FireFight
South East Asia

Project FireFight South East Asia
P.O. Box 6596 JKPWB
Jakarta, Indonesia

Tel: +62 251 622 622
Fax: +62 251 622 100

www.pffsea.com

IUCN
The World Conservation Union

IUCN - World Headquaters
Rue Mauverney 28
CH-1196 Gland, Switzerland

Tel: +41 22 999 0001
Fax: +41 22 999 0002

www.iucn.com

WWF

WWF International
Avenue du Mont-Blanc
CH-1196 Gland, Switzerland

Tel: +41 22 364 9019
Fax: +41 22 364 064

www.panda.org/forests4life

Workshop Report
Land Clearing on Degraded Lands for Plantation Development
A Workshop on Economics of Fire Use in Agriculture and Forest Plantations, Kuching, 24-25 October 2002

FireFight
South East Asia

WWF

IUCN
The World Conservation Union

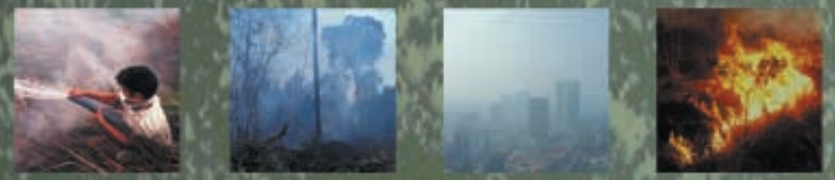
European Union

Workshop Report

Land Clearing on Degraded Lands for Plantation Development

A Workshop on Economics of Fire Use in Agriculture and Forest Plantations, Kuching, 24-25 October 2002

Edited by
Dicky Simorangkir, Peter Moore, Nina Haase, and Ginny Ng
with contribution from workshop participants



Workshop Report

Land Clearing on Degraded Lands for Plantation Development

A Workshop on Economics of Fire Use in Agriculture and Forest Plantations, Kuching, 24-25 October 2002

Edited by
Dicky Simorangkir, Peter Moore, Nina Haase, and Ginny Ng
with contribution from workshop participants

Cover photos:

Background picture:
Eucalyptus plantation in Congo by Dr. Takeshi Toma, CIFOR

Four small cover pictures from left to right:
- Efforts to extinguish fires East Kalimantan in 1998; © WWF-Cannon/WWF Indonesia
- Forest fires in Kinabatangan, Sabah in 1998; © WWF-Cannon/WWF Malaysia
- Haze from 1998 fires in Kuala Lumpur, Malaysia; © WWF-Cannon/WWF Malaysia
- Forest fire in Costa Rica by Stephen Homer, ACDI-CIDA

Large cover picture:
TESSO NILO Plantation, Riau, Sumatra, Illegal logging for paper industry and forest clearing for oil plantation © WWF-Canon / Alain COMPOST

Project FireFight South East Asia is a Global Initiative of
IUCN – The World Conservation Union and WWF – The World Wide Fund for Nature funded by the European Union and supported by the US Forest Service

ISBN No. 979-3260-05-X

Published by Project FireFight South East Asia
P.O. 6596 JKPWB, Jakarta, Indonesia

Printed in Indonesia

For more information on Project FireFight South East Asia, visit http://www.pffsea.com

Preface

The forest fires of 1997 and 1998 created enormous ecological damage and human suffering and helped focus world attention on the problem. There is a growing concern that action is needed to catalyse a strategic international response to forest fires. There are no 'magic bullets' or 'instant solutions'. The issues to be addressed are complex and cut across many interests, sectors, communities, nations and regions. Many believe that action only takes place when fires are burning, with little attempt to address the underlying causes.

For that reason WWF - The World Wide Fund for Nature and IUCN - The World Conservation Union have joined forces to develop Project Firefight South East Asia to secure essential policy reform through a strategy of advocacy using syntheses and analyses of existing information and new outputs. More specifically, the project aims to enhance the knowledge and skills of key stakeholders with regard to forest fire prevention and management and, where necessary, to facilitate the adoption of new and/or improved options. The project works at the national and regional levels across South East Asia to support and advocate the creation of the legislative and economic bases for mitigating harmful anthropogenic forest fires.

The problem of forest fires lies beyond the capacity of national governments and international organisations to handle alone. This is why the project pursues a multiple stakeholder approach, working closely with WWF's extensive network of National Organisations and Programme Offices in South East Asian, IUCN's broad-based membership, world-renowned scientific commissions, and collaboration with ASEAN governments, UN agencies, EU projects, GTZ, CIFOR, ICRAF, RECOFTC, academia and the private sector. The project ensures popular participation, public awareness, policy outreach and programmatic impact in connection with fire-related issues.

Within the South East Asia, the project undertook studies and organised conferences, workshops, and meetings focusing on three areas of fire management: community-based fire management, legal and regulatory aspects of forest fires, and the economics of fire use. Resulting from these activities are the identification of political, private sector and civil society stakeholders and the legal, financial and institutional mechanisms appropriate to South East Asia that can positively influence their fire-related behaviour. In addition, national and international policies, which promote or fail to discourage forest fires are identified.

This report documents and analyses the understanding of land clearing and preparation issues from the industry perspective, as discussed in the workshop "Land Clearing on Degraded Lands for Plantation Development" that was organised with support from Sarawak Timber Association in Kuching, 24-25 October 2002. This work is seen as a first step towards best practices guidelines for fire and non-fire use for land clearing and preparation on degraded land. It is anticipated that the result will promote and encourage the use of alternative methods of fire use, such as zero burning, and support relevant stakeholders, particularly South East Asian governments and private companies, in formulating appropriate solutions for more responsible fire use.

Table of Contents

Preface iii

List of figures v

List of tables v

List of abbreviations vi

1. The Workshop 1
   - 1.1. Background 1
   - 1.2. Structure and flow 2
2. The legal context 6
   - 2.1. Malaysia 6
   - 2.2. Indonesia 7
3. Experiences, problems and opportunities with non-fire land clearing 10
   - 3.1. Reality on the ground 10
   - 3.2. Problems and constraints – an industry perspective 11
   - 3.3. Residues – problem or opportunity 16
4. The need for improved, and better coordinated fire management in plantations 18
5. Conclusion and recommendations 20
6. Bibliography 23

Appendix 1: List of participants 24

Appendix 2: Workshop agenda 27

Appendix 3: Workshop presentation 29

Appendix 4: ‘Things to be done’ 46

List of Figures

Figure 1: Process of the workshop on economic of fire use in agriculture and forest plantations 5

Figure 2: Draft of planned discussions and next steps 22

Figure 3: Fire triangle - O_2, *fuels, heat* 30

List of Tables

Table 1: Impacts of fire use 11

Table 2: Advantages and constraints of burning versus zero-burning 35

Table 3: Advantage of zero-burning method 38

Table 4: Cost of land preparation for oil palm plantation on peat 41

Table 5: Biomass in forest and plantation 44

Table 6: Nutrient loss due to burning residual in land clearing 44

Table 7: Land clearing methods: burning vs. spreading 45

List of Abbreviations

ADB	Asian Development Bank
APHI	Asosiasi Pengusaha Hutan Indonesia (Indonesian Concession Holder Association)
ASB	Alternative Slash and Burn
ASEAN	Association of South East Asian Nations
Bappenas	Badan Perencanaan Pembangunan Nasional (Indonesian National Planning Agency)
BPP	Borneo Pulp and Paper
CIFOR	Centre for International Forestry Research
CPO	Crude Palm Oil
EEPSEA	Economy and Environment Program for South East Asia
EFB	Empty Fruit Brunches
EQA	Environmental Quality Act (Malaysia)
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Development Agency)
ha	hectare
ICRAF	International Centre for Research Agroforestry
INGO	International Non-Government Organisation
IOPRI	Indonesian Oil Palm Research Institute
ISP	Planter Association
IUCN	The World Conservation Union
LCC	Leguminous Cover Crops
LPF	License for Planted Forest
mt	metric ton
MDF	Medium Density Fibreboard
MPI	Masyarakat Perhutanan Indonesia (Indonesian Forest Society)
NCR	Native Customary Right
OHSA	Occupational Health and Safety Act
PFFSEA	Project FireFight South East Asia
POME	Palm Oil Mill Effluent
RAPP	Riau Andalan Pulp and Paper
RM	Malaysian Ringgit
Rp	Indonesian Rupiah
SOM	Soil Organic Matter
STA	Sarawak Timber Association
USD	American Dollar
WWF	World Wide Fund for Nature

1. The Workshop

1.1 Background

As part of its three-theme approach to addressing the underlying causes of forest fires Project FireFight South East Asia conducted a preliminary Review of the Economics of Fire Use in Agriculture and Forest Plantations, particularly in Indonesia and Malaysia. The report reviewed existing knowledge about the financial costs and benefits of using fire in agriculture and forestry, with particular attention to positive and negative economic impacts of fire use and/or alternative methods in land clearing activities. It is anticipated that the review produced will promote and encourage the use of alternative methods of fire use, such as zero burning, and support relevant stakeholders, particularly South East Asian governments and private companies, in formulating appropriate solutions for more responsible fire use. The review has been published and distributed to various stakeholders.

One of the major finding of the review is that while there is enormous knowledge and experience on fire and non-fire land clearing methods in plantations, their economic aspects - often the main reason for using or not using fire - remains unclear to many plantation companies. The myth of fire use being the cheapest, fastest and easiest method to clear and prepare land for agriculture activities persists. However, the review indicates that zero-burning methods are not more expensive – and may actually be more cost effective in the long term – than burning. This is especially true for replanting oil palm or rubber trees or clearing degraded lands such as grassland or low-density secondary vegetation for new plantations. Burning may be cheaper if it is used for forests with high volumes of biomass because it is more difficult and time consuming to clear such forests mechanically. While forests of special biological and/or social importance have principally to be conserved or preserved at almost any cost, where degraded lands are used for other, particularly agricultural purposes careful assessment has to be made for fire-use. It is therefore important to document, analyse, discuss, and develop best practice guidelines or principles for land clearing and site preparation in plantations.

For that reason, Project FireFight South East Asia with support from Sarawak Timber Association organised a workshop on “Land Clearing on Degraded Lands for Plantation Development” on 24-25 October 2002 in Kuching, Sarawak, which was proposed to review information, knowledge, and experience on fire use and alternative non-fire methods for clearing and preparing degraded lands for forest and agricultural crop plantations in South East Asia and particularly Malaysia and Indonesia. The workshop aimed to improve and document the understanding of land clearing and preparation issues from the industry perspective and in a future step work towards best practices guidelines for fire use and non-fire use in degraded land clearing/ preparation.

Kuching, Sarawak was chosen as the workshop location not only because of its good access to international flights and good workshop facilities but more importantly because the adjoining provinces Sarawak, Sabah, West Kalimantan, Central Kalimantan, and East Kalimantan are amongst the most fire ridden in South East Asia following extensive forest and land conversion for plantation development in the recent decades. This region did not only suffer most from haze, it also generated much of it. For Sarawak fire issues will become more important in the future. Following the implementation of an ambitious reforestation program aiming to establish 1.5 million hectares of timber plantations and oil palm program aiming to convert 1 million hectares over the next 10 years, the fire risk is likely to increase.

Participation was by invitation only. Most of the participants were representatives from forest and agriculture plantation companies in Malaysia (Sarawak, Sabah, and Malaysian Peninsular) and Indonesia (West and East Kalimantan) with experience and knowledge of fire use and non-fire use in land clearing/preparation. The list of participants is attached in Appendix 1.

1.2 Structure and flow

The workshop was designed in a "semi-structured way" (see Fig. 1 for workshop structure) to allow time and flexibility for discussion and sharing of information and experiences with regards to land clearing and preparation using fire and non-fire methods.

In the morning of the first day 5 presentations were delivered divided into 2 sessions (for detail see Appendix 2). The first session consisting of two presentations delivered by Project FireFight South East Asia (PFFSEA), provided framework and direction for later discussions. The first presentation by **Dr. Peter Moore** set the context for discussing fires in South East Asia. It discussed fires as phenomenon and basic knowledge and understanding of fire. The key issues discussed were centred around the questions on what makes fires burn? What burns? What role does fire play in the tropical forests and why has fire incidence increased in the last decade? The intent of this presentation was to direct the participants to examine and evaluate where we are with fires, where we can go with fire use, and what is needed to get there. The need to differentiate between good and bad fires along with the positive and negative effects of fire was stressed.

The next presentation by **Dr. Dicky Simorangkir** summarized a study by PFFSEA concerned with the economic aspects of fire use. The report reviewed and analysed existing knowledge on the financial costs and benefits of using fire in agriculture and forestry, with particular attention on the positive and negative economic impacts of fire use in land clearing activities. It also compared burning with non-fire methods in commercial agriculture and timber plantations focusing and taking into account several cost components: land clearing, plantation management (land immobilization and planting operations), soil fertility and availability of nutrients, crop protection, and yield differences. This presentation was delivered as an 'entry-point' from the general overview of fire issues given in the first presentation to the thematic of the workshop on the issue of land preparation and fire use in plantation development.

'Real' on the ground knowledge and field experience on fire use was the focus of the second session. Three presentations from representatives of Indonesian and Malaysian private companies (two from oil-palm sector and one from a timber plantation) were delivered in the session giving the field experiences on burning and/ or non-burning.

The first presentation was given by **Dr. D. Darnoko** of the Indonesian Oil Palm Research Institute in Medan, North Sumatra. The presenter gave an overview of past, current, and likely future developments of Indonesian oil palm industry including the use of fire in plantation development. Most interesting was an account of new possibilities the institute had explored to use oil palm residues. The removal of 'valueless' residue remains the main reason for burning.

The second presentation by **Mr. Pupathy a/l Uthrapathy Thandapani** of the Golden Hope Plantation Sdn. Bhd. illustrated the economic and technical feasibility of using non-fire mechanical methods in the establishment and management of oil palm plantations on peat lands based on the company's field experience in Sarawak.

The last presentation of this session told the experiences of the presenter, **Mr. Sim Boon Liang**, who is currently working for Samling Sdn. Bhd., in establishment of timber plantations on degraded lands in Sabah. As the previous presentations, the report was focused on the negative and positive impacts of burning, its constraints and opportunities, but this time from the view of a timber plantation. The presentation also emphasized the issue of increased fire risk from remaining slash after land clearing activities.

The presentations in the first half-day set the context for discussion in two working groups in the afternoon. The mission for working group discussion was to identify best and worse case examples and gaps in the knowledge and information on land clearing methods using fire and fire alternatives, based on the participant's first hand experience in the field. Preliminary analysis, including on forest policy reforms and social, legal and regulatory framework, was also done to explore the constraints, conflicts and inconsistencies in fire use practices.

One major point discussed in the working groups concerned the definition of 'degraded lands'. While many commercial companies define degraded lands as non-productive land with no or very little commercial timber, others argue that each piece of land (and forest) with special biological and/or social importance is not 'degraded' and should therefore be protected. In the end 'degraded land' defined consensually, for the workshop purpose, as land allocated for conversion by the appropriate authority. This recognizes that decisions about biodiversity are made *before* fire is applied, in the process of land use planning, when choosing and allocating areas for conversion. The assumption often is that lands allocated for conversion are not particularly rich in biodiversity or other values. As noted by the participants this is often a point of conflict and tension.

The workshop agenda for the second day was kept open. After presentation and discussion of the results of the working groups in the first plenary session, the discussion was continued focusing on the two main concerns voiced strongly in the first day. The first issue concerned vegetation residues left after land clearing without burning. Many companies feel the slash poses a serious threat as it increases fuel

levels and could be a considerable fire risk in years of drought, such as 1997/98. Company representatives therefore felt that prescribed burning was important to prevent future more destructive fires. The concern with increased fire risk from residues, the failure of the companies to deal with fires in 1997/98 and the high probability of dry period in 2003 due to the present El-Nino weather phenomenon, led then to the discussion about the second issue, which was about a possible fire management system, with focus on Sarawak.

In the final session, recommendations including further work and next steps were identified and scheduled.

Opening remarks by Dr. Peter Moore (PFFSEA) and Mr. Barney Chan (STA)

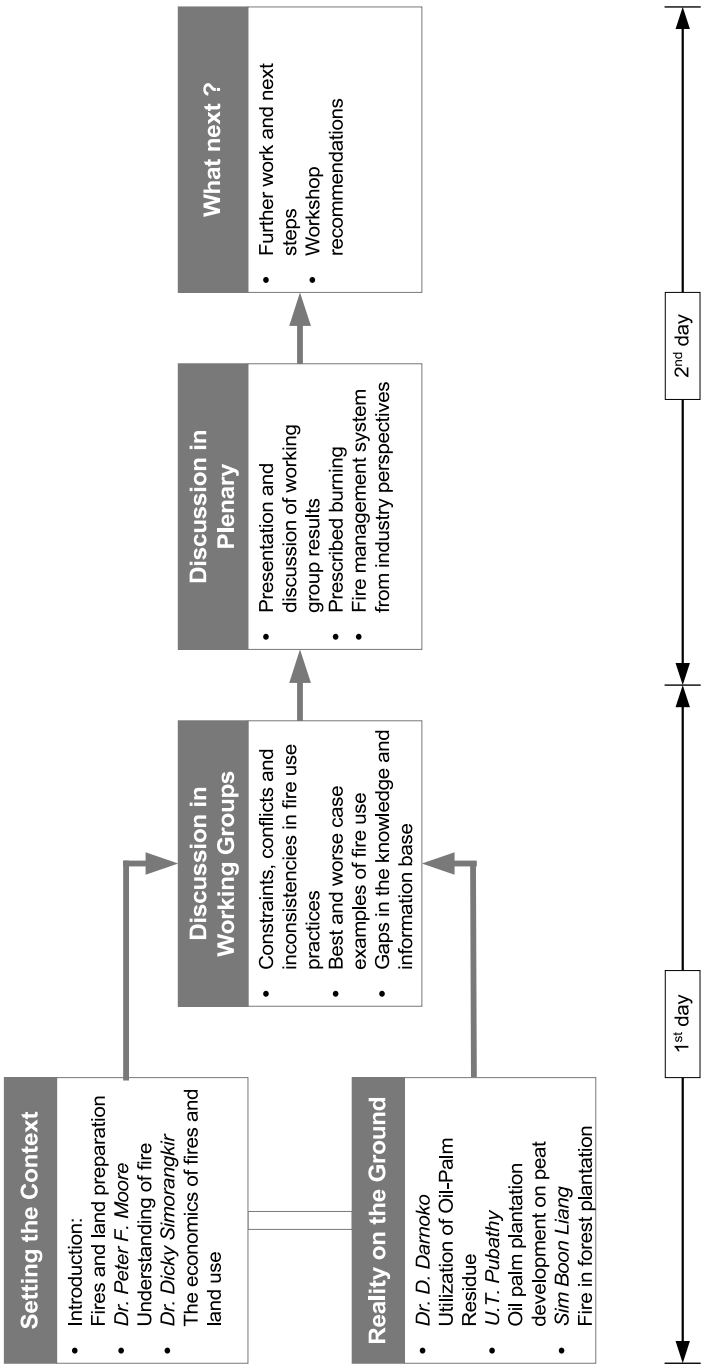


Figure 1: Process of the workshop on economics of fire use in agriculture and forest plantations

2. The legal context

The institutional arrangements and legal framework regarding fire in Malaysia and Indonesia differ considerably. Generally the legal framework in Malaysia is more advanced and more elaborate with respect to than in Indonesia. Law enforcement in Malaysia also seems to be more consistent than in Indonesia. What follows is the summary of the workshop discussions regarding the legal context regarding fire and the use of fire in both countries.

2.1 Malaysia

Malaysia is a federation of 13 states and two federal territories, of which, 11 states are located in the Malay Peninsular and two on the island of Borneo. There have been no major incidences of forest fires in the Peninsular, only isolated outbreaks tended to occur in forests cleared for commercial crop plantations. The threat of forest fires in Sabah and Sarawak is more serious. Most of the documented fires were caused by negligence or misuse of fire in land clearing activities. Fire in Sarawak tends to be confined to plantations, and is mostly started by agricultural activities in adjoining farms. Fire occurrences in the natural forest are minimal.

Under the Malaysian Constitution, land is a state matter and is thus within the jurisdiction of the respective state governments. Each state is empowered to enact laws on forestry and formulate forest policy independently. At the federal level, there are two important laws with respect to fire: the National Forestry Act and the Environmental Quality Act. The National Forestry Act was passed in 1984 (amended in 1993) to streamline and standardise management of forests in Malaysia. The Forestry Department is responsible for the administration and the implementation of this Act, based on which the use of fire for removing timber from permanent forest reserves is prohibited unless specially authorised (Section 81). Section 82 states that no person shall kindle, keep or carry any fire, or leave any fire burning, within a permanent forest reserve in such a manner as to endanger the forest reserves. The penalty for both offences is a fine of not more than RM 50,000 or imprisonment for a term not exceeding five years, or both.

So far, the National Forestry Act inadequately addresses forest fire issues as its legislative authority is restricted to forest reserves under the administration of the Department of Forestry, while many forest fires start outside the boundaries of permanent forest reserves. Provisions for prevention and mitigation measures are also absent.

Malaysia amended its Environmental Quality Act 1974 (EQA) in July 2000 to address problems related to open burning and to ensure Malaysia's zero burning policy is implemented. The provisions include maximum fines up to RM 500,000 and five-

year imprisonment. Recognizing that enforcement is needed to ensure the implementation the act was amended to expand the power of investigation and enforcement of various agencies including the fire fighting and police services, and officers from the Ministry of Health and local councils/municipalities. The amendment to the EQA abolished the Department of Environment's powers to issue contravention licences for burning but instead provided a specific list of authorised prescribed activities for open burning. There are 15 instances in which open burning is allowed including the burning of any diseased and noxious plants, agricultural equipment, residues from land cleared for cultivating food crops, paddy stalks, sugar cane leaves prior to harvesting in an area that does not exceed 20 hectares, and residues from smallholdings cleared for planting or replanting crops in an area not exceeding 2 hectares per day.

The palm oil industry is under pressure to achieve zero burning in their land clearing operations since the EQA 1974 has effectively banned open burning on vast plantation areas. Since the implementation of the act, the number of fire occurrences in the plantation areas has reduced significantly, because the companies are deterred by the high fines and also because the monitoring by government agencies, particularly through air surveillance, works well. It must be noted that the zero burning policy advocated by the Malaysian government is a misnomer because exemptions are given to allow open burning. The amendment however, placed a complete ban on burning on any peat soil area.

A key contention of the plantation companies is the issue of NCR (Native Customary Right) land. The law still allow the villagers to use fire for their traditional farming within their NCR land. Moreover, the law still applies if the land within the NCR is converted. Unofficially there are currently around 300,000 hectares of such a NCR land in Malaysia, where fire is still used to clear the land. The total area might be larger since it is very difficult to identify and verify the NCR lands, which are not strongly documented, and therefore it seems anyone can claim a part of their land as NCR land although it might not be true. The burning by the local people is therefore a serious problem, particularly if fires escape control and become wildfires spreading into plantation areas.

Some industry representatives' claimed that shifting cultivation is responsible for quite a large area burnt and smoke in Sarawak. This perception, however, needs to be verified since many studies (e.g. Borneo Research Bulletin 1990/91) show, that only about 5% of shifting agriculture land area is new, i.e. indigenous people in Sarawak are moving away from shifting cultivation to intensive cultivation, and hence move away from fire use.

2.2 Indonesia

Indonesia has experienced forest and land fire problems in the past, often these are associated with extended drought, mainly due to indiscriminate land clearance activities, widespread use of fire to clear previously logged forest and other degraded land in preparation for oil palm, rubber or pulpwood plantations. In dealing with these problems, the Indonesian government has issued numerous laws, regulations, decrees, guidelines, and directives on the management of forest and land fires, especially after the big fires in 1997/98. The most important regulations on fire are the

Government Regulation No. 28, the Environmental Act No. 23/997, the Forestry Act No. 41/1999, and the Government Regulation No. 4/2001.

In 1995, the Indonesian government issued Government Regulation No. 28 of 1985 on Forest Protection that expressly forbids the use of fire to clear land for plantations with exception for special cases approved by the legal authorities (Article 10, Paragraph 1). This ban was strengthened under the 1999 Forestry Act, which superseded the Forestry Act No. 5/1967. The new act placed more emphasis on forest protection, nature conservation and provision against criminal activity. This included: 1) holders of concessions or licenses shall be responsible for forest protection including forest fire, 2) no one is allowed to set fire to the forest. Forest burning is allowed only for special purposes such as to control forest fires, pest and diseases, and to manage natural habitats with approval from the legal authority, and 3) fire offenders, intentional or careless, can be sentenced to a maximum 15-year jail term and a fine of up to five billion Rupiah (approximately USD 500,000).

Another important law related to fire management in Indonesia is the Environmental Management Act No. 23, which was issued in 1997 and superseded Act No 4 of 1982 concerning Basic Provisions for the Management of Living Environment. This was a big step towards law enforcement related to forest and land fire issues. In the past, fire ignition was seen as a 'personal-crime' allowing guilty companies to deflect accusations to individuals. The new act recognises corporate liability for environmental crime, including causing forest and land fires. This effectively means that every concession or plantation company is responsible for fire outbreak on its concession area.

Together with the 1999 Forestry Act, the Environment Management Act No. 23 /1997, led to the development of Government Regulation No. 4/2001 concerning Control of Environmental Degradation and Pollution in Correlation with Forest and Land Fires. This regulation strengthens the criminal provisions stipulated in Act No. 23/1997 and specifically regulates the tasks and responsibilities of all stakeholders (government at various levels, private sector, and community) involved in fire prevention and control activities.

One can say that theoretically Indonesia does not lack the legal and institutional tools to regulate and manage forest and land fires. Beside significant numbers of relevant laws and regulations have been issued to cover the authority, directions, responsibilities, obligations and technical aspects, the Indonesian government has also developed multi-sectoral organisational structures at various levels to supervise and control the implementation of those laws and regulations.

The experiences in the last two decades, however, when forest and land fires occurred continuously with alarming intensity and scale, have shown that the developed institutional, legal and regulatory frameworks have not functioned effectively for various reasons, mainly because of: 1) unsynchronised and inconsistent development policies, 2) non transparent and uncoordinated procedures and mechanisms, 3) unclear regulations, and 4) uncoordinated programmes and activities focusing on sectoral approach and on suppression aspects. The biggest problem, however, is the weak enforcement of laws and regulations. Even though since 1997 hundreds of forest concessionaires, plantation companies, and transmigration area developers have been identified and accused of using fire in their land-clearing activities, only a few were

brought to the court, and only small percentage had their operational permits suspended by the Ministry of Forestry. However, most of these sanctions were rehabilitated within three months. The failures to take legal action against these companies could be traced to the weaknesses of the laws enforcers as well as the lack of political will, which is influenced by the practices of corruption, collusion and nepotism.

In the last four years, the overall situation in Indonesia has radically changed. Before, during Suharto's era, everything was controlled from Jakarta and no political decisions could be made in the provinces and districts without permission from the central government. Since the fall of Suharto in 1998, provinces and districts started to voice their disagreements and disappointments with the system and claimed more independence and rights in governing their natural resources. The issuance of Act No. 22/1999 and Government Regulation No. 25/2000 triggered the 'autonomy euphoria' all across Indonesia. Thousands of local (Provincial and Districts) Regulations were issued by local governments. Many of them were prepared as justification for the local governments and local communities to exploit their own (natural) resources for 'local development' or 'improvement of local people's livelihood' often at a cost to the environment. Combined with weak law enforcement and lack of control and supervision from the central government, forest and natural resources exploitation continues at increasing pace and scale. Uncontrolled logging, both legally and illegally, encroachment and conversion of forestland using fire, and other kinds of destruction of forest and other natural resources in Indonesia has accelerated in the last 3 years. The situation has led to the degradation of vast forest areas into very poor, less dense secondary forests, and grass/bushland, making it more susceptible to fire. On the other hand, the development and implementation of a comprehensive and integrated fire management strategy will be more difficult due to the strong interest of most local governments to be more independent from central government and to prioritise economic development in their programmes and activities.

With the reformation process, the land use and ownership pattern have also changed towards increased community plantation owners. A source has reported that currently in Sumatra and Kalimantan, there are now more middle-size developments belonging either to local entrepreneurs or to groups of wealthy farmers pooling their resources. They typically develop between 100 and 10,000 hectares at once. As such, these local people use fire to clear land and may in future contribute more than big plantation owners in the past. If this were the pattern, it would be less controllable.

3. Experiences, problems and opportunities with non-fire land clearing

3.1 Reality on the ground

Although open burning has been prohibited for many years in Malaysia and Indonesia (Chapter 2), fire outbreaks originating from land clearing activities using fire continued to occur. In the years following the devastating forest fires of 1997/98, the annual round of burning, and the resulting smoke and haze continue on although on a smaller scale and with less intensity. Although satellite information revealed that in the previous years most of the hot spots occurred in the area of oil palm plantations, timber plantations and forest concessions, lack of clarity remains about who is actually igniting the fires. Main problems are inaccurate maps and land use classification that do not reflect the reality on the ground with: very bad overlapping of forest and non-forest area, large area of forest that in reality has been converted to plantation, alang-alang *(Imperata spp.)* or bare land, etc. Furthermore, there are many enclaves and settlements within and surrounding plantation areas and fires may originate from activities of villagers using fire for hunting, fishing or land clearing for shifting cultivation. Inaccuracies inherent to hot spots, such as location errors up to 3 kilometres and a certain level of uncertainty whether a hot spot actually represents a fire render interpretation difficult. It means that not all hotspots found within a forest or plantation areas are fires and some fires may not lit by the landholders.

During the El Niño year in 1997/98, small fires occurred in the *reforestation* area (*Acacia* and *Eucalyptus* plantations) of Samling in Sabah, for example, originating from the villagers living *in* and around the reforestation area. Nonetheless the pattern is repeating itself of plantation and logging companies using fire to clear land after removing commercial timber in the last years: In West Kalimantan, for example, many plantation companies continue to use fire for land clearing with burning usually conducted in the dry period (August, September) to clear secondary forests.

The persistence of fire use in land clearing activities indicates in part weak judiciary and law enforcement systems (Chapter 2). Particularly in Indonesia, the continuing corruption and nepotism practices, coupled with limited capability and capacity of government agencies create opportunities for private companies to burn. Only in a few cases, plantation companies have been brought successfully to court for causing environmental damage by burning.

3.2 Problems and constraints – an industry perspective

Discussions in the workshop have identified many reasons for the companies to use fire in their land clearing activities. The main reason is still the economic one, following by technical and other specific reasons.

Economic aspect

In theory the majority of private companies are aware about the positive and negative impacts of fire use. Such as shown in Table 1 (see also Table 2 in Appendix 3), prepared by the workshop participants, the main advantage of burning is the lower land clearing/preparation cost: burning is cheaper than using heavy machine to clear the land. However, the cost difference between both methods is location specific and varies strongly on an array of factors, particularly site (soil, vegetation density), and labour and equipment costs. A study conducted by PFFSEA has determined that between provinces in Indonesia, for example, there is great disparity on land preparation cost -up to several hundred percent- due to differences in labour cost.

Table 1. Impacts of fire use

	Immediate/Short-Term	Medium/Long-Term
Cost	(+) Fire use is cheaper for land clearing	(+) Lower maintenance cost (+) Returns over crop performance (+) Reduction of crop loss through pest and disease
Soil	(+) Easy access for planting crops trees, legumes and cover crops (+) Some tree species (e.g. *Eucalyptus spp.*) needs ash beds	(–) Loss of nutrients through export of biomass (trees), erosion, and leaching
Environment	(–) Air pollution (–) Water (river) pollution	(–) Air pollution (–) Water (river) pollution
Crop Protection	(+) Less pest and disease (+) Less competition for crops (wild banana and pioneer trees species) (+) Less fire hazard (–) Encourages *Imperata spp.*	

Other advantages from burning include better access for planting crop trees, including leguminous cover crops (e.g. *Calopogonium caeruleum* and *Pueratia phaseoloides*) that have positive effects on soil fertility and protection from erosion. Ash beds created after burning can also improve the growth of certain tree species such as *Eucalyptus spp.*

Fire has different effects on crop protection. On the positive side after burning less pioneer tree species and wild bananas compete with crops. Fire use also reduces the risk of pest and disease such as the rhinoceros beetle *(Oryctes rhinoceros)* and oil palm root rot (*Ganoderma boninensis)* that can cause severe loss to the plantation companies. Instead of using fire, *Ganoderma* can be controlled by deep ploughing and the use of pesticides and *Oryctes* can be contained using a combination of cropping

practices (pulverisation, shredding the vegetation debris and covering it with leguminous cover crops), insecticide applications or biological control, like pheromone traps. However, this means an additional cost for the company. A company in Sarawak, for example, has reported that the additional cost of a pheromones trap for beetle control is ca. USD 50 per year per ha.

On the negative side, burning of land encourages the growth of alang-alang *(Imperata spp.)*. This kind of grass is known for being difficult and very expensive to manage once it has spread, which can happen very quickly. In some places in Sumatra and Kalimantan, large areas have been invaded and occupied by alang-alang after the big fires 1997/98.

From the plantation manager's view, the main disadvantage of burning is the loss of nutrients through the export of biomass (vegetation), leaching and erosion. Findings from plantation sites in Sumatra and Kalimantan indicate that nutrient loss and the resulting loss of crops production will become obvious only after the 2nd or 3rd rotations (ca. 20-30 years). Because of the long time span, many companies continue to underestimate the cost of fertilizer required to compensate the nutrient loss. A study conducted in Sabah showed that almost 90% of N was lost through burning and the potential economic value of nutrient loss by burning in a timber plantation is more than RM 2,000 per ha. Another study conducted by GTZ in East Kalimantan has discovered that when burning prior to the establishment of *Eucalyptus* and *Acacia* plantations most of the nutrients will disappear after several rotations. Furthermore, replacing nutrients in intensively managed timber plantations constitutes a major operating cost. While standard fertiliser applications account for an average of 4% of the plantation's total costs, the costs necessary to replace the expected nutrient losses range from 9 to 40% of the plantation's total costs depending on the species, site management and fertiliser. On the other hand, the compaction, which often results from the use of heavy machinery for land clearing, can cause stunting with up to 35% less growth, based on a report from a tree plantation in Sabah.

Other major negative impacts of fire use are the impacts to the environment such as air pollution through smoke and haze, and increased erosion and leaching causing pollution of water bodies. This 'cost' component is however very difficult to estimate. Although there are a lot of studies on the economic cost of the environmental damage, for example those conducted by ADB/Bappenas or WWF/EEPSEA on the economic impacts of the 1997/98 fires, most of these studies were done for specific purposes, and thus differ in their approach and the components they take into account. While these studies calculated the cost for indirect impacts of fire resulting from smoke and haze, such as increased medical costs, cost for transportation disruption, and loss of revenue from tourism, the loss of 'intangible' benefits (biodiversity, habitat, etc.) remained difficult or even impossible to estimate. Most importantly, these environmental impacts from fire and haze are extremely difficult to attributes to who bears them. So far there are only few cases where companies had to pay for the environment degradation resulting from their fire use. Hence, it is not surprising that companies do not consider environmental impacts of burning as a cost component in their financial calculation.

Besides land productivity (loss of nutrients) and environmental degradation, there are other economic disadvantages of fire use. One example is the cost for

establishment of a fire management system. Each use of fire bears the risk of fire escaping. Therefore the fire user has two choices: to be a responsible or an irresponsible fire user. If the company acts responsibly and tries to prevent wildfires the company has to allocate budget for establishing a fire management system. If the company is irresponsible and lets fires burn uncontrolled, they may have to bear additional costs in the form of fines and conflict settlement. In Kalimantan, for instance, many companies had to compensate villagers for the impacts of wildfires the companies lit. In some cases compensation payments were as high as several hundred USD.

The discussions above show how complex the economic discussion of fire use and fire impacts are. While the immediate impacts of burning seems to be more economically due to lower land preparation cost, most of the costs of burning are hidden costs or will only appear in the long-term. In practice, therefore, most of the companies still focus their attention to the short-term economic advantage of burning ignoring the potential economic costs in the long-term. Due to political and economic uncertainties in Indonesia, but also in general elsewhere, private companies are usually not inclined to undertake long-term investment. This leads to an unsustainable mode of operation reaping the 'highest profit in the shortest period', mainly at a cost to the environment.

Technical aspect

Beside the economic aspect, the technicalities in the development of plantations play a crucial role in decision making whether to burn or to use non-burning methods for land clearing and preparation. With respect to technicalities, the key factors are the amount and type of residues left after land clearing and the need to remove these from the plantation for better access and working, reducing potential pest and disease problems and potential fuel increasing the plantation's vulnerability to fires. The need for burning varies markedly and depends on local and site specific conditions, particularly:

1. Plantation objectives

The main reason for clearing the land is to create space for planting trees. Its urgency is very different depending on the crop or tree species to be cultivated. While non-fire land clearing and preparation has become standard practice for many oil palm plantations, no-burn land clearing methods seem to be more difficult to adapt to tree plantations because trees are planted much closer together than oil palm trees. In most cases, in an oil palm plantation around 120 trees per hectares is planted, while in a tree plantation over 1000 trees/ha. This means that in tree plantations, there is no space for stacking rows, without loosing plantation area and hence production. On the other hand, the land clearing costs without burning in a tree plantation may be lower, because a tree plantation tends to be managed less intensively and clearing does not have to be as complete as for oil palm plantations.

The initial growth of certain tree species improves with fire use in land preparation. From Sabah, for instance, it has been reported that *Eucalyptus spp*. need ash bed to grow best during the first three months.

Discussion in working group

For the establishment of new plantation, the need for burning depends very much on the amount of biomass in the area to be cleared. Generally, the lower the amount of biomass to be removed the easier the use of heavy machinery (non-fire land clearing methods). Fire is less applicable to clearing land with low volume of biomass such as grassland, low secondary vegetation or heavily logged-over forest. Burning is more economical[1] for clearing high-volume forest because it is more difficult and time consuming to dispose of high volumes of piled wood mechanically.

The need for using fire diminishes the longer the plantation is cultivated: mechanical land clearing in the second and later rotations is easier and cheaper compared to initial land preparation for new establishment (first rotation), because there will be less vegetation/biomass to be cleared. This is one of the reasons why at the time of writing many more Indonesian companies were using fire compared to Malaysian companies. While most of the plantations in Malaysia, particularly in East Malaysia, have been established for decades and are already in the second or later rotations, many plantations in Indonesia are still being established on forested areas.

2. Site (soil, topography)

The effectiveness of mechanical land clearing and therefore its cost depends strongly on the plantation site. Generally, heavy machinery, such as tractor and excavator, are very difficult and costly to use in peat swamp compared to mineral

[1] For a high-volume forest with a significant percentage of commercial timber, mechanical land clearing could be very profitable and cost effective compared to fire use by selling the timber produced.

soils. Additionally, the use of machinery in deep peat soil is more difficult and risky than in shallow peat. On the other hand, the impact of burning is much more serious in peat swamp than on mineral soils. Fires in peat swamp areas are difficult to detect and control, last long, and produce great amounts of haze. It should be borne in mind that the current ban on fire in peat swamps is due to the smoke rather than the fire itself.

In some cases, the use of tractor for land clearing and terracing can cause immense technical problems. In the concession area of Samling in Sabah, where 80 % of the sites are clayey with more than 40 % clay content, the use of tractors caused severe soil compaction. The compaction has resulted in stunted growth by 35 %. The increased bulk density and loss of infiltrability resulted also in gulley formation and serious soil erosion, especially in areas with broken terrain and high rainfall.

In peat swamp, however, the use of tractor can have positive effects for plantation growth and survival. Golden Hope in Sarawak reported that in its peat areas the planting rows and harvesters' paths need compaction using excavator. The compaction is an absolute prerequisite particularly to reduce excessive porosity, improve root anchorage, and minimize future subsidence and leaning of the oil palm trees.

Golden Hope's case, however, is a specific case; with flat terrain and not much vegetation debris to be removed.

The terrain can facilitate non-fire land clearing methods or make it more difficult. Some methods of residue removal might not be possible in all terrains: e.g. the use of excavator in hilly terrain might be difficult, flat terrain will be easiest to clear without using fire.

3. Fire risk of

The accumulation of fuel in plantations and the resulting increase in fire risk arose as a major concern of plantation companies with respect to non-fire land clearing and preparation during the workshop. The dry slash left in the field during mechanical land clearing creates large amounts of dry fuel that becomes a major fire hazard. Particularly for newly developed plantations this presents a big problem since the time of high fire vulnerability would be greatest in the first years: the fire risk is considerably reduced, once the plantation reaches crown closure.

The conversion of a forest without burning, in fact, will leave large amounts of slash on the ground. A study in Sabah, for instance, reported that the mechanical land clearing of a forest will leave 440 mt/ha dry weight slash if not removed. In tree plantations, the amount of residues is not as high as in a conversion of a forest, but it is still a major fire hazard depending on the tree species. An example is the plantation area of Samling in Sabah that was established by reforesting degraded land with *Acacia*. This tree species accumulates a thick leave litter on the ground up to around 60 mt/ha dry weight, which is a dangerous fuel in times of drought (Table 5, Appendix 3). Other studies estimate the residues to 100 mt/ha or more after extraction of usable wood.

Though the amount and characteristics of residues are different from one plantation to the other, e.g. tree plantations leave small diameter wooden residues and leaf litter, while oil palm plantations leave oil palm trees and empty fruit bunches,

and not all biomass will be easily burnt,[2] but dry slash is seen as a time bomb by the companies. If there is a major drought such as in the El-Nino year in 1997/98, dry slash can become the fuel leading to a major fire catastrophe, as happened in some plantation areas during the 1997/98 fires. This issue should be discussed further and considered very carefully. In some regions this issue becomes very critical, for example in Sarawak where within the next 10 years an ambitious reforestation program is aiming to establish 1.5 million hectares of timber plantations and 1 million hectares of oil palm plantation.

In the end, the decision to clear land mechanically or using fire will be based mostly on financial calculations whether the cost of removing residue without burning is economically feasible and whether the residue has economic value that can compensate the additional cost for labour and heavy machinery used in land preparation is critical in this decision.

3.3 Residues - problem or opportunity?

The concern with residues varies according to the industry and the crop planted. Pulp and paper companies tend to use most of their residues, while other tree plantations have great difficulties reducing their residues. Especially for companies producing wood chips, it would be comparatively easy to use and remove residues. RAPP in Riau, for example, could easily practice zero burning, as they produce chips for their own industry and could therefore reduce residues down to about 20 tons/ha. Once the amount of residues is reduced the residues can be distributed equally on the ground, and if necessary crushed, to leave a small layer only. This resolves problems of access and reduces the fire risk.

Generally, the use of residues is depending on market demand and infrastructure. Currently, most plantations companies without their own processing industry find it difficult to sell their residues. Beside poor infrastructure, particularly in the Indonesian part of Kalimantan and Sumatra, the demand for wood chips is currently too small for the supply. Due to lack of markets, BPP in Sabah, for example, currently leaves 80-100 m^3/ha of usable wood behind, while they could reduce their residue down to 10 m^3 per hectares with the appropriate market incentives. In any case, localities and site area remain decisive to whether the use of debris will be economically viable. To reduce the residues costs RM 1,200-1,400 per hectares in Malaysia and around RM 200-220 /ha^3 in Indonesia.

For oil palm plantations, there seem to be more options to use the residues compared to tree plantations. In Sarawak, for example, the Sarawak Timber Association has an initiative to use oil palm residues for MDF (Medium Density Fibreboard). Furthermore, the Indonesian Oil Palm Research Institute in Medan, North Sumatra, has shown that the utilization of oil palm residue can be very profitable. Some examples are:

---

[2] Concerning the potential fire risk that residues pose, it must be understood, that not all residues left behind pose a fire risk. Fuel needs to have specific characteristics to burn. With regards to fire risk, it was found in Samling plantations that it is especially the fine fuels (small wood with less than 20 cm in diameter and leaves, which need only 2-3 dry days to become inflammable) that are potentially dangerous. Fire research elsewhere indicates the strongest role for fuels less than 25mm in diameter.

- Oil palm trunks for lumber: From average 56 tons/ha of oil palm trunk, around 28 tons/ha of lumber can be produced, which after treatment and drying can be used for wood products such as furniture;
- Oil palm trunks for charcoal briquettes: Briquettes can sell at USD 100/ton;
- Empty Fruit Bunches (EFB) and Palm Oil Mill Effluent (POME) for high quality compost: The current production rate is 70 tonnes of compost per day from 360 m^3 of POME per day and 138 tonnes of EFB per day.
- Oil palm biomass for pulp and paper production.

Unfortunately, many Indonesian companies do not know these potential uses of residue due to weak socialisation and communication of ideas. Moreover, as for tree plantations, the utilization of oil palm residue is currently hampered by poor infrastructure and limited access to the market.

The use of oil palm biomass for pulp and paper may contribute to solving the supply problem of raw materials faced by some pulp and paper companies, particularly in Sumatra. While Sumatra has a large amount of oil palm residue that currently is not used, these companies 'have to' use illegal timber to feed their pulp and paper industries due to acute shortage of raw material supply from timber plantations. Admittedly there is a technical constraint in using oil palm residue for paper due to its physical characteristics.[4] Moreover, one major hindrance to a wider use of this technology could be the connection of oil palm with forest conversion, which leads to paper mills not wanting to be associated with the oil palm business, which sounds illogical, if they then accept illegal wood. Despite the technical and public relations constraints, the option of using oil palm residue for pulp and paper production should be considered seriously as one possibility to break the 'evil cycle' between the pulp and paper industry's demand-and illegal timber supply, forest conversion, illegal logging and fires.

[3] These costs are assuming that big machinery is used (big machinery cost is borne by logging industry) for wood plantations; residues are crushed and spread before planting.

[4] The physical characteristic of oil palm fibre is different to wood (timber). Fibre from oil palm is shorter and therefore needs to be mixed with wood for paper production. Fibre is only about 40% of oil palm residues.

4. The need for improved, and better coordinated, fire management in plantations

The large loss of plantation companies caused by fires in 1997/98 made the need for effective fire management clear. As a response to the fires, many companies rethought their approach to fire management. Samling in Sabah reports that the failure to prevent and fight fires in their project area in 1997/98 resulted from a combination of factors (Appendix 3): Extreme climatic conditions due to the El-Niño phenomenon, difficulties in controlling fires ignited by local communities living in and around their plantations, the availability of large amount of dry fuel in form of slash remained after mechanical land clearing, and most importantly unprepared fire management system, including poor infrastructure and access, inappropriate equipment and poorly trained fire crews, lack of water reservoirs and fire towers, aggravated by lack of coordination with relevant agencies, and, critically, lack of an appropriate fire management plan.

Effective fire management system was an important and much discussed issue

Samling is not an isolated case. Most plantation companies in Indonesia and Malaysia have the same experiences at different scale and intensity. The companies present agreed that better and better-coordinated fire management has to be established and developed, particularly to deal with the increasing fire risk due to the future drought and El-Niño events. However, many companies are deterred by its relatively complex technicalities that require new skills and initial investments in training and acquisition of equipment. Some companies, such as Golden Hope and Samling reported that the cost for fire prevention and control is around RM 10 per ha, but the initial costs for training and purchase of specialized equipment is very high.

Unfortunately, fire does not receive consistent attention, since not every year sees bad fires. Moreover, during times of economic recession, fire management is usually a target for cutback, especially after several incident-free years.

It became obvious in the workshop that there is a big gap in the knowledge of fire management and expertise. Moreover, there is no ’standard’ or ’one size fits all’ fire management. Each system has to be developed or adapted to physical, social, and environment local circumstances. Efforts to address fires must also take into account the five components of fire management (analysis, prevention, preparedness, suppression and restoration) and embed fire management efforts in a comprehensive and balanced land use strategy with adequate attention to underlying causes of forest fires. Instead of fighting fires, more emphasis should be put on their prevention.

5. Conclusion and recommendations

The role of fire differs between ecosystems, land use and management systems. Therefore no categorical prescription or ban of fire is appropriate. Not all fires are bad, and in some situations, burning might be a better option lesser evil. It is necessary however for all plantation companies to develop an appropriate fire management system, including perhaps prescribed burning under strong supervision and with appropriate and prepared fire management facilities, in line with the existing legal framework and physical, economic, social, and ecological circumstances.

Following are some recommendations subtracted from the discussions and a list prepared by workshop participants on 'things that should be done' in Appendix 4:

1. Reformulation and establishment of a comprehensive forest fire management plan involving relevant stakeholders at various levels. The plan should be developed based on well-balanced approach taking into account the five components of fire management (analysis, prevention, preparedness, suppression and restoration).
2. Annual training program by companies with support from government agencies to improve fire prevention and fire fighting capacity and readiness. Cooperation amongst relevant institutions is also needed to optimize the use of resources and increase the effectiveness. Proper fire fighting equipment is essential.
3. Integrating indigenous people and local communities in the management of fires and land is important. This reduces conflict and also increases productivity of the land and plantations. Furthermore, to mitigate sporadic burning by villagers, community agro-forestry in and around the plantation sites could be organized.
4. Raise awareness and improve education on the use and threats of fires.
5. It became clear that there is a large gap of knowledge about fire use and management. More specific research is needed to address those questions that currently hamper the implementation of non-fire land clearing methods in the field. Private companies should play an active role in this, including allocating resources. Other stakeholders, particularly the government agencies, should also be involved.
6. Fire use may be permitted in specified situations after appropriate research, evaluation and planning to identify the best and balanced approach. Prescribed burning should be conducted under proper planning and supervision to systematically remove the dry slash. Burning should not be allowed under any circumstances during major dry spells.

7. However, the use of fire must be carefully balanced based on well-founded scientific understanding of the role and potential positive and negative effects of fire in the particular environment and its social, economic, ecological and political costs.
8. The implementation of prescribed burning should be controlled under strict legal framework. It needs appropriate guidelines for fire use and well developed rural fire services.
9. Viable fire insurance schemes (covering establishment costs and value of the plantation) as incentives for more responsible fire use.

Next Steps

In line with the recommendations above, participants of the workshop agreed to the follow-up activities below (see Figure 2):

1. Document the meeting as a starting point in seeking resources and commitments as well as a leverage mechanism to move towards next steps from the workshop (this report).
2. Formation of working group(s) to:
   - Oversee and manage data and information collection and analysis;
   - Frame fire management system;
   - Plan and implement the development of a fire management system; and
   - Communicate outputs to relevant government agencies.
3. Re-convene to follow-up, monitor and adapt, and move forward, which is planned to be held within a year's time in Kuching.

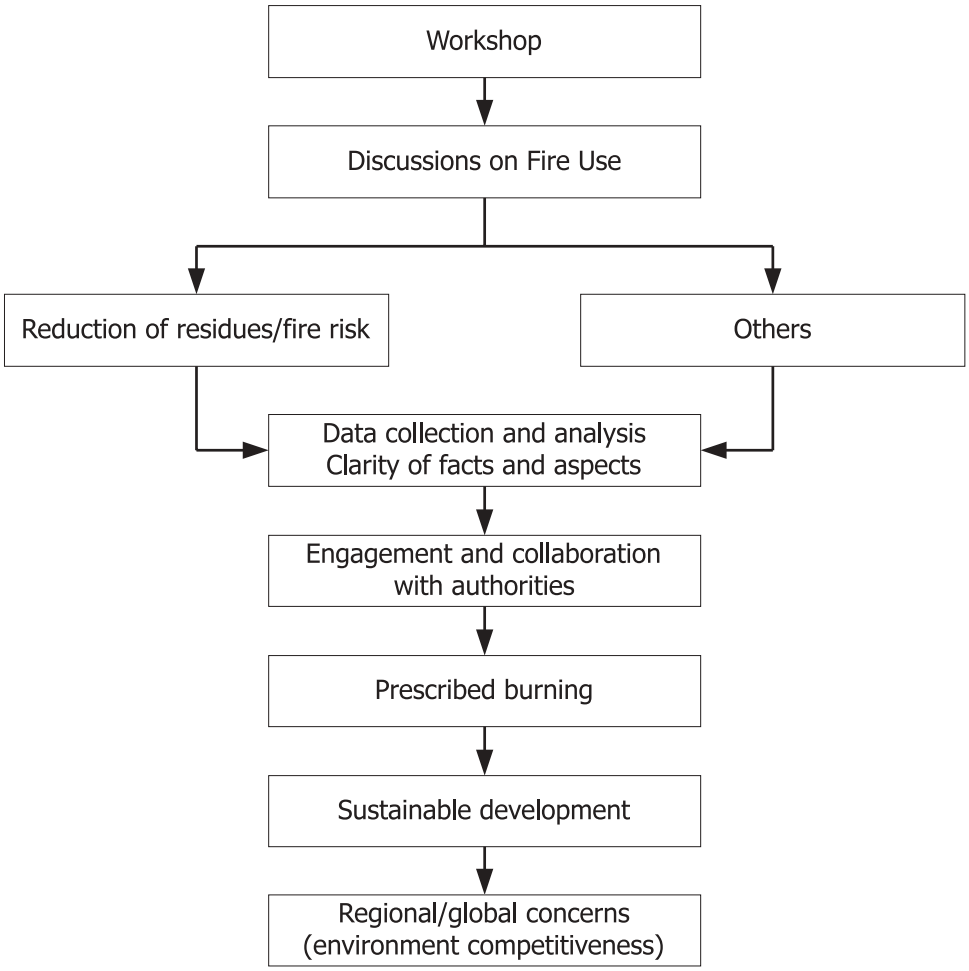
Who does what?

It was suggested that for Sarawak STA supported by its member companies would take the lead in data and information collection, while INGOs such as PFFSEA, IUCN and WWF could support in facilitating meetings, discussions and providing inputs and analysis. Timeframe for the activities still needs to be set.

The participants were of the opinion that the forestry department and oil palm association should also play a role. In the Indonesian context, it was considered that MPI (*Masyarakat Perhutanan Indonesia*/Indonesian Forest Society) and / or APHI (*Asosiasi Pengusaha Hutan Indonesia*/Indonesian Concession Holder Association) could be asked to take the lead. ISP (Planters Association) also has a role to play.

Regarding the involvement of communities, appropriate strategies and mechanisms have to be developed. Alternatively existing strategies and mechanisms based on studies and research from various institutions such as IUCN, WWF, CIFOR and ICRAF's ASB (Alternatives to Slash and Burn)-Programme can be used for this purpose.

Figure 2: Draft of planned discussions and next steps



6. Bibliography

Abdullah, Azrina (2002). *A Review and Analysis of Legal and Regulatory Aspects of Forest Fires in South East Asia.* Project FireFight, Bogor, Indonesia.

ASEAN. Regional Haze Action Plan. http://www.aseansec.org/function/pa_haze.htm

Ganz, David and Peter F. Moore (2002). Précis of Communities in Flames, an *International Conference on the Involvement of Communities in Fire Managemen*t. Jakarta, Indonesia.

Guyon, Anne, Dr. and Dr. Dicky Simorangkir (2002). *The Economics of Fire Use in Agriculture and Forestry – A preliminary Review for Indonesia.* Project FireFight, Bogor, Indonesia.

Karki, Sameer (2002*).* *Community Involvement in and Management of Forest Fires in South East Asia*. Project FireFight South East Asia, Jakarta, Indonesia.

Moore, P.F (1998). *Forest Fires in ASEAN: Data, Definitions and Disaster?* Paper presented at the Workshop on Forest Fires: "*Its impact on biodiversity*", 20-23 March 2001, ASEAN Regional Centre for Biodiversity Conservation, Brunei Darussalam.

National Development Planning Agency (BAPPENAS) (1999). *Final Report, Volume 1+II: Causes, Extend, Impact and Costs of 1997/98 Fires and Drought*. BAPPENAS and ADB. Indonesia.

Simorangkir, Dicky and Sumantri (2002). *A Review of Legal, Regulatory and Institutional Aspects of Forest and Land Fires in Indonesia*. Project FireFight South East Asia, Bogor, Indonesia.

Tacconi, Luca (forthcoming). *Fires in Indonesia: causes, costs, and policy implications*. Cifor publication draft, May 2002.

Appendix 1: List of participants

Participant	Address	Tel/Fax/Email
Dr. Ir. D. Darnoko Pusat Penelitian Kelapa Sawit (IOPRI)	Jl. Brigjend Katamso 51, Medan 20158, Sumatera Utara, Indonesia	Ph.: +62 (61) 786 2477 Fax: +62 (61) 786 2488 Email: iopri@idola.net.id ddarnoko@yahoo.com
Mr. Febri Wibawa Parsa Sihombing PT. Multi Prima Entakai	Jl. Mangga Besar VIII/20, Jakarta 11150, Indonesia	Ph.: +62 (21) 659 5130, 629 5450, 629 8561 Fax: +62 (21) 639 9616 Email: febriwp@yahoo.com
Mr. Putut Sudarmadji PT Multi Prima Entakai	Jl. Mangga Besar VIII/20, Jakarta 11150, Indonesia	Ph.: +62 (21) 659 5130, 629 5450, 629 8561 Fax: +62 (21) 639 9616
Mr. Muhammadsjah Djafar PT. Rea Kaltim Plantations	Jl. P. Irian No. 26, Samarinda, 75113, East Kalimantan, Indonesia	Ph.: +62 (541) 732 898 Fax: +62 (541) 200 321 Email: msjafar@plasa.com rkpsam@samarinda.org
Mr. John Edwards KTS Group	7th Floor, Crown Towers, 88, Jalan Pending, 93450 Kuching, Sarawak	Ph.: +60 (82) 345 033 Fax: +60 (82) 345 678 Email: johnedw@po.jaring.my
Mr. Sim Boon Liang Samling Group	Wisma Samling, Lot 296, Jalan Temenggong Datuk Oyong Lawai Jau, 98000 Miri, Sarawak	Ph.: +60 (86) 391 503 Fax: +60 (86) 391 498 Email: simbl@tm.net.my
Mr. Tang Sing Kiong Ta Ann Group	No 6, Jalan Rawang, P.O. Box 1489, 96008 Sibu, Sarawak	Ph.: +60 (84) 331 125 Fax: +60 (84) 312 815 Email: tapop@tm.net.my
Mr. Yii Puan Ching Rimbunan Hijau Group	No 66 - 78, Pusat Suria Permata, Jalan Upper Lanang, 96000 Sibu, Sarawak	Ph.: +60 (84) 216 155 Fax: +60 (84) 215 217 Email: puanchin@tm.net.my
Dr. Willi Wunder GoodMatch Sdn Bhd Sarawak Indigenous Tree Centre	Level 26, Wisma Sanyan, No.1, Jalan Sukan, 96000 Sibu, Sarawak	Ph.: +60 (84) 328 518, 328 889 Fax: +60 (84) 334 809 Email: willi.wunder@web.de
Mr. Ting Sing Chuon Sanyan Group	Level 26, Wisma Sanyan, No.1, Jalan Sukan, 96000 Sibu, Sarawak	Ph.: +60 (84) 328 888 Fax: +60 (84) 334 809 Email: sting@mylink.com.my

Mr. Warren John Ellis Grand Perfect Sdn Bhd	1st & 2nd Floor, Lot 3469 & 3470, Parkcity Comerce Square, P.O. Box 3375, 97010 Bintulu, Sarawak	Ph.: +60 (86) 311 990 Fax: +60 (86) 333 990 Email: wje78@yahoo.co.uk
Tuan Haji Johari Ho Sabah Forest Industries Sdn Bhd	Kompleks SFI, No 10, Jalan Jeti WDT 31, 89859 Sipitang, Sabah	Ph.: +60 (87) 801 027 Fax: +60 (87) 801 061 Email: johariho@sfisb.com.my johariho@tm.net.my
Dr. Ir. Gary Tan Shin Yang Forestry Sdn Bhd.	124-126, 1st Floor, Jalan Bendahara, P.O.Box 1599, 98008 Miri, Sarawak	Ph.: +60 (85) 426 999 Fax: +60 (85) 422 299 Email: piasausl@tm.net.my
Mr. Pupathy a/l Uthrapathy Thandapani Golden Hope Plantations (Sarawak) Sdn Bhd	P.O. Box 1288, 97008 Bintulu, Sarawak	Ph.: +60 (86) 332 659 Fax: +60 (86) 332 695 Email: utp@goldenhope.com pupathyut@hotmail.com
Mr. Glen MacNair FDS/KTS	7th Floor, Crown Towers, 88, Jalan Pending, 93450 Kuching, Sarawak	Ph.: +60 (82) 345 033 Fax: +60 (82) 345 678 HP: 012-8881038 Email: glen@pd.jaring.my gmacnair@hotmail.com
Mr. Dania Codeb Goyog Natural Resources & Environment Board	Tingkat 18 & 19, Menara Pelita, 93050 Kuching, Sarawak	Ph.: +60 (82) 319 519 Fax: +60 (82) 312 800 Email: dania_goyog@yahoo.com
Mr. Semilan Ripot Forest Department Sarawak	Ibu Pejabat Jabatan Hutan, Tingkat 4, Wisma Sumber Alam, Petra Jaya, 93660 Kuching, Sarawak	Ph.: +60 (82) 319 246 Fax: +60 (82) 441 240 Email: semilanr@sarawaknet.gov.my
Ms. Ginny Ng WWF Malaysia	49, Jalan SS23/15, 47400 Petaling Jaya, Kuala Lumpur, Malaysia	Ph.: +60 (3) 7803 3772 Fax: +60 (3) 7803 5157 Email: gng@wwf.org.my
Dr. Geoffrey Davison WWF Malaysia, Borneo Programme	WWF Malaysia Suite 1-6-W11, 6 Floor, CPS Tower, Centre Point Complex, 88000 Kota Kinabalu, Sabah	Ph.: +60 (88) 262 420 Fax: +60 (88) 242 531 Email: gdavison@tm.net.my
Mr. Hermayani Putera WWF Indonesia	Jl. Alianyang, No.46, Pontianak 78116, Kalimantan Barat, Indonesia	Ph.: +62 (561) 733 921 Fax: +62 (561) 733 921 Email: wwf@pontianak.wasantara.net.id

Dr. Peter Moore PFFSEA Indonesia	Jalan CIFOR, Situgede, Sindang Barang, Bogor Barat 16680, Indonesia	Ph.: 62 (251) 622 622 Fax: 62 (251) 622100 Email: p.moore@cgiar.org
Dr. Dicky Simorangkir PFFSEA Indonesia	Jalan CIFOR, Situgede, Sindang Barang, Bogor Barat 16680, Indonesia	Ph.: 62 (251) 622 622 Fax: 62 (251) 622 100 Email: d.simorangkir@cgiar.org
Ms. Nina Haase PFFSEA Indonesia	Jalan CIFOR, Situgede, Sindang Barang, Bogor Barat 16680, Indonesia	Ph.: 62 (251) 622 622 Fax: 62 (251) 622 100 Email: n.haase@cgiar.org
Mr. Barney Chan Sarawak Timber Association	11 Floor, Wisma STA, 26, Jalan Datuk Abang Abdul Rahim, 93450 Kuching, Sarawak	Ph.: 60 (82) 332 222 Fax: 60 (82) 487 999 Email: sta@sta.org.my
Dr. Peter Kho Sarawak Timber Association	11 Floor, Wisma STA, 26, Jalan Datuk Abang Abdul Rahim, 93450 Kuching, Sarawak	Ph.: 60 (82) 332 222 Fax: 60 (82) 487 999 Email: peter@sta.org.my
Ms. Belinda Tsen Sarawak Timber Association	11 Floor, Wisma STA, 26, Jalan Datuk Abang Abdul Rahim, 93450 Kuching, Sarawak	Ph.: 60 (82) 332 222 Fax: 60 (82) 487 999 Email: sta@sta.org.my
Ms. Emily Wong Sarawak Timber Association	11 Floor, Wisma STA, 26, Jalan Datuk Abang Abdul Rahim, 93450 Kuching, Sarawak	Ph.: 60 (82) 332 222 Fax: 60 (82) 487 999 Email: sta@sta.org.my

Appendix 2: Workshop agenda

Date/Time	Program	Remarks
Day 1 Thursday, 24 October 2002		
08:30 – 09:00	Registration	At Hotel Hilton Kuching
	Setting the Context	
09:00 – 09:15	Opening Remarks (STA and PFFSEA)	Setting the context – fires and land preparation
09:15 – 09:30	Introduction (Dr. Peter Moore – PFFSEA)	Theme: bad fires / good fires, underlying causes of forest and land fires, fire situation in SE-Asia
09:30 – 10:00	Presentation 1 (Dr. Dicky Simorangkir – PFFSEA)	Theme: The Economics of Fires and Land Use – A Preliminary Review
10:00 – 10:30	Discussion Facilitator: Dr. Peter Kho, STA	
10:30 – 11:00	Coffee Break	
	Reality on the Ground – Sharing Experiences	
11:00 – 11:30	Presentation 2 (Dr. D. Darnoko – Indonesian Oil Palm Research Institute)	Theme: Eco-Technology for Oil Palm Biomass Utilization
11:30 – 11:45	Presentation 3 (Mr. U.T. Pubathy – Golden Hope)	Theme: Developing oil palm plantations on peat in Sarawak – Golden Hope`s experience
11:45 – 12:00	Presentation 4 (Mr. Sim Boon Liang – Samling Reforestation Sdn. Bhd.)	Theme: Fire – A burning issue in forest plantation
12:00 – 12:30	Discussion Facilitator: Barney Chan, STA	
12:30 – 14:00	Lunch	
	Working groups – Discussion	
14:00 – 17:00	Discussion in Working Groups Preparation for presentation in the plenary session on the next day	Data/information collection and experience sharing: ➤ Constraints, conflicts and inconsistencies in fire use practices ➤ Best and worse case examples of fire use ➤ Gaps in the knowledge and information base
19:30	Workshop Dinner	Hosted by PFFSEA

Day 2 Friday, 25 October 2002		
	Discussion of Results	
08:00 – 09:30	Presentation and discussion Facilitator: Dr. Peter Moore, PFFSEA	Working group A: the technical aspects, advantages and disadvantages of land clearing using fire and no-fire methods Working group B: the legal and customary context and constraints, in the industry's effort to use prescribed burning
11:00 – 11:30	Coffee Break	
From the industries` perspective: The ideal fire management system		
11:30 – 12:30	Plenary session Facilitator: Dr. Peter Moore, PFFSEA	Collective reflections on a possible fire management system for Sarawak (what is it, and what do we want it to be, who should lead it, what resources needed?), including the possibility of prescribed burning
12:30 – 13:30	Lunch	
	Workshop Statement – Next Steps	
13:30 – 15:30	Plenary session Facilitator: Dr. Peter Moore, PFFSEA	Draft workshop statement identifying further work and next steps to: ➤ Fill gaps and conduct further analyses as identified ➤ A generic recommendation to develop a management system and to speak with the authorities on advocating the use of fire in specific circumstances, such as prescribed burning
15:30 – 16:00	Coffee Break	
16:00 – 17:00	Conclusion and Closing Remarks	Adoption of workshop statement
19:00	Farewell Dinner	Hosted by STA

Appendix 3: Workshop presentations

Session 1: Setting the Context

1. Dr. Peter F. Moore *(Project FireFight South East Asia)*

"Setting the context – fires and land preparation"

What makes fire burn?

Three things are required for a fire to burn (Figure 3):

1. Oxygen

No fire can burn without oxygen, which is required for combustion (burning).

In the open air, the wildfire scenario, there will always be more oxygen available than fire needs to burn.

2. Ignition

The next ingredient for fire is heat, which raises fuel to ignition point.

This can only partly be influenced, by controlling and preventing people from lighting fire or preventing human activities, which could cause fire in times of high fire danger.

Natural ignition sources such as lightning, and spontaneous ignition remain uncontrollable.

3. Fuel

What burns is called "fuel". Its characteristics include:

- Dryness (moisture content)
  - Fuels must be dry to ignite
    - Fuel above 60% moisture content will normally not burn
    - Fuel below 20% moisture content will ignite easily and burn quickly
  - The rate fuels dry out depends on:
    - Wind – to remove the moisture around the fuel
    - Humidity – low humidity increase the rate at which the fuel loses moisture to the atmosphere
    - Temperature – particularly if direct sunlight but mainly through its influence on humidity

- Size - indicated by diameter classes
  - Usually <5mm, 6-10mm, 11-25 mm, 26-100mm and >100mm.
  - Smaller diameter fuels dry more quickly than the larger ones since they have more surface area for their volume
  - Finer fuel ignites more easily than larger and therefore smaller fuels are needed to pre-heat and ignite larger fuels
- Arrangement (how densely packed – the weight per unit volume)
  - Densely packed fuels burn more slowly (for example peat) and scattered discontinuous fuels may not carry a fire across the land
  - There is an ideal arrangement for fuel to burn – much like shredded paper – which provides optimum air flow (oxygen), pre-heating (for ignition) and connection/contact with other fuels

The factors of dryness, size and arrangement combine to provide a figure of available fuel – how much of what is there can burn if ignition takes place.

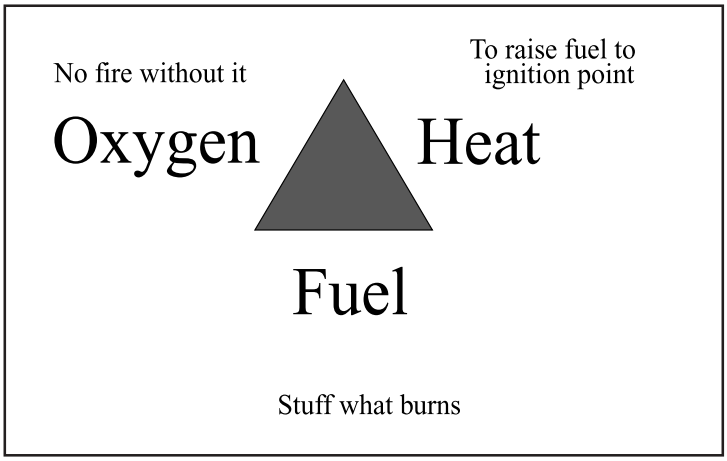


Figure 3: Fire triangle – O_2, fuels, heat

In their natural state tropical forests have little fuel available to burn, because of the following fuel characteristics:

- high moisture content since they are shaded and in a humid environment;
- smaller sizes since the litter that falls naturally generally consists of fine branches and leaves from the canopy and undergrowth; and
- is arranged mainly flatter, since the decomposition rate is very high.

Changes in all these factors are one reason for the increase in tropical fires in recent decades.

Land and forest management practices often leave plant debris behind, and change forest conditions. The debris represents a significant increase in fuel availability from the natural levels and the changed forest condition leads to more rapid drying and slower decomposition of plant materials. Additionally the humidity in disturbed forest is lower and the amount of sunlight below the canopy is increased. This is often the case after logging activities or the construction of roads.

In this situation the amount of fuel for fires has increased dramatically and with it the chance of fires. While these circumstances have been created by shifting agricultural practices in the past, in recent decades the rate of change has been accelerated by large-scale forest conversion and other forest changes, mainly logging.

This is the reason for gathering together the people to the workshop in Kuching – to examine the debris (fuels) produced by land management on degraded forest lands and look at the positive and negative aspects of its economics, practice and planning. Depending what is found out there may be specific work or research to be done, knowledge transfer, socialisation of ideas and practices, development of training or the identification of policy issues to be addressed. Collectively these things might be progressed through the development of best practice guidelines.

Good Fires and Bad Fires

Humans have been using fire to serve their purposes for thousands of years. Overwhelmingly the fires of the tropical region are human caused. Natural causes of ignition are extremely rare in the tropics. As there are more people, closer together and more land management options some of the uses and outcomes of fire have begun to come into conflict.

- Fires can be deliberate
  - Lit on purpose to
    - Remove residues from agriculture or land preparation
    - Prepare land for an activity – planting, hunting or other activities
- Fires can be unintentional
  - Resulting from accidents, carelessness or escape from originally purposefully lit fires. (important to differentiation between wanted and unwanted fires)
- Fires can be beneficial
  - Meeting the objective they were lit for
  - Adding value to the results of activities or actions
- Fires can be damaging
  - Negative impacts on:
    - People – health, livelihoods, assets
    - Environment – ecological values, environmental services

As nations and their people developed their economies and industry initially the impacts of fire use were mainly felt at local level. As the scale of industry has expanded and the number and types of activity have increased development has begun to both interact within itself **(**one type of land use, sector in competition with another, or traditional use, for land or resources and impacting on each other when fires escape for example) and the outcomes are being felt above and beyond the local level, where the major negative impacts remain strongest, to provincial, national, regional and in some respects global scales.

Fires and their emissions are one of the most visible expressions of this heightened interaction and widening circle of impact from rapidly expanding and large-scale land use change**.**

The purpose of this workshop is to examine and evaluate fire use by the private sector.

- Where we are with fires
  - When, how and for what do we use fires?
- Where we can go with fire use
  - What might be improved or changed?
- What we need to get there
  - Research? Operational methods? Policy Change?

2. Dr. Dicky Simorangkir *(Project FireFight South East Asia)*

"The economics of fire use in agriculture and forestry:A preliminary review for Indonesia"

In the last two decades many studies and analyses were conducted by various stakeholders on causes and impacts of forest and land fires. Most of the studies focused on the impacts of forest fires, particularly after the 1997/98 fires (examples include BAPPENAS/ADB and the Economy and Environment Program for South East Asia (EEPSEA)/WWF). Despite criticism about the methodology used and choice of cost elements analysed, some of these studies provide a better account of the economic impact of forest fires. On the other side, there were only few studies that dealt with the economic aspect as the causes of fires. It is a common understanding that economic is one of the main reasons why people continue to use fire for agriculture activities such as land clearing. A commonly held belief is that fire is the cheapest, fastest and most effective land clearing method with the added benefit of providing nutrients from ash residues. However, there is no clear and convincing information about whether this is true or not and under which condition/situation the use of fire is economically advantageous. More needs to be known about the costs and benefits of using and managing fire. Information on the costs of responsible fire use, alternatives and how they can be promoted to make them financially attractive, and who pays the price when fire is used irresponsibly are still missing.

PFFSEA undertook a study that is concerned with the economic aspect of fire use, which is critical for a comprehensive understanding of the underlying causes of forest and land fires, and ultimately necessary for sustainable fire management. The study reviewed and analysed existing knowledge on the financial costs and benefits of using fire in agriculture and forestry, with particular attention on the positive and negative economic impacts of fire use in land clearing activities. It also compared burning with zero-burning method in commercial agriculture and timber plantations focusing on and taking account of several cost components: land clearing, plantation management (land immobilization and planting operations), soil fertility and availability of nutrients, crop protection, and yield differences. The results are provided in Table 1.

Furthermore, the financial analysis of fire use needs to include fire management. Every use of fire bears the risk of escaped fires, and the consequences have to be evaluated. Hence for a fire user, two choices can be considered:

- Controlled use of fire, integrating fire management measures to ensure prescribed fires do not escape and become wildfires; and
- Uncontrolled use of fire, without any particular attempt at preventing wildfires and establishing fire management systems. In this case, however, the user may have to bear additional costs in the form of fines, conflict settlement, and unfavourable public relations.

Following are some main findings and lesson learnt from PFFSEA study:

1. Much confusion reign about costs and benefits of fires. So far, little or no consideration has been paid to the entire suit of costs, including benefits and externalities. Available cost estimates of fire damage are not known well enough by national officials. A better understanding of the costs of fire will provide crucial support to existing, and possible new efforts and perhaps lead to improved funding of fire management and other essential agencies.
2. Data on the economics of fire use is not readily available. While the differences in costs of land clearing operations are well documented, there is less quantitative information on other aspects of plantation management. Even less available are economic data on non-fire land clearing from industrial timber plantations. Information on land clearing costs was mostly obtained through interviews with practitioners and experts. Good studies on this subject are few and far between. An exception is the study by the German Development Agency (GTZ) in East Kalimantan. It has documented the fertiliser needs and costs for timber plantations that have been established with and without fire use.
3. A commonly held belief is that fire is the cheapest, fastest and most effective land clearing method with the added benefit of providing nutrients from ash residues. The review of existing experience and studies has shown that this remains true for subsistence farming but not necessarily for larger plantations. For larger plantations the financial analysis of the costs and benefits of fire versus zero burning showed that the economic advantage of fire use varies very strongly and depends on many factors, such as site (soil fertility, vegetation density), labour cost, investment cost for equipment and training cost for establishing and maintaining a fire management system, etc.
4. Generally zero-burning methods are not more expensive than burning, especially when replanting oil palms or rubber trees, or clearing low secondary vegetation or heavily logged-over forests. Burning is more economical for clearing high-volume forest because it is more difficult and time consuming to dispose of high volumes of piled wood mechanically. In the long term, however, zero burning will actually be more cost effective mainly due to lower fertilization costs, pay off of fire management system, and lower socio-economic costs of fire damages.
5. Many companies continue to use fire for land clearing even they are fully aware of the economic and other advantages of non-fire methods. This can be explained by short-term oriented management, but also because managers are deterred by the relatively complex and technical operation for non-fire land clearing methods

Table 2: Advantages and constraints of burning versus zero-burning

Impact	Burning		Zero-burning	
	Advantage	**Constraint**	**Advantage**	**Constraint**
On the environment		Air pollution (smoke/haze) Erosion and leaching, increased pollution of water bodies	No pollution	
On fire risks and hazard		Risk of wildfires		Leaves piles of dead vegetation (fuel) that constitutes a fire hazard
On land clearing and planting operations	Simple and easy No need for heavy equipment Eases supervision Applicable in all types of terrain	Requires fire control system Weather dependant	Windrows can be used for contouring More flexibility in scheduling operations	Needs heavy equipment Difficult in hills or swamps Piles of vegetation hamper field supervision and movement
On soil and fertility	Quick release of nutrients (especially P, K, Ca, Mg)	Affects soil properties (pH, organic matter, structure) Higher bulk density (soil porosity and infiltration decrease Higher erosion Loss of N, C and part of S to the atmosphere and other nutrients through leaching	Nutrients locked up in the wood are released slowly to the roots of the planted rubber or oil palm when the dead trees decay, hence long-term fertiliser needs are reduced Better soil properties (pH, SOM*) result in better yields and growth	Heavy machinery may compact the soil or disturb the topsoil Nutrients are slowly released and initial growth of the plants can be slower or require more fertilisers (can be improved by pulverising the debris and planting of LCC**)
On pests and diseases	Destroys many pests and diseases	Trees that are not uprooted may propagate root diseases		Higher risk of pests and diseases, especially *Oryctes rhinoceros* and *Ganoderma*, hence higher losses and/or higher costs for control (see above, can be reduced)
On weed control	Suppresses the growth of bushy weeds	*Imperata cylindrica* may grow more quickly	Less problem with *Imperata*	More problem with weed growth (which can be suppressed by spraying herbicides)
On costs and benefits	Less expensive to implement in the short term No need for heavy equipment	Reduces soil fertility in the long term, i.e. increases the use of fertiliser	If used properly, will reduce the use of fertilisers and increase yields	Requires heavy machinery and special skills

requiring new skills and investment in heavy equipment. In some cases plantation managers are reluctant to adopt the new practice because they dislike the 'messy' appearance of mechanically cleared sites with their high windrows of residues. Likewise, implementing a fire management system in a forest concession or a plantation requires initial investments in training and acquisition of equipment. Unfortunately, fire management is usually a target for cutback to meet short-term economic targets.

6. For local farmers, the situation is different. In most cases fire is the only affordable land-clearing tool, since they do not have the financial resources and/or skills to practice zero burning.

7. Alternative methods to fire use have been developed on a commercial scale, particularly in Malaysia, but suited mainly to clearing low volume of biomass such as replanting oil palms or rubber trees. More data and analyses is needed to develop and implement alternative methods that are suited for the development of timber plantations and allow the adoption of the Malaysian practice to other conditions and circumstances such as in Indonesia.

Session 2: Reality on the Ground – Sharing Experiences

3. Dr. D. Darnoko *(Indonesian Oil Palm Research Institute)*

"Eco-Technology for Oil Palm Biomass Utilization"

In 2001 oil palm remains a very important sector in Indonesian, which provided the country a foreign exchange earning of USD 1.2 Billion. Until that year, the total area of oil palm plantation was 3.5 millions hectares producing 7.2 millions tons of CPO *(crude palm oil)*, from which 3.0 million tons for domestic consumption and the other 4.2 millions tons were exported.

The economic crisis since 1997/98, which hit Indonesia very hard did not seem to influence the development of new oil palm plantations. Since the beginning of 90's the extent of oil palm plantation has increased continuously, from less than 1.5 millions hectares in 1992 to ca. 3.6 millions hectares in 2001. There is however a clear change in the ownership: an increasing percentage of oil palm plantations are owned by local communities/smallholders (individually and/or as a group). Since 1998 the portion of smallholders owned oil palm plantation has amounted to more than 60% of the total oil palm plantation area.

Most of the existing 3.6 million hectares of oil palm plantations are located in Sumatra (Riau, North Sumatra, South Sumatra, Jambi) and Kalimantan (particularly West Kalimantan). This will not change in the future, since the largest designated area for oil palm development are located on both islands. From the total 9.8 million hectares of forest[5] to be converted to oil palm plantation, the biggest part (more than 60%) is located in only 4 provinces: Central, West and East Kalimantan, and Riau.

In the past, most fire outbreaks in Indonesia occurred in Sumatra and Kalimantan and many studies link land conversion for plantation establishment to those fires. It is therefore expected that most of future fires will also break out in those two islands. This prediction has raised concerns among various stakeholders and the needs for more responsible fire use or alternative methods become stronger.

The Indonesian Oil Palm Research Institute has conducted various experiments and researches towards improved management of oil palm plantation that is environmentally sound, economically viable and socially accepted. Hereby the development of zero burning method and better utilization of oil palm residues have gained increased attention.

---

[5] Part of the totally 13.7 million hectares of conversion forest, which –under Indonesian forest system– can be converted for other purposes such as plantation development

Application of Zero Burning

Non- burning land clearing method has been developed and implemented in limited scale by IOPRI in collaboration with some of its member companies. The methodology and procedure for zero burning is essentially the same as what has been developed and practiced for decades in many regions: lining - land preparation (using ploughing tractor and ditch digger) - shredding and stacking (using excavator equipped with chipping bucket and blade) - pulverising (using tractor equipped with rotary disc) and planting.

The objectives of zero burning applications are: 1) to maintain existing soil fertility, 2) to maintain soil structure, 3) to ensure nutrient recycling through decomposed materials, and 4) to prevent surface/soil erosion. The use of zero burning method also resulted in higher fruit brunch yields in the first year as shown in Table 2.

It has to be noted that the absence of fire use in land clearing/preparation increases the risk of pest and disease. The two major pests associated with zero burning, especially for oil palm plantations in second rotation, are the rhinoceros beetle *(Oryctes rhinoceros),* which breeds in the stacked debris, and oil palm root rot (*Ganoderma boninensis)*. IOPRI, however, has proved that both pests can be controlled effectively and economically: *Ganoderma* can be controlled by deep ploughing and pesticides, while *Oryctes* can be contained using a combination of cropping practices (pulverisation, shredding the vegetation debris and covering it with leguminous cover crops), insecticide applications or biological control, like pheromone traps.

Table 3: Advantage of zero burning method

Treatment	Fruit Brunch Yield in the First Year (ton FBB/ha)
Zero Burning	**9.70**
Zero Burning and Pulverised	10.72
Burning	8.86

Utilization of Oil Palm Residue

One of the main reasons why many oil palm companies still burn residues is because the residue is perceived to be valueless and expensive to clean with heavy machinery. IOPRI has shown that the utilization of oil palm residue can be very profitable. IOPRI has tried different uses of the residue such as:

- Oil palm trunks for lumber: From average 56 tons/ha of oil palm trunk, around 28 tons/ha of lumber can be produced, which after treatment and drying can be used for wood products such as furniture;
- Oil palm trunks for charcoal briquettes: Briquettes can sell at USD 100/ton;
- Empty fruit bunches (EFB) and oil palm biomass from the mill (POME) for high quality compost: The current utilization rate is 70 tonnes of compost per day from 360 m^3 of POME per day and 138 tonnes of EFB per day.
- Oil palm biomass for pulp and paper production.

However, the utilization of oil palm residue requires good infrastructure (to transport the residue), good management, and access to the market. Regarding pulp and paper industries in Sumatra, while there is a very acute shortage of raw materials supply from timber plantation, large amounts of oil palm residue are left unused. Even though the characteristic of paper produced from oil palm is different to paper produced from timber, oil palm residue could be a very attractive alternative as raw materials for pulp.

Based on its experience and studies, IOPRI concluded that:

- Large are of land is still available for oil palm development;
- International sensitization to forest conversion for oil palm plantation and fire caused by oil palm plantations requires oil palm development to be sustainable;
- Zero burning should be applied for land clearing or replanting to preserve soil fertility as well as to prevent environmental degradation; and
- Available environmental friendly technologies for converting oil palm biomass into valuable products should be used.

4. Pupathy a/l Uthrapathy Thandapani *(Golden Hope Plantations Sdn Bhd)*

"Developing Oil Palm on Peat in Sarawak"

Non-fire land clearing techniques have proven an environmentally sound and practical method for oil palm and rubber replanting in which the old stand of tree crops are felled and shredded and left to decompose *in situ*. The technique has been adopted since 1989 as a standard practice in Golden Hope Plantations Bhd. and other plantation companies in Malaysia in compliance with the Environmental Quality (Clean Air) regulation 1974.

In 1996, Golden Hope had initiated Lavang Project near Bintulu, Sarawak, covering an area of about 11,900 hectares. Out of this, about 3820 hectares i.e. 32 % of total area was developed for oil palm planting on peat. The whole project area was adapted from jungle or logged-over forest into oil palm planting. The zero burning technique was employed during the land preparation and development of oil palm planting on peat.

Following is the sequence of land preparation activities as practised by Golden Hope:

1. Identifying the natural flow of streams (to facilitate future drainage and road systems).
2. Clearing existing streams and outlets and constructing perimeter drains where necessary.
3. Constructing main and collection drains and roads.
4. Underbrushing of bushes and shrubs.
5. Felling of larger trees.
6. Pre-lining for stacking & subsidiary drains.
7. Stacking of debris.
8. Compaction of planting rows and harvesters' paths.
9. Constructing subsidiary drains and field roads.
10. Further consolidation of main and field roads.
11. Lining and holing.
12. Field planting.

Very critical for the development of oil palm on peat is the removal of excess water to facilitate accessibility and field operation and to further lower the water table. The water was maintained in which the existing streams/rivers were desilted and deepened, perimeter drains and additional outlets constructed, and obstructive materials removed. This must be conducted carefully to avoid over-drainage.

The planting area is cleared using excavator and chain saw. All trees are felled. Big stumps are allowed to remain. The height of the stump is determined by trunk size. Undergrowths, shrubs and bushes up to 7.5 cm diameter are under brushed. To minimize erosion, the risk of water stress (dryness) and as firebreaks, riparian reserves were retained along riverbanks.

Selected timber with diameter larger than 10 cm were used as road foundation, which was then filled with mineral soils and surfaced with stones. The height of the road maintained at 50 cm – 100 cm after compaction.

Stacking of debris was carried out firstly with pre-lining for stacking avenues and planting rows. After that, debris was stacked at the central avenue of 4 palm rows. This has to be carried out carefully so as not to interfere with future holing and planting.

The planting rows and harvesters' paths must be compacted using excavators. The compaction is an absolute prerequisite to 1) reduce excessive porosity, 2) increase bulk density, 3) reduce fertilizer leaching, 4) minimize future subsidence, 5) improve root anchorage, and 6) reduce leaning of palm trees. This is conducted 3-4 weeks after the construction of subsidiary drains. This is usually a very difficult and ineffective job if water level is high. As such, this would be carried out preferably during the drier season.

Once the planting area was compacted, lining and field planting can be started. To plant the trees hole-in-hole planting technique was adopted, whereas a 'puncher' was used for holing. Since peat is relatively infertile, planting was done at 160 stems per hectare.

Overall, the cost analysis of fire versus non-fire use indicates that non-fire methods are not more expensive. In the Lavang Plantation Project, the cost of land clearing without the use of fire is RM 130 per hectare cheaper than using fire. A detail on cost comparation is given in Table 3.

Table 4: Cost of land preparation for oil palm plantation on peat

Description of Job	Peat					
	Clean Clearing			Zero Burning		
Felling	RM	450.00		RM	450.00	
Stacking	RM	450.00		RM	450.00	
Burning	RM	40.00		RM	–	
Restacking/Reburning	RM	70.00		RM	–	
Terracing (14Õ)	RM	–		RM	–	
Lining	RM	43.00		RM	43.00	
Holing/Planting	RM	442.00	*SPH 158* *Mechanical/Hole - RM1.40* *Planting - RM1.40* } *RM2.80/palm*	RM	442.00	*SPH 158*
Compaction	RM	425.00		RM	425.00	
	RM	**1,920.00**		**RM**	**1,790.00**	

Field Management

The management of planted area focused on 2 aspects: water management and the establishment of LCC (*Leguminous Cover Crops*).

Water management, is focusing to discharge the excess water and maintain the water level at 50-75 cm height by using water gates and drainage blocks that were installed at strategic points. It the water table drops too low, fire becomes a major risk.

LCC are planted after stacking of debris to 1) speed up the decomposition and mineralization processes, 2) reduce rhinoceros beetle infestation, 3) keep weeds out, and 4) act as soil binder. Two species of crops are usually used, *Calopogonium caeruleum*

and *Pueratia phaseoloides*. So far, the use of LCC has shown very good results only on shallow peat. Very poor growth of LCC was noticed in moderate and deep peat areas.

Major problems to be dealt with in oil palm plantation on peat are low soil fertility, termite infestation and leaning of palm trees. Peat with high C/N and N/K ratios and very low content of K, P, Cu, Zn, and B. Additionally the low pH of peat slows down the mineralization process. To coop with this problem, different type of fertilizers must be used. To increase the major nutrients content in the soil, SRF and CIRP were used in the first year, while in the 2nd and subsequent years compound and mixture fertilizers were used (8-10 kg/palm/yr). For micro nutrients, which is critically required for first generation of palms, $ZnSO_4$ and $CuSO_4$ were applied in combination with *sodium tetraborate* in the 2nd and 3rd4 years.

Termite infestation is a major pest problem. In the project area, termite infestation incidences are reported as high as 4%. To handle this problem prophylactic and control measures were taken in which lorsban *(chlorpyrifos)* or regent *(fipronil)* was drenched to palm spear and 10 cm wide band around palm base.

The leaning of palm is caused because of peat's spongy texture and high water holding capacity. After drainage it is common for peat to oxidize and shrink. This results in poor anchorage of the palms and palm trees leaning. This occurs as early as 2 years after planting and at the end leads to yield depression. To reduce the loss, therefore, the planting rows must be compacted using excavator (see above).

For a better understanding of these problems, Golden Hope Plantations has embarked on several trials to find solutions. As the trials are in their preliminary stage, no conclusive results are available yet.

5. Sim Boon Liang *(Samling Reforestation Sdn. Bhd.)*

"Fire – A burning Issue in Forest Plantation"

Samling Reforestation Sdn. Bhd. held several reforestation licences in Sarawak with a gross area of 520,000 hectares. The main trees species for their reforestation programs are *Acacia mangium*, *Acacia crassicarpa*, *Eucalyptus grandis*, and other indigenous species. The timber produced is used mainly to produce plywood and MDF (Medium Density Fibreboard).

So far Samling plantations have been spared from major fire incidences. However, lesson on forest plantation fire can be drawn from the major forest fire during the El Niño year in 1997, which affected 11,000 hectares of *Eucalyptus* and *Acacia* plantations in Sabah. A study uncovered some factors that contributed to the spread of fires in that area:

1. Climatic condition

1997 was a year where a very strong El-Niño phenomenon occurred and caused the worst drought of the century in Sabah. High temperature, low humidity and very strong wind were the ideal conditions for fire ignition and spread.

2. *Fuel*

The dry slash left in the field during land clearing, and the thick *Acacia* leave litter, build up a large amount of dry fuel that became a major fire hazard.

3. Ignition

Fires were ignited by local communities living in villages in and around the project site by careless hunter, fisherman, and shifting cultivators whose traditional practice is to clear and burn land for planting paddy. In normal years these practices seem do not cause significant fire problems. However, in El-Niño years fires could easily escape and become wildfires.

4. Fire management

The failure to prevent and fight fires in the project area was a result and combination of various factors. When small fires started, their risks were underestimated. Once the fires had become big, it was too late to control them. Inappropriate equipment was a further problem: water pumps used were proven inefficient (took half a day to fill up water bowser), rubber garden hoses used by the fire fighters were clumsy and melted under the heat, and water bowser could not climb hilly site. Additionally, in times of high fire risk and drought, rivers dry out and there were no water reservoir available. The hilly and poor accessibility in the project area made it very difficult to deploy fire crews.

Based on the experience in 1997 and due to a very ambitious plan to convert a large area of under the reforestation program (28 LPF for 1.5 million ha) and oil

palm program (1 million ha) in Sarawak over the next 10 years, the fuel problem has become to a major concern of many plantation companies. As shown in Table 4, where the result of a study on the amount of biomass of a forest compared to a 3 years old *Acacia* plantation, the conversion (land clearing) of a forest without burning will leave large amounts of slash (440 mt/ha dry weight) on the ground if these are not removed. Though not all biomass will be easily burnt,[6] but dry slash is like a time bomb. If there is a major drought like the El-Nino year in 1997/98, the dry slash will become the fuel leading a major fire catastrophe, as illustrated by the case in Sabah in 1997.

Table 5: Biomass in forest and plantation

Biomass (mt/ha dry wt.)	Forest	*Acacia* (3 years)
Leaves	7	2.4
Branches < 20 cm	106	7.9
Dead	0	4.3
Log > 20 cm	149	22.7
Bark	18	7.2
Total tree biomass	273	44.5
Under storey	3.3	5.4
Stumps & roots	179	11.3
Total Biomass	**440**	**61.2**

Another important aspect is that the major species planted for reforestation is currently *Acacia*. This tree species accumulates thick leave litter on the ground, which -again- is a dangerous fuel in drought time.

Related to the discussion on fire use in plantation development –therefore- companies differ in opinion: While many company owners continue to advocate open burning as a cheaper means of land clearing, other companies are aware of the damaging impacts of open burning, particularly for the environment and with respect to nutrient loss. An example from a study in Sabah shows that burning the vegetation residue in land clearing will lead to significant loss of N, P, K, Ca, and Mg (Table 5).

Table 6: Nutrient loss due to burning residual in land clearing

Nutrient	Nutrient loss (kg/ha)
N	220*
P	2.3
K	33
Ca	26
Mg	8

[6] The major concern identified are the small fuels, less than 20 cm in diameter and leaves, which need only 2-3 dry days of dry weather to become susceptible for fire

In the long term, it will cost the company a significant amount of money to compensate the loss of nutrient through burning of residue through intensive fertilization program. Table 6 shows that the value of nutrient loss in land clearing with fire use was more than RM 2,000 per ha. The table also shows the overall advantages and disadvantages of each option (burning versus non burning/spreading). Each option has positive and negative sides. From the economic point of view, it seems that the use of heavy machinery (tractor/excavator) to clear the land (push logs into piles and spread out the branch and other vegetation debris) is in the short term more expensive than using fire but in long term will be more cost effective due to lower cost of fertilization. From the technical side, however, the use of tractor for land clearing and terracing in the project sites caused immense problem. Since 80 % of the sites are clayey with more than 40 % clay content the use of tractor caused severe soil compaction. The compaction has resulted in stunted growth by 35 %. Furthermore, the increased bulk density and loss of infiltrability resulted in gulley formation and serious soil erosion, especially in the area with broken terrain and high rainfall.

Table 7: Land clearing methods: burning vs. spreading

	Burning	**Spreading**
Limitation	Difficult when wet	Need terrace for steep terrain
Land clearing cost	Cheaper	+ RM 400 / ha
Nutrient loss	> RM 2,000 / ha	**Slowly released**
Environment	Smoke, erosion	Less erosion
Pest/disease	Clean	Rodent, termite

Based on the experience of fire in the 1997/98 fires and the result of the study, some recommendations are made to prevent the recurrence of fires in the project sites:

1. Conduct prescribed burning under proper planning and supervision to systematically removes dry slash, especially before major El-Nino year. Burning should not be allowed during major dry spell, as that can be dangerous and cause haze.
2. Organise community agro-forestry in and around the plantation sites to mitigate sporadic burning by villagers
3. Reformulate and establish a comprehensive forest fire management plan and instituted annual fire fighting training program. Cooperation amongst relevant institutions is needed to optimise the use of resources and increase the effectiveness of activities. Proper fire fighting equipment is also essential.
4. Raise awareness and improve the education on the use and threats of forest fires.
5. Develop fire insurance schemes as incentives for more responsible fire use.

Appendix 4: 'Things to be done'

What are the key technical and operational issues with respect to fire use in plantations?

- Means for reducing residues, of which fire may be one.
- Permits to do prescribed burns – consultation with various agencies
- Provide with a reduction in restrictions/ broadening of opportunities
- 'Cells' take concerns on fires for/ to government
- Occupational Health and Safety Act (OHSA)
- Coordinated forest fire protection units
- Working to create standardization equipment and plans
- Information gathering and distribution from a number of weather stations, Fire Dept., fire data
- Standard training delivery (with partners)
- Early warning system – analysis, advice
- Prevention – prepare in advance, system of prevention
- Support/ resource – assistance, strategic infrastructure plans
- Research coordination, monitoring of research
- Education
- Interaction/communication/relationships with neighbours/community
- Communications infrastructure – radios, phones, fax, internet, website(s)

What steps should be taken?

- Forming the facts
  - obtaining and collating data (residues/fuels, fires – number, cause, source, areas of management and planned, haze and emissions, mineral soils and peat)
  - analysis (clarity of facts and aspects, further work/research)
- Consider a fire management system consistent with existing legislation, organisations, roles

What resources are needed/ available?

- Small organizational core (hosted)
- Nominated fire officer each company/ partner
- Local presence
- Using existing staff for suppression, prevention, prescribed fires

What is the role of STA (and other plantation/timber association)?

- Coordination in the beginning but later, to be handed over to the industry and supported by the small permanent staff with the specification for fire management.
- There would be a roster/rotation for training.

[6] The major concern identified are the small fuels, less than 20 cm in diameter and leaves, which need only 2-3 dry days of dry weather to become susceptible for fire


LAND CLEARING ON DEGRADED LANDS
FOR PLANTATION DEVELOPMENT
A WORKSHOP ON THE ECONOMICS OF FIRE USE
IN AGRICULTURE AND FOREST PLANTATIONS
24-25 OCTOBER 2002