regulations on the Conservation of Biological Resources, covering protection for life support systems, the conservation of botanical and zoological biodiversity and their ecosystems, the sustainable utilization of biological resources and their ecosystems, and community participation in conservation activities.

3. Law no.5, 1994

   This law is the ratification of the United Nations Convention on Biodiversity, incorporating it into policy on biodiversity in Indonesia. The convention contains 42 articles concerning general measures for the conservation and sustainable utilization of biodiversity, community awareness raising, technological development and funding.

4. Law no.6, 1994

This law concerns ratification of the United Nations Convention on Climate Change. The convention comprises 26 articles, which cover the convention's aims and principles, the obligations of the parties, the participants, and regulations concerning the procedures of the convention. Land and forest fire is very closely related to this convention, considering that the fires release tons of sequestered carbon from vegetation, peat, etc.

5. Law no.23, 1997

This law on environmental management comprises 52 articles and clarifies the terms related to environmental management; the principles, aims and goals of environmental management in Indonesia; the rights and obligations of the public in managing the environment; stipulations concerning environmental planning and conservation; investigation and solution of disputes and penalties for disobeying regulations on environmental management.

6. Law no.41, 1999

This law, comprising 17 chapters and 84 articles, is a revision of Law no.5 of 1967 concerning forestry policy in Indonesia.

- ❒ In chapter V, it is explained that rehabilitation, forest protection and nature conservation are part of forestry management in Indonesia.
- ❒ The fourth part of chapter V makes stipulations concerning the types of rehabilitation, location, implementation methods, and the implementers of the rehabilitation.
- ❒ The fifth part of chapter V concerns regulations for forest protection and nature conservation, where forest fire prevention is part of measures for the protection of forests and their surrounding areas, responsibility and authority for implementing forest protection.

- ❒ Article 48 paragraph 1 explains that the government regulates all aspects of forest protection, both inside and outside the forest areas
- ❒ Responsibility for fire incidents is stipulated in article 49 where it is stated that the concession holders and licence holders are responsible for forest fire occurring in their work area.
- ❒ Measures for forest protection (including fire) are carried out with the participation of the community (article 48 clause 5)
- ❒ Basically, every individual is forbidden to burn forest or discard anything which could cause fire (article 50 clause 3d,l)
- ❒ Penalties for offenders are given in article 78 clauses 3, 4 and 11. Whoever intentionally burns forest faces a maximum prison sentence of 15 years and a maximum fine of 5 billion rupiah, and can also be subjected to additional sentences. If the fire is started unintentionally (through negligence), the maximum punishment is 5 years imprisonment and a 1.5 billion rupiah fine. Anyone found throwing away incendiary materials thus causing a fire could be sentenced to a maximum of 3 years jail and 1 billion rupiah fine.

7. Government Regulation (PP) no. 4, 2001

PP no 4, 2001 concerns the control of environmental pollution and damage related to land and forest fires. This regulation covers measures for prevention, handling and amelioration, as well as for supervising the control of environmental pollution/damage control related to land and forest fires; the responsibilities and authority of central and local government and all parties involved in controlling environmental pollution and/or damage; the granting of regional authority to form land and forest fire organizations; regulations on the obligations of individuals, groups and business practitioners if land and forest fire occurs; and penalties for offenders.

APPENDIX 2. LIST OF INSTITUTIONS CONCERNED WITH LAND AND FOREST FIRE, AT REGIONAL, NATIONAL AND LOCAL LEVELS

The ASEAN Secretariat
70A Jl. Sisingamangaraja
Jakarta 12110 - Indonesia
Tel : (6221) 7262991, 7243372
Fax : (6221) 7398234, 7243504
Email : public@aseansec.org
Website : www.aseansec.org
www.haze-online.or.id

Departemen Kehutanan
Gedung Manggal Wanabakti
Jl. Jend. Gatot Subroto, Jakarta
Tel : (021) 573-1820
Fax : (021) 570-0226
http://www.dephut.go.id

Departemen Pertanian
Jl. Harsono RM. No. 3 Ragunan
Pasar Minggu Jakarta 12550
Tel : (021) 780-4056
Fax : (021) 780-4237
http://www.deptan.go.id

Departemen Tenaga Kerja dan Transmigrasi
Jl. Jend. Gatot Subroto Kav. 51
Jakarta 12950
Tel : (021) 522-9285, 798-9924
Fax : (021) 797-4488
http://www.transkep.go.id

Kementerian Lingkungan Hidup
B Building, 2nd Floor,
Jl. DI. Panjaitan, Kav. 24
Kebon Nanas, Jakarta 13410
Tel : (021) 858-0103
Fax : (021) 858-0101
http://www.menlh.go.id

Lembaga Penerbangan dan Antariksa Nasional (LAPAN)
Jl. Pemuda, Persil No. 1
Rawamangun, Jakarta 13220
Tel : (021) 489-2802
Fax : (021) 489-4815
http://www.lapan.go.id

Badan Pengkajian dan Penerapan Teknologi (BPPT)
Jl. M.H. Thamrin No. 8
Jakarta 10340
Tel : (021) 316-8440 / 8453
Fax : (021) 390-4537
http://www.bppt.go.id

Kementrian Koordinator Bidang Politik dan Keamanan
Jl. Merdeka Utara No. 7
Jakarta 10110
Tel : (021) 3849453, 3451064
Fax : (021) 3450918
http://www.polkam.go.id

Badan Meteorologi dan Geofisika
Jln. Angkasa I/2 Kemayoran
Jakarta Pusat 10720
INDONESIA
Ph. (62-21) 4246321, 6546311 Fax. (62-21) 4246703
http://www.bmg.go.id

Badan SAR Nasional
Jl. Medan Merdeka Timur no.5
Jakarta 10110
Tel (021) 348-32881,32908,32869
Fax (021) 348-32884,32885
e-mail: Basarnas@Basarnas.go.id
http://www.basarnas.go.id

Prop. Daerah Istimewa Aceh (Nanggroe Aceh Darussalam)

❒ **Dinas Kehutanan Propinsi**
Jl. Jenderal Sudirman No 21
Banda Aceh
Tel. (0651) 42277, 43628;
Fax. (0651) 43628

❒ **DinasPertanian TPH**
Jl. Panglima Nyak Makam No.24
Banda Aceh
Tel (0651),51301, 53541, 53640
Fax (0651) 51301

❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Pertanian & Kehutanan Kota Sabang
  Jl. Haji Agussalim – Sabang
  Tel 0652-22002

- Dinas Kehutanan Kabupaten Aceh Besar
  Jl. Prof. A. Majid Ibrahim – Jantho
  Tel 0651-92257

- Dinas Perkebunan & Kehutanan Kabupaten Aceh Pidie
  Jl. Prof Madjid Ibrahim, Sigli
  Tel 0653-21547
  Fax 0653-25422

- Dinas Perkebunan & Kehutanan Kabupaten Bireun
  Jl. Sultan Iskandar Muda, Bireun

- Dinas Perkebunan & Kehutanan Kabupaten Aceh Utara
  Jl. Mayjend T. Hamzah Bendahara – Lhokseumawe
  Tel 0645-43229
  Fax 0645-43949

- Dinas Perkebunan & Kehutanan Kabupaten Aceh Timur
  Jl. A. Yani No. 108 – Langsa
  Tel 0641-21475
  Fax 0641-21475

- Dinas Pertanian Kabupaten Aceh Tamiang
  Kuala Simpang
  0641-332892

- Dinas Kehutanan Kabupaten Aceh Tengah
  Jl. Yos Sudarso No. 5 – Takengon
  Tel 0643-21103
  Fax 0643-21103

- Dinas Kehutanan & Perkebunan Kabupaten Aceh Jaya, Calang

- Dinas Perkebunan & Kehutanan Kabupaten Aceh Barat
  Jl. Sisingamaharaja No. 65-67 Meulaboh
  Tel 0655-21240
  Fax 0655-21722

- Dinas Kehutanan Pertanian & Transmigrasi Kabupaten Nagan Raya
  Jl. Nigan No. 48 Suka Makmue

- Dinas Kehutanan Kabupaten Aceh Barat Daya
  Jl. At Taqwa No. 79 Blang Pidie
  Tel 0655-21240
  Fax 0655-21722

- Dinas Perkebunan & Kehutanan Kabupaten Aceh Selatan
  Jl. T. Cut Ali No. 95 Tapaktuan
  Tel 0656-21114
  Fax 0656-322009

- Dinas Kehutanan & Perkebunan Kabupaten Aceh Tenggara
  Jl. Raya Tanah Merah Km. 4,5 Kutacane
  Tel 0629-21251

- DInas Kehutanan & Perkebunan Kabupaten Gayo Lues
  Blang Kejeren

- Dinas Kehutanan Kabupaten Simeulue
  Jl. Nusantara No. 28 – Sinabang
  Tel 0650-21055, 21597
  Fax 0650-21055

- Dinas Kehutanan Kabupaten Aceh Singkil
  Jl. Utama No. 1 – Singkil
  Tel 0658-21039
  Fax 0658-21317

- Dinas Pertenian, Peternakan & Perikanan Kelauta
  Kota Langsa

Prop. Sumatera Utara

❒ **Dinas Kehutanan**
Jl. Sisingamangaraja Km. 5,5 No. 14 Marindal Medan 20147
Tel. (061) 7868438;
Fax. (061) 7862065

❒ **Dinas Pertanian**
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan dan Perkebunan Kabupaten Mandailing Natal
  Komp. Perkantoran Pemda Madina - Penyabungan
  Tel. (0636) 20935

- Dinas Kehutanan Kabupaten Tapanuli Selatan
  Jl. Perintis Kemerdekaan No. 54 Kel. Padang Matinggi, Padang Sidempuan
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- Dinas Kehutanan dan Perkebunan Kabupaten Asahan
  Jln. Turi No. 1 Kisaran
  Tel. (0623) 41946

- Dinas Kehutanan Kabupaten Simalungun Jln. Sisingamangaraja No. 124 Pemantang Siantar
  Tel. (0622) 22286

- Dinas Pertanian dan Kehutanan Kabupaten Tapanuli Tengah
  Jl. Perintis Kemerdekaan No. 1 Pandan 22611
  Tel. (0631) 21513

- Dinas Pertanian dan Kehutanan Kabupaten Nias
  Jln. WR. Supratman No. 9 Gunung Sitoli
  Tel. (0639) 21829

- Dinas Kehutanan dan Perkebunan Kabupaten Karo
  Jln. Samura No. 5 Kabanjahe
  Tel. (0628) 20570

- Dinas Kehutanan dan Perkebunan Kabupaten Langkat
  Jln. Imam Bonjol No. 6 Stabat
  Tel. (061) 8910066

- Dinas Kehutanan dan Perkebunan Kabupaten Labuhan Batu
  Jl. Gouse Gautama No. 088 Rantauprapat
  Tel. (0624) 21866

- Dinas Kehutanan dan Perkebunan Kabupaten Dairi
  Jl. Barisan Nauli No.8 Sidikalang Kab. Dairi
  Tel. (0627) 21032

- Dinas Kehutanan Kabupaten Deli Serdang
  Jl. Karya No. 1 Komp. Perkantoran Pemda Kab Deli Serdang
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- Dinas Kehutanan dan Perkebunan Kabupaten Toba Samosir
  Jln. Dr. Hadrianus Sinaga No. 1 Pangururan
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- Dinas Kehutanan Kabupaten Tapanuli Utara
  Jln. Pahae Km. 2,5 Tarutung
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- Dinas Kehutanan dan Perkebunan Kabupaten Madina
  Jln. Merdeka No. 131 Penyabungan
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Prop. Riau

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❒ **Dinas Tanaman Pangan**
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❒ **Dinas Kehutanan dan Pertanian Kabupaten**

- Dinas Kehutanan Kabupaten Bengkalis
  Jl. Jend. Sudirman No. 024,
  Bengkalis 28712.
  Tel. (0766) 21016, 23845;
  Fax. (0766) 21014

- Dinas Kehutanan Kabupaten Rokan Hulu
  Jl. Diponegoro Km. 1 Pasir Pengarayan
  Tel. (0762) 91452

Prop. Sumatera Barat

❒ **Dinas Kehutanan**
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❒ **Dinas Pertanian TP & Perkebunan**
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan dan Perkebunan Kabupaten Padang Pariaman
  Jl. Imam Bonjol No. 30
  Pariaman
  Tel. (0751) 92985

- Dinas Kehutanan dan Perkebunan Kabupaten Lima Puluh Kota
  Jl. Tabek Panjang No. 1
  Payakumbuh 26251
  Tel/Fax. (0752) 90380

- Dinas Kehutanan dan Perkebunan Kabupaten Sawah Lunto-Sijunjung
  Jl. Sudirman No. 17 Muaro Sijunjung
  Tel. (0754) 20061

- Dinas Kehutanan dan Perkebunan Kabupaten Pasaman
  Jl. Prof. Hazairin No. 1
  Pasaman
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- Dinas Kehutanan dan Perkebunan Kabupaten Solok
  Jl. Koto Baru - Solok
  Tel. (0755) 20975

- Dinas Kehutanan dan Perkebunan Kabupaten Pesisir Selatan
  Jl. Mohamad Hatta - Painan
  Tel. (0756) 21441

- Dinas Pertanian dan Perkebunan Kabupaten Tanah Datar
  Jl. Letjen. Suprapto No. 3
  Batu Sangkar
  Tel. (0752) 71595 , 73184

- Dinas Kehutanan dan Perkebunan Kabupaten Kep. Mentawai
  Jl. Nipah - Padang
  Tel. (0751) 37241

- Dinas Pertanian, Perkebunan dan Kehutanan Kabupaten Lubuk Basung Agam
  Jl. Koto Padang Baru Lubuk Basung
  Tel. (0752) 76316

- Dinas Pertanian dan Kehutanan Kotamadya Padang
  Jl. S. Parman Lolong - Padang
  Tel. (0759) 54174

Prop. Jambi

❒ **Dinas Kehutanan**
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❒ **Dinas Pertanian TP**
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan dan Konservasi Tanah Kabupaten Kerinci
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- Dinas Kehutanan Kabupaten Sorolangun
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Prop. Sumatera Selatan

❒ **Dinas Kehutanan**
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❒ Dinas Kehutanan & Pertanian Kabupaten

- Dinas Kehutanan dan Perkebunan Kabupaten Muara Enim
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- Dinas Kehutanan dan Perkebunan Kabupaten Musi Banyuasin
Jl. Kol. Wahid Udin No. 254
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- Dinas Kehutanan Kabupaten Musi Rawas
Jl. Pembangunan, Taba Pingin,
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- Dinas Kehutanan dan Perkebunan Kabupaten Ogan Komering Ulu
Jl. Mayor Iskandar No. 1164
Baturaja
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- Dinas Kehutanan Kabupaten Ogan Komering Ilir
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- Dinas Kehutanan dan Perkebunan Kabupaten Lahat
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Prop. Bangka Belitung

❒ **Dinas Kehutanan dan Pertanian**
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan dan Perkebunan Kabupaten Bangka
Jl. Diponegoro No. 15,
Sungai Liat,
Kab. Bangka
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- Dinas Pertanian dan Kehutanan Kabupaten Bangka Belitung
Jl. A. Yani No. 90
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Prop. Bengkulu

❒ **Dinas Kehutanan**
Jl. Pembangunan Simpang Harapan Bengkulu
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❒ **Dinas Pertanian dan Ketahanan Pangan**
Jl. Pembangunan pd Harapan Bengkulu 38225
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan Kabupaten Bengkulu Utara
  Jl. Ir. Soekarno 174
  Argamakmur
  Tel. (0737) 521367

- Dinas Kehutanan Kabupaten Bengkulu Selatan
  Jl. Raya Padang Panjang, Manna,
  Bengkulu Selatan
  Tel. (0739) 21294

- Dinas Kehutanan dan Perkebunan Kabupaten Rejang Lebong
  Jl. S. Sukowati No. 60 Curup
  Rejang Lebong
  Tel/Fax. (0732) 21424

Prop. Lampung

❒ **Dinas Kehutanan**
Jl. H. Zainal Abidin Pagar Alam Rajabasa, Bandar Lampung 35144
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❒ **Dinas Pertanian dan Ketahan Pangan**
Jl. Hj. Zainal Abidin Pagaralam No.1 Rajabasa, Bandar Lampung 35144
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas kehutanan dan Perkebunan Kabupaten Way Kanan
  Jl. Trans Sumatera Km. 191, Bumi Ratu, Blambangan Umpu Kab. Way Kanan
  Tel. (0828) 722163

- Dinas Perkebunan dan Kehutanan Kabupaten Tulang Bawang
  Jl. Cemara Komplek Perkantoran Pemda Kab. Tulang Bawang, Menggala
  Tel. (0726) 21163;
  Fax. (0726) 21642

- Dinas Kehutanan dan Perkebunan Kabupaten Tanggamus
  Jl. Jendral Suprapto Kota Agung, Tanggamus - Lampung
  Tel. (0722) 21835

- Dinas Perkebunan dan Kehutanan Kabupaten Lampung Timur
  Jl. Kol Hasan Basri Sukadana
  Lampung Timur

- Dinas Kehutanan dan Perkebunan Kabupaten Lampung Tengah
  Jl. K.H.M. Muchtar No.1
  Gunung Sugih - Lampung Tengah
  Komplek Perkantoran Pemda

- Dinas Kehutanan Kabupaten Lampung Selatan
  Jl. Indra Bangsawan No. 26
  Kalianda
  Tel. (0727) 2012

- Dinas Kehutanan Kabupaten Lampung Utara
  Jl. Soekarno Hatta No. 40
  Kota Alam, Kotabumi - Lampung Utara
  Tel. (0724) 22666

Prop. DKI Jakarta

❒ **Dinas Kehutanan**
Gd. Dinas Teknis Pemda DKI Jakarta
Jl. Gunung Sahari Raya Lt. 7 No. 11
Jakarta Pusat
Tel. (021) 6285486 / 6007244, psw. 256; Fax. (021) 6007249

❒ **Dinas Pertanian**
Jl. Gunung Sahari Raya No. 11 Lt. 5 ,6 dan 7 Jakarta Pusat 10720
Tel (021)6286625-26,6285485
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Prop. Jawa Barat

❒ **Dinas Kehutanan**
Jl. Soekarno Hatta No. 751 Km. 11,2 Bandung 40292
Tel. (022) 7304031;
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❒ **DinasPertanian TP**
Jl. Surapati No. 71 Bandung 40133
Tel (022) 2503884, 2500713, 2506109,
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas kehutanan dan Perkebunan Kabupaten Bogor
  Jl. Bersih, Desa Tengah, Cibinong 16914
  Tel. (021) 8760050-8760226

- Dinas Perhutanan dan Konservasi Tanah Kabupaten Cianjur
  Jl. Pangeran Hidayatullah No. 154, Cianjur 43215
  Tel. (0263) 265476

- Dinas kehutanan dan Perkebunan Kabupaten Purwakarta
  Jl. Purnawarman Barat No. 5/9, Purwakarta
  Tel/Fax. (0264) 201006

- Dinas Kehutanan dan Perkebunan Kabupaten Sukabumi Jl. K.H. A. Sanusi K. 840, Sukabumi-43152
  Tel. (0266) 215572

- Dinas Perkebunan dan Kehutanan Kabupaten Garut
  Jl. Pembangunan No. 181 Garut 44151
  Tel. (0262) 233539;
  Fax. (0262) 540430

Prop. Banten

❒ **Dinas Kehutanan**
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❒ **Dinas Pertanian**
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan dan Perkebunan Kabupaten Lebak
  Jl. Raya Siliwangi - Lebak
  Tel. (0252) 201068

- Dinas Kehutanan dan Perkebunan Kabupaten Pandeglang
  Jl. Lintas Timur - Pandeglang
  Tel. (0253) 201334

Prop. Jawa Tengah

❒ **Dinas Kehutanan**
Jl. Menteri Soepeno 1/2 Semarang
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❒ **Dinas Pertanian TP**
Jl.Jenderal Gatot Subroto-Tarubudaya-Ungaran PO Box Ungaran 139
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Pertanian dan Kehutanan
  Kabupaten Batang
  Jl. Dr. Wahidin No. 56 Batang
  Tel. (0285) 391092

- Dinas Kehutanan Kabupaten Cilacap
  Jl Kalimantan No. 34 Cilacap
  Tel. (0282) 543706

- Dinas Pertanian dan Kehutanan Kabupatem Demak
  Jl. Sultan Patah No. 01, Demak
  Tel. (0291) 685013, 685636

- Dinas Kehutanan dan Perkebunan kabupaten Jepara
  Jl. Ratu Kalinyamat No. 7 Jepara
  Tel. (0291) 591211

- Dinas Pertanian Kabupaten Karanganyar
  Jl. K.H. Samanhudi No. 2
  Komp. Perkantoran Cangakan karanganyar
  Tel. (0271) 494801

- Dinas Pertanian Kabupaten Kebumen
  Jl. Ronggowarsito 298, Pejagoan, Kebumen 54361
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- Dinas Pertanian dan Kehutanan
  Kabupaten Klaten
  Jl. Perintis Kemerdekaan Km 3, Jonggrangan, Klaten
  Tel. (0272) 326206

- Dinas Pertanian dan Kehutanan
  Kabupaten Purworejo
  Jl. Mayjen. Sutoyo No. 29-31 Purworejo
  Tel. (0275) 321404

- Dinas Pertanian Kabupaten Semarang
  Jl. Letjen. Suprapto No. 9 B Ungaran, Semarang
  Tel. (024) 6924728

- Dinas Lingkungan Hidup Kabupaten Sukaharjo
  Jl. Tentara Pelajar, Jondor Komplek Gelora Merdeka, Sukoharjo
  Tel. (0271) 591613

- Dinas Pertanian, Perkebunan dan Perhutanan
  Jl. Ir. H. Juanda No. 10 Slawi
  Tel. (0283) 491872

- Dinas Kehutanan dan Perkebunan Kabupaten Wonosobo
  Jl. Mayjend Bambang Sugeng 159, Wonosobo
  Tel. (0286) 324056

Prop. Daerah Istimewa

❒ **Dinas Kehutanan Yogyakarta**
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❒ **Dinas Pertanian**
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❒ Dinas Pertanian & Kehutanan Kabupaten

- Dinas Pertanian dan Kehutanan Kabupaten Bantul
  Jl. KH. Wakhid Hasyim 210, Bantul 55173
  Tel. (0274) 367541, 367316

- Dinas Kehutanan dan Perkebunan Kabupaten Gunung Kidul
  Jl. Brigjen Katamso No. 8 Wonosari, Gunung Kidul
  Tel. (0274) 391539

- Dinas Pertanian Dan Kehutanan Kabupaten Kulonprogo
  Jl. Sugiman, Wates, Kulonprogo
  Tel. (0274) 773009

- Dinas Pertanian dan Kehutanan Kabupaten Sleman
  Jl. Rajiman, Sucen,Triharjo, Sleman
  Tel. (0274) 868043

Prop. Jawa Timur

❒ **Dinas Kehutanan**
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❒ **Dinas Pertanian**
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Kantor Kehutanan Kabupaten Bangkalan
  Jl. Halim Perdana Kusuma No. 7, bangkalan
  Tel. (031) 3096578

- Dinas Kehutanan dan Perkebunan Kabupaten Banyuwangi
  Jl. KH. Agus Salim No. 128
  Banyuwangi
  Tel. (0333) 426645

- Dinas Kehutanan dan Perkebunan Kabupaten Bojonegoro
  Jl. Patimura No. 26,
  Bojonegoro 62115
  Tel. (0353) 881526

- Dinas Kehutanan dan Perkebunan Kabupaten Bondowoso
  Jl. Mastrip 237 Bondowoso
  Tel. (0332) 421425

- Dinas Pertanian Kabupaten Gresik
  Jl. Dr. Wahidin Sudirohusodo 231, Gresik
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  Fax. (031) 3950930

- Dinas Kehutanan, Perkebunan dan Lingkungan Hidup Kabupaten Kediri
  Jl. Pemenang No. 01,
  Kediri 64182
  Tel. (0354) 682405

- Dinas Lingkungan Hidup dan Kehutanan Kabupaten Madiun
  Jl. Raya Dungus Km. 4
  Madiun 63181
  Tel. (0351) 495355

- Dinas Kehutanan Kabupaten Magetan
  Jl. Samudra No. 98 Magetan 63315
  Tel. (0351) 894521

- Dinas Kehutanan Kabupaten Malang
  Jl. Raya Genengan Km. 9,3 Pakisaji
  Kotak Pos.17 Kebon Agung, Malang 65161
  Tel. (0341) 806454

- Dinas Perkebunan dan Kehutanan Kabupaten Mojokerto
  Jl. Raya Jabon No. 188 Kec. Puri
  Kotak Pos 107 Mojokerto
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Prop. Bali

❒ **Dinas Kehutanan**
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❒ **Dinas Pertanian TP**
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kotak pos 3038
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Perhutanan dan Perkebunan Kabupaten Badung
  Jl. Mataram No.1 Denpasar 80237
  Tel. (0361) 222195; Fax. (0361) 225095

- Dinas Pertanian, Perkebunan dan Perhutanan Kabupaten Bangli
  Jl. Merdeka No. 81, Bangli Tel. (0366) 91021

- Dinas Kehutanan dan Perkebunan Kabupaten Buleleng
  Jl. Jatayu No. 17 Singaraja, Bali - 81116
  Tel. (0362) 31267

- Dinas Pertanian Bidang Kehutanan Kabupaten Gianyar
  Jl. Raya Gianyar Bangli
  Tel. (0361) 941466

- Dinas Kehutanan dan Perkebunan Kabupaten Jembrana
  Jl. Ngurah Rai No. 86 Negara
  Tel. (0365) 41027

- Dinas Kehutanan dan Perkebunan Kabupaten Karangasem
  Jl. Ngurah Rai No. 52 Amlapura
  Tel. (0363) 21474

- Dinas Kebersihan dan Lingkungan Hidup Kabupaten Klungkung
  Jl. Gunung Agung No. 55 Klungkung
  Tel. (0366) 21357

- Dinas Kehutanan Kabupaten Tabanan
  Jl. Gatot Subroto II/1 Sanggulan Tabanan
  Tel. (0361) 810937

Prop. Nusa Tenggara Barat

❒ **Dinas Kehutanan**
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Fax. (0370) 640457

❒ **Dinas Pertanian**
Jl. Pejanggik No. 10 Mataram
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan dan Perkebunan Kabupaten Lombok Timur
  Jl. Dr. Cipto Mangunkusumo No. 6 Selong - 83612
  Tel. (0376) 21562

Prop. Nusa Tenggara Timur

❒ **Dinas Kehutanan**
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❒ **Dinas Pertanian TPH**
Jl. Polisi Militer No.7 Kupang
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan Kabupaten Belu
  Jl. Moruk Pasunan - Tini Atambua
  Tel. (0389) 21006, 21515

- Dinas Pertanian dan Kehutanan Kabupaten Kupang
  Jl. Eltari II Bundaran PU - Kupang
  Tel. (0380) 828002, 830225

- Dinas Kehutanan Kabupaten Manggarai
  Jl. Achmad Yani, Ruteng.
  Tel. (0385) 21039 Fax. (0385) 21039

- Dinas Kehutanan Kabupaten Ngada
  Jl. Soekarno Hatta, Bajawa
  Tel. (0384) 21068

- Dinas Kehutanan Kabupaten Sumba Barat Jl. Wee Karou
  Kec. Loli - Wakabubak
  Tel. (0387) 21724

Prop. Kalimantan Barat

❒ **Dinas Kehutanan**
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❒ **Dinas Pertanian TP**
Jl. Alianyang No. 17 Kotak Pos 1094. Pontianak 78116
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan dan Perkebunan Kabupaten Bengkayang
  Jl. Sanggauledo No. 37
  Tel.(0562) 441556

- Dinas Kehutanan dan Perkebunan Kabupaten Kapuas Hulu
  Jl. Danau Luar No.4, Kab. Kapuas Hulu Putussibau
  Tel. (0567) 21359

- Dinas Kehutanan Kabupaten Ketapang
  Jl. Letkol. M. Tohir No. 11, Ketapang Kalimantan Barat
  Tel. (0534) 32401
  Fax. (0534) 32724

- Dinas Kehutanan dan Perkebunan Kabupaten Landak
  Jl. Pangeran Cinata
  Ngabang

- Dinas Kehutanan dan Perkebunan Kabupaten Pontianak
  Jl. R. Kusno Mempawah
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- Dinas Pertanian, Kehutanan dan Perkebunan Kabupaten Sambas
  Jl. Gusti Hamzah Sambas No. 21
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- Dinas Kehutanan dan Perkebunan Kabupaten Sanggau
  Jl. Kornyos. Sudarso No. 32, Kec. Beringin Sanggau
  Tel. (0564) 21067

- Dinas Kehutanan dan Perkebunan Kabupaten Sintang
  Jl. Dr. Wahidin
  Tel. (0565) 22222
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Prop. Kalimantan Tengah

❒ **Dinas Kehutanan**
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❒ **Dinas Pertanian**
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Palangkaraya
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- Dinas Kehutanan Kabupaten Kotawaringin Timur
  Jl. Jend. Sudirman KM. 6,5, Sampit 74322
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- Dinas Kehutanan Kabupaten Kotawaringin Barat
  Jl. HM. Rafi'i Pangkalan Bun, Kalimantan Timur
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Prop. Kalimantan Selatan

❒ **Dinas Kehutanan**
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❒ **Dinas Pertanian**
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Banjarmaru, kodpos 70711
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan dan Perkebunan Kabupaten Banjar

  Jl. Barintik No. 24, Martapura 70814
  Tel. (0511) 721932

- Dinas Kehutanan dan Perkebunan Kabupaten Barito Kuala
  Jl. Jend. Sudirman No. 74
  Marabahan-70513

- Dinas Kehutanan dan Perkebunan Kabupaten Hulu Sungai Selatan
  Jl. Singakarsa No. 38
  Kandangan
  Tel. (0517) 21283

- Dinas Kehutanan dan Perkebunan Kabupaten Hulu Sungai Utara
  Jl. Bihman Villa No. 3 Amuntai 71416
  Tel. (0527) 61287

- Dinas Kehutanan dan Perkebunan Kabupaten Hulu Sungai Tengah
  Jl. Perintis Kemerdekaan Rt.2
  Batali Raya, Barabai, 71351
  Tel. (0517) 71351

- Dinas Kehutanan Kabupaten Kota Baru
  Jl. P. Kesuma Negara
  Kotabaru, Pulau laut
  Tel. (0518) 21227

- Dinas Kehutanan dan Perkebunan Kabupaten Tabalong
  Jl. Pangeran HM. Noor,
  Tanjung 71571
  Tel. (0526) 22222

- Dinas Kehutanan Kabupaten Tanah Laut
  Jl. A. Syairani – Palaihari 70814
  Tel. (0512) 21256
  Fax. (0512) 21256

- Dinas Kehutanan dan Perkebunan Kabupaten Tapin
  Jl. Jend Sudirman No. 59
  Rantau 70111
  Tel. (0517) 31492

- Dinas Pertanian dan Kehutanan Kotamadya Banjarbaru
  Jl. Pangklima Batur Timur,
  Banjarbaru
  Tel. (0511) 772471

Prop. Kalimantan Timur

❒ **Dinas Kehutanan**
Jl. Kesuma Bangsa, Samarinda 75123
Tel. (0541) 741963, 741803, 741807;
Fax. (0541) 736003

❒ **Dinas Pertanian TP**
Jl. Basuki Rahmat Samarinda
Tel (0541) 742484,741676
Fax (0541) 743867,271048

❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan Kabupaten Pasir
  Jl. Jend. Sudirman No. 167 B
  Tanah Grogot 76211
  Tel. (0543) 22558
  E-mail : dk-psr@indo.net.id

Prop. Sulawesi Utara

❒ **Dinas Kehutanan**
Jl. Pomurow, Banjer K. Pos 1132,
Manado 95125
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Fax. (0431) 855883

❒ **Dinas Pertanian dan Peternakan**
Komplek Pertanian Kalasey
Kotak Pos 1158, Manado 95103
Tel (0431) 821138,821177-78
Fax (0431) 862654

❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan dan Perkebunan Kabupaten Bolmong
  Jl. Beringin Katamso,
  Kotamobagu, Bolmong
  Tel. (0434) 23834

- Dinas Pertanian Kabupaten Sangihe Talaud Jl. Apeng Sembeka Tahuna Sangihe
  Tel. (0432) 21658

- Dinas Agribisnis dan Kehutanan Kotamadya Bitung

  Jl. Samratulangi 45 Bitung
  Tel. (0438) 36147

Prop. Gorontalo

❒ **Dinas Kehutanan**
Jl. P. Kalengkongan No. 2
Gorontalo
Tel. (0435) 821236; Fax. (0435) 821236, 832379
website :
www.dinashutbungtlo.go.id

❒ **Diperta dan Ketahanan Pangan**
Jl. Andalas Komp. UPPPIII-IKIP
Gorontalo
Tel (0435)838071

❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan Kabupaten Boalemo
  Jl. Trans Sulawesi Kec. Tilamuta
  Tel. (0443) 210734

- Dinas Kehutanan, Pertambangan dan Energi Kabupaten Gorontalo
  Jl. Rajawali No. 295
  Tel. (0435) 881096
  Fax. (0435) 881111

Prop. Sulawesi Tengah

❒ **Dinas Kehutanan**
Jl. S. Parman No. 9 Palu
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Fax. (0451) 426860

❒ **Dinas Pertanian, Perkebunan&Peternakan**
Jl. R.A. Kartini No. 80 Palu (94112)
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Fax (0451) 421060

❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan Kabupaten Banggai
  Jl. Urip Sumoharjo No. 15 Luwuk
  Tel/Fax. (0461) 22838

- Dinas Pertanian dan Kehutanan Kabupaten Banggai Kepulauan
  Jl. Mandapar No. 8 - Banggai
  Tel. (0462) 21435
  Fax. (0462) 21347

- Dinas Kehutanan Kabupaten Morowali
  Jl. Yos Sudarso No. 3 Kolonodale
  Tel. (0465) 21502

- Dinas Kehutanan Kabupaten Toli-Toli
  Jl. Jend. Sudirman No. 22 Toli-Toli
  Tel. (0453) 22723

Prop. Sulawesi Tenggara

❒ **Dinas Kehutanan**
Jl. Tebao Nunggu No. 7 Kendari - 93111
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Fax. (0401) 322335

❒ **Dinas PerTanian**
Jl. Balai Kota No.6 Kendari , 93111
Tel (0401) 321365
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Prop. Sulawesi Selatan

❒ **Dinas Kehutanan**
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❒ **Dinas Pertanian**
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Ujung Pandang
Tel (0411) 854796,871290
Fax (0411) 854913, 854494

❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Sub Dinas Kehutanan Kabupaten Bulukumba
  Jl. Sultan Hassanudin No. 43, Kab. Bulukumba
  Tel/Fax. (0413) 83097

- Dinas Kehutanan dan dan Perkebunan Kabupaten Enrekang
  Jl. Bt. Juppandang, No. 77 Enrekang
  Tel/Fax. (0420) 21414

- Dinas Kehutanan Kabupaten Gowa
  Jl. Masjid Raya, Sungguminasa 92111
  Tel. (0423) 868261

- Dinas Kehutanan dan Perkebunan Kabupaten Luwu
  Jl. Tandipau No.8 - Palopo
  Tel. (0471) 21369

- Dinas Kehutanan dan Perkebunan Kabupaten Luwu Utara
  Jl. Jend. Ahmad Yani No.1 Masamba
  Tel/Fax. (0473) 21184

- Kantor Kehutanan Kabupaten Majene
  Jl. Rangas Km. 3,5 Majene
  Tel./Fax. (0422) 21657

- Dinas Kehutanan dan Perkebunan Kabupaten Pangkajene dan Kepulauan
  Jl. Andi Mandacingi No. 2, Pangkajene
  Tel. (0410) 21695

- Dinas Kehutanan dan Perkebunan Kabupaten Pinrang
  Jl. Gatot Subroto No. 2 Pinrang
  Tel. (0421) 981071

- Dinas Kehutanan dan Perkebunan Kabupaten Sinjai
  Jl. Jendral Sudirman 21, Sinjai
  Tel. (0482) 21226

- Dinas Kehutanan dan Perkebunan Kabupaten Soppeng
  Jl. Salotungo - Watan Soppeng
  Tel. (0480) 21421

- Dinas Kehutanan dan Perkebunan Kabupaten Tana Toraja
  Jl. Budi Utomo No. 25 Rantepao, Tana Toraja
  Tel. (0423) 21005

Prop. Maluku

❒ **Dinas Kehutanan**
Gedung ex. Kanwil Dephut, Jl. Kebun Cengkeh - Ambon
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❒ **Dinas Pertanian**
Jl. W.R. Supratman Tanah Tinggi, Ambon
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Prop. Maluku Utara

❒ **Dinas Kehutanan**
JL. Advokat No. 29 Kel. Toboko Ternate
Tel. (0921) 23452
Fax. (0921) 23803

❒ **Dinas Pertanian**
Jl. Baru Tabahawa No.7
Tel (0921)23984, 24086
Fax (0921)23984

❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan Kabupaten Maluku Utara Jl. Monunutu No. 12 Tanah Raja Ternate
  Tel. (0921) 21209

- Dinas Kehutanan Kabupaten Halmahera Tengah
  Jl Jendral Ahmad Yani No. 12, Kel. Indonesian, Tidore
  Tel. (0921) 61068

Prop. Irian Jaya (Papua)

❒ **Dinas Kehutanan**
Jl. Tanjung Ria Base G
Jayapura 99117
Tel. (0967) 542778, 541222;
Fax. (0967) 541041

❒ **Dinas TPH**
Jl. Raya Kota Raja Jayapura (99112)
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❒ **Dinas Kehutanan & Pertanian Kabupaten**

- Dinas Kehutanan Kabupaten Jayapura
  Jl. Raya Abepura – Megapura, Skyline - Jayapura
  Tel. (0967) 582931

- Dinas Kehutanan Kabupaten Jayawijaya
  Jl. Diponegoro No. 29, Wamena PoBox 292 Jayawijaya
  Tel. (0969) 31537

- Dinas Kehutanan Kabupaten Merauke
  Jl. A. Yani No. 08, Merauke - Irja
  Tel/Fax. (0971) 321796

- Dinas Kehutanan Kabupaten Mimika
  Jl. Yos Sudarso No.10 Sempang,
  Timika - Irian Jaya
  Tel. (0901) 321397

- Dinas Kehutanan Kabupaten Sorong
  Jl. Pramuka No.31 Remu, Sorong - Irian Jaya
  Tel. (0951) 321216, 321218, 323071

APPENDIX 3. LIST OF PROJECTS RELATED TO LAND AND FOREST FIRE IN INDONESIA

No	Name of Project	Project Aims/Activities/Outcomes	Donor	Time Period	Location	Institution Receiving/Implementing Project
1	*IFFM (Integrated Forest Fire Management) http://www.iffm.or.id/*	• Community-based Fire management • Organise volunteer fire-fighters at village level • Fire Prevention Materials (Public Awareness)	GTZ DM 4.5 mio	Phase I 1994-1997	Bukit Soeharto	Ministry of Forestry and Plantations
		• Fire Information System • Fire Danger Rating System • GIS Mapping	GTZ DM 5.0 mio KFW DM 5.0 million	Phase II 1997-2000	East Kalimantan	
		• Development of Fire Management Institutions at Provincial Level • Set up 12 local fire centres (LFC) with equipment distributed at forestry agency branches at district (kabupaten) and municipal levels in East Kalimantan	GTZ DM 3.5 mio KFW DM 5.0 million	Phase III 2000-2003	East Kalimantan	
2	*Underlying causes and impacts of fires*	• Conduct a socio-economic study on the causes and impacts of fire at the fire site, using mythology which integrates social science and remote sensing and GIS	United States Forest Service (United SFS), EU	1999	Sumatra Kalimantan	CIFOR-ICRAF
3	*Rider No. 1 to Berau Forest Management Project*	• Risk assessment in the area of forest management; • Develop an early warning system at PT. Inhutani I in East Kalimantan • Set up a fire fighting unit • Training and public awareness • Economic evaluation of fire control measures at forestry company level • Policy and administrative support related to the aspect of fire prevention	EU, EC-Indonesia Forest Programme (ECIFP).	1998	East Kalimantan	Forestry Ministry
4	*Forest Liaison Bureau*	• Develop a forestry information database • Raise public awareness	EU 5,000,000 Euro	1997-2004	East Kalimantan	Forestry Ministry

No	Name of Project	Project Aims/Activities/Outcomes	Donor	Time Period	Location	Institution Receiving/Implementing Project
5	*Forest fire prevention and control Project (FFPCP) PALEMBANG SUMATRA SELATAN. http://www.mdp.co.id/ffpcp.htm*	• Analyse the causes of land and forest fires in South Sumatra province • Create operational procedures for fire prevention and control actions • Provide hardware, software and training related to the process of receiving images from the NOAA satellite system to detect hot spots	EU is contributing a EUR 4.1 million grant budget of EUR 4.6 million	1995-1999	South Sumatra	Forestry Ministry
6	*South Sumatra Forest Fire Management Project (SSFFMP) www.ssffmp.or.id*	• To assist and facilitate the creation of a coordinated fire management system at provincial, district (kabupaten), subdistrict (kecamatan) and village levels in South Sumatera province	EU	January 2003-December 2008	South Sumatera	South Sumatera Province and Forestry Ministry
7	*Impacts of fire and its use for sustainable land and forest management in Indonesia and northern Australia*	• To determine a fire control strategy for western Indonesia (south Sumatra, south Kalimantan), eastern Indonesia (Sumba, Flores), northern Australia. • Review policy on fire control at national and regional level • Identify positive and negative impacts of fire control strategies, especially on forestry • Determine an appropriate fire control strategy and identify policy which can be implemented. • Improve stakeholders' land and forest management capability through the transfer of technology, training, and education	Australian Centre for Agricultural Research (ACIAR)	2002-2006	western Indonesia (south Sumatra, south Kalimantan), eastern Indonesia (Sumba, Flores), northern Australia	Forestry Ministry

No	Name of Project	Project Aims/Activities/Outcomes	Donor	Time Period	Location	Institution Receiving/Implementing Project
8	*Forest Fire Prevention Management Project (FFPMP) http://www.jica.go.jp/indonesia/str_ex_shrt5.html*	• Early Warning System • Community education and training • Counterparting methodology	Japan International Cooperation Agency (JICA)	15 April 1996 - 14 April 2001	Office; Bogor Rantau Rasau, Jambi (peat swamp, Berbak NP) Nanga Pinoh, Sintang, West Kalimantan (highland plain, plantation, natural forest, fields)	Ministry of Forestry and Plantations
9	*Forest Fire Prevention Management Project 2 (FFPMP2) http://ffpmp2.hp.infoseek.co.jp/indo.htm*	• Early Detection and Warning System • Early handling of Forest Fires Community education and public relations Participative Prevention of Forest Fire	Japan International Cooperation Agency (JICA)	April 2001-april 2006	Berbak NP - Jambi Bukit Tigapuluh NP - Riau and Jambi Way Kambas NP - Lampung Gunung Palung NP – West Kalimantan	Directorate General for Forest Protection and Nature Conservation, Forestry Ministry of the Republic of Indonesia
10	*The establishment of a demonstration plot for rehabilitation of forest affected by fire in East Kalimantan*	• To determine the best method, in economic, ecological and social terms, for rehabilitating burnt land, which can be applied to different types of forest area. • To demonstrate this method on a plot of land.	ITTO	1990-1995	Indonesia	LITBANG DEPHUT
11	*Regional Technical Assistance on Strengthening ASEAN's capacity to Prevent and Mitigate Transboundary Pollution*	• Draw up strategy and policy to prevent and mitigate land and forest fires. • Develop a regional early warning system • Improve fire suppression capability at national and regional levels	ADB	April 1998-April 1999	SE Asia, Jakarta	ASEAN Secretariat

No	Name of Project	Project Aims/Activities/Outcomes	Donor	Time Period	Location	Institution Receiving/Implementing Project
12	*Advisory Technical Assistance Planning for Mitigation of Drought and Fire Damage*	• To identify the causes of fire and its impacts on ecological and socio-economic factors, policy study, to determine the financial losses due to fire	ADB	July 1998	East Kalimantan, Riau	BAPPENAS
13	*Project FireFight South East Asia*	• Conduct focused studies of three fields of fire management. These are: community based fire management, the legal and institutional aspects related to forest fire, and the economic aspect of the use of fire in Southeast Asia • Fire Bulletin	WWF and IUCN funded by the EC – European Commission	2000	SE Asia	
14	*Sumatra Fire Fighting Surveillance Pilot Project-* *www.rrcap.unep.org/projects/forestfires.cfm*	• Conduct early detection using aircraft, develop basic information, photographic documentation at fire sites, disseminate fire information to regional level, speed up surveillance and fire suppression action	UNEP-GEF	*Phase 1* 27 July to 8 August 1998	Riau	
		• Conduct early fire detection through high resolution remote sensing • Create a spatial database comprising elevation, hydrology, geology, habitation and land use, which can be used to plan suppression activities • (output 1500 copies CD-Room GIS Database)		Phase 2 November-December 1998	Sumatra	
15	*Peat fire prevention at the National Laboratory in Central Kalimantan*	• Form a fire-fighting team (*tim serbu api TSA*) • Construct 9 transects/canals 8.75 km in length • Sink 23 well boreholes as water sources for fire suppression • Fell 394 dead trees • Extinguish 50-60 ha fire and prevent spread of fire to peatswamp forest in block c-ex PLG project, Sebangau and SMU 5 highschool in Palangkaraya	Global Peatland International (GPI)	1/8/2002 - 30/9/2002	Central Kalimantan	CIMTROP

No	Name of Project	Project Aims/Activities/Outcomes	Donor	Time Period	Location	Institution Receiving/Implementing Project
16	*Peatland Fire Mitigation in Berbak National Park and Surrounding Area, Jambi - Sumatera*	• Extinguish fire over an area of 0.5 km x 2 km • Monitor fire and disseminate awareness in Simpang Melaka and Simpang Gajah • Extinguish primary fire in Berbak National Park • Conduct an awareness campaign among fishing communities in the Raket area (Berbak NP) • Create a strategy to overcome fire in the Berbak area in the future	Global Peatland International (GPI)	1/8/2002-31/9/2002	Jambi	WI Indonesia Programme
17	*Towards the reduction and prevention of future fire risks in Berbak National Park and its surroundings*	• Public Awareness	Global Peatland International (GPI)			WI Indonesia Programme
18	*Peatland Fire Mitigation in Central Kalimantan*	• Form a fire brigade with members from local NGO, community, satkorlak, BKSDA • Coordinate and provide logistic support for the fire brigade • Coordinate and provide health service support for the fire brigade and victims of the fire • Extinguish 129 hotspots out of the 977 hotspots observed in September 2002 • Conduct an awareness campaign	Global Peatland International (GPI)	1/8/2002 - 30/9/2002	Central Kalimantan	WI Indonesia Programme
19	*Fire management Program*	• Develop the best system for fire control and a Fire Suppression Mobilization Plan	USDA Service	1998-2000	Indonesia	Forestry Ministry
20	*Environmental Emergency Project*	• Improve the Indonesian Government's capability to investigate, respond to and monitor environmental disasters	UNDP	Dec 1997-May 1998		Ministry of the Environment

No	Name of Project	Project Aims/Activities/Outcomes	Donor	Time Period	Location	Institution Receiving/Implementing Project
21	*Investigation of The Steps needed to rehabilitate the areas of East Kalimantan seriously affected by fire*	• Investigate the impact of fire • Draw up an action plan for the rehabilitation of burnt areas	ITTO	June 1988-May 1989	Kalimantan	LITBANG DEPHUT
22	*Indonesia Fire Danger Rating System* *http://www.fdrs.or.id*	• Carry out adaptation, operator training and application activities based on fire danger rating system output in Sumatra • Support Indonesian institutions in directing the above activities.	Canadian International Development Agency (CIDA) - The Canadian Forest Service (CFS)	1999-2005	SE Asia, Jakarta, Sumatra, Kalimantan	BPPT, BMG, Forestry Ministry, Bakornas
23	*National Guidelines on the Protection of tropical forests against fire in Indonesia*	• Draw up *National Guidelines on the Protection of Forest Against Fire*	ITTO	April 1997-March 1999	Indonesia	Faculty of Forestry Bogor Agricultural University
24	*EU Fire Response Group*	• Support fire suppression activities in Indonesia	EU	1997-1998	Sumatera, Kalimantan	Forestry Ministry
25	*Analysis of the Causes and Impacts of Forest Fire and Haze*	• Conduct a study of the causes and the economic, policy, biological, GIS and social impacts of fire in Indonesia	WWF Netherlands WWF Switzerland WWF-UK Body Shop	Oct 1997-Sept 1998	SE Asia, Jakarta, Kalimantan	WWF Indonesia

APPENDIX 4. PERALATAN UNTUK SATU KRU PEMADAM KEBAKARAN (15 ORANG) YANG TERDIRI DARI MASYARAKAT SEKITAR

Description	Total
Protective Clothing	15
Safety Helmet	15
Leather Boots	15
Leather Gloves	15
Plastic Goggles	15
Protective Scarf	15
Sword Belt	15
Water Canteen	15
Training Cap	15
Fire Rake	7
MacLeod Tool	7
Fire Swalter	7
Back-pack Pump	3
Radio VHF HT	2
First Aid Kit	1


PAKAIAN PELINDUNG Protective Gears
HELM PELINDUNG
Safety Helmet
KACA MATA PLASTIK
Plastic Goggles
SLAYER SAL
Protective Scarf
PEPLES AIR
Water Canteen
SARUNG TANGAN
Leather Gloves
KOPEL
Sword Belt
WERPAK
Protective Clothing
SEPATU BOOT
Leather Boots