



# Forestry Department

Food and Agriculture Organization of the United Nations

## Fire Management Working Papers

### Global Forest Resources Assessment 2005 – Report on fires in the South East Asian (ASEAN) Region

*by*

B.J. Shields, R.W. Smith and D. Ganz

March 2006

Forest Resources Development Service  
Forest Resources Division  
Forestry Department

Working Paper FM/10/E  
FAO, Rome, Italy

## **Disclaimer**

The Fire Management Working Papers report on issues addressed in the work programme of FAO. These working papers do not reflect any official position of FAO. Please refer to the FAO website ([www.fao.org/forestry](http://www.fao.org/forestry)) for official information.

The purpose of these papers is to provide early information on on-going activities and programmes, and to stimulate discussion.

Comments and feedback are welcome.

For further information please contact:

Mr. Petteri Vuorinen, Forestry Officer (Forest Fire Management)

Mr. Peter Holmgren, Chief

Forest Resources Development Service

Forest Resources Division, Forestry Department

FAO

Viale delle Terme di Caracalla

I-00100 Rome, Italy

e-mail: [petteri.vuorinen@fao.org](mailto:petteri.vuorinen@fao.org)

[peter.holmgren@fao.org](mailto:peter.holmgren@fao.org)

or: FAO Publications and Information Coordinator:

[andrea.perlis@fao.org](mailto:andrea.perlis@fao.org)

For quotation:

FAO (2006). Global Forest Resources Assessment 2005 – Report on fires in the South East Asian Region. Fire Management Working Paper 10. [www.fao.org/forestry/site/fire-alerts/en](http://www.fao.org/forestry/site/fire-alerts/en).

## FOREWORD

Fires impact upon livelihoods, ecosystems and landscapes. Despite incomplete and inconsistent data, it is estimated that 350 million hectares burn each year; however, the nature of fires determines whether their social, cultural, environmental and economic impacts are negative or positive. Up to 90 percent of wildland fires are caused by human activities primarily through uncontrolled use of fire for clearing forest and woodland for agriculture, maintaining grasslands for livestock management, extraction of non-wood forest products, industrial development, resettlement, hunting and arson - thus any proactive fire management needs to adopt integrated, inter-sectoral, multi-stakeholder and holistic approaches. The situation varies markedly in different regions of the world.

As a supplement and complement to the Global Forest Resources Assessment, 2005, this working paper is one of a series of twelve prepared by regional and country contributing authors to provide a greater depth of data and information on fire incidence, impact, and management issues relating to the twelve UN-ISDR Regional Wildland Fire Networks around the world.

The working paper series assesses the fire situation in each wildland fire region, including the area extent, number and types of fires and their causes. The positive and negative social, economic and environmental impacts are outlined. Prediction, preparedness and prevention as key elements in reduction of the negative impacts of fire, rapid response to extinguish fire incidents and restoration following fires are addressed.

The working paper series also addresses institutional capacity and capability in wildland fire management, including the roles and responsibilities of different stakeholder groups for prevention and suppression, particularly the unique role of community-based fire management.

From these working papers, a FAO Forestry Paper on Fire Management will synthesize the highlights from each region, but also provide a global summary of important lessons that can be used in fire management in the future. These papers are a valuable resource in the process to prepare the Fire Management Code, the Global Strategy to Enhance International Cooperation in Implementing the Fire Management Code and associated capacity building.

## **ACKNOWLEDGEMENTS**

This working paper is the product of a global team of dedicated people willingly giving of their time and specialist expertise within each of the twelve UN-ISDR Regional Wildland Fire Networks.

B.J. Shields, R.W. Smith and D. Ganz, as the authors, obtained key information and data for this working paper from Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Viet Nam and Brunei Darussalam.

We wish to acknowledge the dedicated work of Johann G. Goldammer, Global Fire Monitoring Center (GFMC), for contributing materials and for reviewing this working paper.

We also wish to thank Michèle Millanès for the excellent editing and formatting undertaken.

To all persons who contributed to this working paper, we express our grateful thanks.

## TABLE OF CONTENTS

1.	BACKGROUND .....	1
2.	SUMMARY .....	1
3.	ASSESSMENT OF THE FIRE SITUATION IN THE REGION .....	1
3.1	<i>Extent, number and types of fire/forests burned</i> .....	4
3.2	<i>Reasons (prescriptive/wild, natural or human causes)</i> .....	4
3.3	<i>Damages (social, economic and environmental)</i> .....	5
3.4	<i>Fire Prevention</i> .....	5
3.5	<i>Fire Suppression</i> .....	5
3.6	<i>Community involvement</i> .....	6
3.7	<i>Needs and limitations</i> .....	6
3.8	<i>Analysis and recommendations</i> .....	7
4.	COUNTRY-BY-COUNTRY INFORMATION.....	8
4.1	<i>Brunei Darussalam</i> .....	8
4.2	<i>Cambodia</i> .....	9
4.3	<i>Indonesia</i> .....	10
4.4	<i>Lao PDR</i> .....	12
4.5	<i>Malaysia</i> .....	12
4.6	<i>Myanmar</i> .....	15
4.7	<i>Philippines</i> .....	16
4.8	<i>Singapore</i> .....	17
4.9	<i>Thailand</i> .....	18
4.10	<i>Viet Nam</i> .....	21
	REFERENCES .....	23

## 1. Background

Following the release of the Global Forest Resources Assessment 2000 (FRA 2000) report in 2001, the global FRA process has now entered its next reporting cycle. FAO's Committee on Forestry (COFO) 2003 confirmed the directions of global FRA's that the Kotka IV Expert Consultation recommended in July 2002. Recommendations included the preparation of an update of the global FRA-data in year 2005 and to increasingly involve countries directly in the assessment and reporting, in particular to submit national reports on the status and trends of a range of forestry parameters. More information about FRA 2005 is available at [www.fao.org/forestry/fra](http://www.fao.org/forestry/fra).

FRA 2005 also included thematic studies, including e.g. one on forest fire, forests and water, and mangroves. The thematic study on wildland and forest fire in 2005 is built on regional reviews on forest fire management in the United Nations International Strategy for Disaster Reduction (UNISDR) Global Wildland Fire Networks (GWFN). The current report is a contribution and makes a review of the countries of Insular and Continental Southeast Asia members of ASEAN and the UNISDR Regional Southeast Asia Wildland Fire Network.<sup>1</sup>

This Working Paper FM/10/E has been written by B.J. Shields, R.W. Smith and D. Ganz, and does not reflect any official position of FAO.

## 2. Summary

In the period 2000-2004, of greatest significance in the Association of South East Asian Nations (ASEAN) region was the ASEAN Agreement on Transboundary Haze Pollution, signed by all ASEAN Member countries in June 2002 and entered into force on 25 November 2003. Although this agreement has been accepted in principle and cast as a global role model for other regions to follow, it is noted that not all member countries have ratified the agreement and given it their full endorsement. Indonesia falls into this category. Until such time as all member countries have ratified the agreement, it will not become legally binding and its effectiveness remains open to question.

Community-Based Fire Management (CBFiM) has emerged as a new and increasingly adaptive mechanism for working with and managing fire in the region. The region has embraced the early development of CBFiM through donor projects, international workshops and international conferences that have been hosted in the region. The future of CBFiM and the benefits it can derive for communities will only be ensured if regional and international efforts continue its development.

The region has generally not incurred the extended drought and fire weather conditions that persisted across 1997-98. This in turn means that the capabilities and resource development created in the past five years have not been heavily tested since that time. This may alter in the short term as, at the time of drafting this review in mid-August 2005, Indonesia is experiencing very significant fire activity in Sumatra. Peninsular Malaysia is reporting its highest levels of haze since 1997-98.

Significantly, Thailand offered the only source of fire-related data, including fire numbers and extent, for any ASEAN member for the period. Data for the period post 1997-98 has been difficult to obtain other than the limited data recorded in the Global Forest Resources Assessment 2005 (FAO) for six countries, or extracted from publications such as Ganz (2003).

## 3. Assessment of the Fire Situation in the Region

### Fire Data

Annually, many countries in the region experience significant areas of "routine" agricultural burning. Over the past two decades when a drought escalates, the resultant smoke and haze is generally regarded as a disaster. To the untrained observer, sometimes there is little difference between a "normal" dry season and a "deep drought" dry season. Confounding this is an almost complete

<sup>1</sup> <http://www.fire.uni-freiburg.de/GlobalNetworks/SouthEastAsia/ASEAN-FireNet.html>

absence of reliable data from which to prepare a competent comment about the relativity between seasons or indeed what progress is being made or not made in introducing more effective fire management.

In attempting to source data for this report, it was not possible to locate authentic data post 1997-98 for most countries, and of course, equally difficult to make apposite analyses of current situations. Most recent literature focuses almost exclusively on 1997-98 and little or no records are available for the following years. The most comprehensive data generally available is included in the Country Reports within the Global Forest Resources Assessment 2005 (FAO), but not all member countries are so included. Most statistics focus solely on area burned and there is little or no identification of total ignitions, perceived causes or geographic location.

## **Fire Weather**

Whilst no fire incidents of the magnitude of 1997-98 have since occurred, short periods of dry weather providing favourable conditions for application of land-use fires, wildfires and production of their associated smoke haze have occurred, such as in August 2000 and perhaps in August 2005. In the 2000 instance the haze episode was short lived and few publicly available records, apart from newspaper clippings, allow either a qualitative or quantitative assessment of the fires that produced the haze. The 2005 event only emerged at the time of drafting this review and its impact is yet fully unknown.

Numerous land conversion fires, including slash-and-burn agriculture fires and wildfires affected forests and other vegetation on the Indonesian Island of Sumatra, causing serious haze problems during August 2005. In addition to Riau Province in Indonesia, the haze also affected areas in Malaysia and Thailand. Air quality emergencies were declared in various locations of Malaysia but these emergencies were short lived and did not replicate the extended emergencies apparent in 1997-98.

According to the Global Fire Monitoring Centre (GFMC), fires on peat soils were burning in deep peat layers and therefore it was not possible to suppress them by conventional techniques. Numerous slash-and-burn agricultural/land clearing fires occurred and burned out of control because of very dry weather conditions. No overall assessment of the areas affected by fire is available yet.

The Transboundary Haze Agreement was apparently not invoked, as it still awaits ratification by all member countries prior to implementation. ASEAN also established a panel of experts during this episode to assist member countries tackle forest fires.

International assistance was offered to Indonesia, although none was specifically requested. Indonesia did accept assistance from Singapore (54 firefighters) and Australia (a 12-person assessment team to identify potential need for larger scale international assistance.) Thailand and Viet Nam offered immediate assistance and other regional countries were considering assistance offers when the short-lived event ended. Weather conditions improved by the end of August 2005 and the looming crisis did not emerge.

The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) compiled two situation reports in mid-August (16 and 19 August 2005). More detailed information can be accessed via the web-based daily updates at GFMC.<sup>2</sup>

---

<sup>2</sup> GFMC daily update archive: <http://www.fire.uni-freiburg.de/current/archive/archive.htm>. Go to South East Asia and then to 15/08/2005; 16/08/2005; 17/08/2005; 18/08/2005; 19/08/2005; 20/08/2005; 21/08/2005; 22/08/2005; 23/08/2005; 24/08/2005; 25/08/2005; 26/08/2005.

## **Fire Studies**

The most recent in-depth study of forest fire, its impacts and country-by-country analyses in the region was completed in 2002 by Project FireFight South East Asia (Ganz, 2003).<sup>3</sup> These analyses were a direct follow on from the 1997-98 fire and haze episode.

A more recent collation of fire-related benchmark papers is being prepared by the Center for International Forestry Research (CIFOR). Current plans are that this work, entitled "Forest and Land Fires in Southeast Asia: Local and Global Perspectives" will be published during the first half of 2006 in the Journal for Mitigation and Adaptation Strategies for Global Change (Murdiyaso and Lebel, eds., 2006).

## **Fire-related Donor Projects**

During and immediately after the 1997-98 fire and haze event, many international aid agencies and donors initiated projects within various parts of the region to analyze the event. A review of immediate emergency assistance at the height of the 1997-98 event is described by Qadri (2001), including a lengthy schedule of donors and assistance. Further descriptions of longer-term aid projects are also included. Some projects or their successors remain current in 2005.

The majority of projects were established at the height of, or shortly after large fire events and mostly focused on a specific sub-national target area. There are few, if any, projects that targeted a whole nation and, as a result, national perspectives on fire management issues, including statistics, are difficult to locate.

In some instances, donor projects have attempted to transplant fire management philosophies and systems from other parts of the globe. Experience is proving that different parts of the globe show quite different fire characteristics, including climate, forest type, fuel characteristics to those prevailing in South East Asia. Differing cultural and economic characteristics are also apparent and simple transplantation of management systems are not necessarily the answer.

Recently the German Agency for Technical Cooperation (GTZ) Integrated Forest Fire Management (IFFM) project drew together the elements of fire management and coherently structured them into a tropical fire management framework. Prior to the IFFM report (Shields, 2004), there was no assessment of what a systematic fire management approach might look like. The IFFM project included a clear basis for underpinning information that would create fire understanding at management levels. The underpinning knowledge required to develop a systematic approach to fire management is:

- Underlying Fire Cause (who starts fires and why?)
- Fire Impact (who does fire benefit or disadvantage? quantum?)
- Fire Behaviour (how easy or difficult is suppression?)

Fire-related projects are continuing in the region but to a much lesser extent than during the immediate aftermath of 1982-83 through 1997-98. Fire project design and analysis for recurring fire events should be considered at a time when there is no immediate impetus for post-fire disaster relief and support.

## **Aircraft**

A meeting of fire managers took place in Chiang Mai, Thailand in 2000, and considered the use of waterbombing aircraft for suppression. At that time, effectiveness and cost considerations of aircraft excluded their use. More recent reports, in 2005, of ASEAN countries considering the use of aircraft for waterbombing have emerged. Similar effectiveness considerations evident in 2000 remain, but increased understanding on aircraft use is now apparent and the complexities and potential inefficient nature of aircraft in fire management is appreciated.

---

<sup>3</sup> Project FireFight South East Asia was a Global Initiative of The World Conservation Union (IUCN) and The World Wide Fund for Nature (WWF), funded by the European Union and supported by the US Forest Service. Further information is available from the project website: [www.pffsea.org](http://www.pffsea.org)



## **Fire Danger Rating**

The availability of fire-related weather information has improved in the period 2000-2004. The ASEAN Specialized Meteorological Center (ASMC) and the Southeast Asian Fire Danger Rating System now provide relevant fire danger and meteorology information via their websites.<sup>4</sup> These tools are valuable to the fire manager, although difficulty in accessing and interpreting the information remains in some rural and semi-rural locations.

Viet Nam has developed and made available a National Fire Danger Rating. Fire-related weather data is collected in the field and centralized for analysis and distributed as a fire danger rating across the country. The fire danger rating that is made available in rural areas via different media including facsimile, radio and roadside sign boards.

## **Satellite remote sensing of active fires**

The peak of interest in the use of satellite-detected active fires following the 1997-98 fires has slowed as recognition of its limitations in fire management accelerates. Increasingly "hotspot" identification using NOAA AVHRR is accepted as offering no practical value for strategic and tactical suppression purposes. It is recognized that limitations of using existing fire location maps generated by NOAA AVHRR data center on coarse resolution, cloudiness, time delays in information relay to field sites and accuracy. Given the status of development, generally, of fire management capabilities and systems in South East Asia, the application of spaceborne information other than for monitoring purposes is difficult to justify at this stage.

### **3.1 Extent, number and types of fire/forests burned**

There is almost no data on fire occurrence for the region since 1997-98 other than the one indicated in the individual country sections, which is largely drawn from the Global Forest Resources Assessment 2005 (FAO).

Most statistics available deal only with area burned and frequently, there is no data at all relating to numbers of fires or causes. To attempt analysis of regional fire improvements or capabilities with effectively no data for fire number, extent, type of fire, cause or impact would be misleading. Likewise, no cogent comment can be made about these aspects without some supporting data to provide the underpinning information for discussion.

In the past two decades, fire events in the region have been measured by the level of intra-regional concern and/or global concern. Global input is often represented through post-event efforts to identify significance or undertake assessments of the nature of the event, including causation, area, forest types and impact.

In-between the acknowledged severe events, there is little data collated to enable any ongoing monitoring or evaluation at national levels. Despite the level of inputs and the good intentions of donor projects, almost no baseline data is routinely collected and available. Therefore there is no continuum of data to provide benchmarks against which routine performance and progress might be measured, other than the series of spikes at irregular intervals at the upper end of the spectrum.

### **3.2 Reasons (prescriptive/wild, natural or human causes)**

The 1997-98 analysis of underlying fire causes by groups, such as Project FireFight South East Asia and CIFOR, is still relevant and valid today.

---

<sup>4</sup> [http://www.kjc.gov.my/english/service/climate/fdrs1\\_x.html](http://www.kjc.gov.my/english/service/climate/fdrs1_x.html) and <http://www.lapanrs.com/SMBA/smba.php?hal=3&kat=fd&per=hr>

Some underlying causes in earlier assessments include:

- Land-use change/conflict
- Increasing land-use pressure
- Inconsistent land tenure policy
- Perverse economic incentives
- Direct economic incentives

The most direct fire cause in the region is people and their creation of livelihoods and wealth, i.e., using fire as part of an agricultural cycle for either food or plantation crops.

Interestingly, the GTZ/IFFM project in East Kalimantan defined the linkage between understanding fire cause to achieve effective fire prevention actions. This may be the first time that fire managers are able to appreciate that fire prevention activities and messages must be directly linked to understanding fire cause. All too often, fire prevention campaigns are aimed at sections of the community that do not cause a significant proportion of fire, e.g. school aged children, while the farming and plantation management communities, i.e. those that use and cause the vast majority of fire, are by-passed in prevention activities. Clearly, fire prevention programmes and activities should be targeted toward those people and groups that are causing and igniting fire.

### **3.3 Damages (social, economic and environmental)**

Forest and other land fires in 1997-98 generated very significant ecological and human impact that focused world attention on the underlying nature of fire problems and causes within the region. International attention had been directed to this region following severe drought and fire in 1982-83, 1991 and 1994. As might be anticipated, with the increasing ability to remotely, albeit very coarsely, monitor fire occurrence and extent, the 1997-98 episode drew far more global attention than prior events and consequently future events will attract at least similar levels of scrutiny, driven heavily by neighbours that cause little fire but are impacted by the outputs from it.

For the period since 2000, there is no new reported country level information on specific social economic and environmental impacts. The only available records are those prepared as part of the 1997-98 fire events.

### **3.4 Fire Prevention**

A significant policy development over the period 2000-2004 is the ASEAN Agreement on Transboundary Haze Pollution, which was signed by all ASEAN Member countries in June 2002 and entered into force on 25 November 2003. This signifies the culmination of concerted and intensive regional efforts over the years to address transboundary haze pollution since the 1994 and 1997-98 severe haze episodes. This agreement is the first legally-binding ASEAN regional environmental accord to have entered into force, although it is noted that not all ASEAN Member countries have yet ratified the agreement and until this occurs, questions about its potential effectiveness will arise.

An ASEAN zero-burning policy was ratified in 1999. It is apparent that the prohibition on burning is proving ineffective in reducing fire in the region. It is now more widely recognized that fire has a deeper requirement in society and livelihood creation than a prohibition policy can enforce. Some reversal or other considerations on zero-burning is now beginning to filter into national fire considerations and through the recently developed guidelines for prescribed burning aimed at small landholders, farmers and shifting cultivators.

### **3.5 Fire Suppression**

Fire suppression resources are available at most national levels in the region but do not offer national fire coverage capabilities. Thailand has a nationally organized fire suppression capability and in 2000 recognized that it could offer coverage between 20-30% of the forested lands. No other national

coverage estimates are presently available. Indonesia has begun a programme to develop fire brigades with trained and equipped staff. The fire brigades are being developed in localities considered high fire-prone areas.

The equipment and resources available in the region comprise a range of locally developed and imported technologies. The development of fire suppression field crews, fitted out with standardized levels of manual and mechanized equipment, is apparent in the region. Crew sizes vary between 3 to 15 people and have designated leaders and specialist people capable of operating and repairing fire fighting equipment. These suppression crews are the backbone of fire fighting operations and their continued development and increasing numbers across the region will mark significant changes in fire suppression in the future, provided they are supported by effective management systems.

Vehicles fitted with water tanks and pumps of varying capacities continue to be used and refined with local pumps and equipment. Their utility is limited by road access which creates a ceiling to their ongoing effectiveness, without corresponding road access development.

Heavy plant and machinery (bulldozers and excavators) are utilized more widely by plantation owners, particularly in peat soil fires.

Aircraft utility is beginning to unfold in the region. Some of the most successful aircraft uses in recent times are the use of light and medium helicopters for remote and rapid access to fires with self-contained and well equipped field crews. The helicopters are being used for manpower deployment to fires and ongoing support for logistics (food, fuel, crew changeover). Fixed wing aircraft have not yet been engaged widely for rapid fire detection or work such as infra-red scanning.

### **3.6 Community involvement**

Significant evolution in Community-Based Fire Management (CBFiM) understanding has taken place in the region since 2000. The first International Workshop on CBFiM took place in Bangkok, Thailand in 2001, jointly managed by the Regional Community Forestry Training Centre for Asia and the Pacific (RECOFTC) and Project FireFight South East Asia. The workshop was followed up shortly after by an International Conference in Balikpapan, Indonesia. Concurrently, several higher order reports and collations of case studies on CBFiM have been published, placing CBFiM firmly into a field of study and understanding that is now increasingly appreciated as a more socially adaptive and capable management method in the region. For further information, see Ganz *et al.* (2001), Moore *et al.* (2002), FAO (2002), and the paper on CBFiM presented at the International Wildland Fire Summit, Sydney, October 2003.<sup>5</sup>

A key driver to the development of CBFiM in the region was generated through Project FireFight South East Asia. The project has now concluded, so it will be essential for continuing projects and counterparts to champion the knowledge and understanding developed in CBFiM to maintain the impetus for it. Continued attention on CBFiM as a practical and suitable form of fire management in the region will increasingly enhance the overall fire management outcomes.

### **3.7 Needs and limitations**

First, while international action and input are seen as necessary to assist the region in guiding fire management along a path that will achieve a level of self-sufficiency, the ultimate goal is to achieve a state whereby effective and practicable fire management can be sustained within the region, indeed within individual countries, without significant external input. In essence, the quintessential solution is for individual countries within the region to develop their own or collective fire management solutions that are matched to the specific cultural, physical and financial constraints within the country/region, rather than adopting fire management solutions for completely different circumstances (vegetation, culture, economics).

---

<sup>5</sup> [http://www.fire.uni-freiburg.de/iffn/iffn\\_29/IWFS-4-Paper-5.doc](http://www.fire.uni-freiburg.de/iffn/iffn_29/IWFS-4-Paper-5.doc)

To achieve this, the region needs support and assistance from the wider global fire management community, but that support must ensure that it focuses on the techniques of guiding, leading and capability strengthening in understanding fire in a local context, rather than attempting to impose systems developed for completely different circumstances.

Second, there is an apparent increasing willingness for governments to cooperate and take action on fire management issues in the region. This needs to be harnessed through the development of appropriate fire management capabilities at national, provincial and local levels. To achieve this, greater care in the analysis of each location and its requirements needs to occur, rather than, as indicated above, to simply import a fire management system from elsewhere.

Third, the routine collection and collation of baseline fire information relevant to a local, provincial or national level are essential to make sound fire management decisions. Effort needs to be directed towards such a programme within each country to collect baseline fire-related data such as the number of fires, the area burned, the vegetation type within which they occurred and, if possible, a descriptor of its impact. This level of understanding will assist in identifying fire management needs and suitable programmes of management appropriately targeted and scaled to circumstance.

Fourth, fire in the region is an annual event, it is not something that occurs without warning or understanding. The management of fire in the region is a balance between livelihood creation, health and environmental concerns. The adverse health, livelihood, environment and economic impacts are all appreciated and have been well documented following prior haze events. The heightened international awareness and pressure that result from haze events must be directed into longer-term management efforts, not simply to immediate suppression and restoration. The majority of fire management effort must be directed to the long-term prevention side of the equation.

### **3.8 Analysis and recommendations**

The management and impact of fire within South East Asia Sub-Region is a matter that requires a combined multi-national and regional approach. This has been recognized and agreed by the Member countries through the establishment of the ASEAN Agreement on Transboundary Haze Pollution, in 2002. As noted above, this agreement is not yet ratified by all Member countries and until it is fully ratified and ready to be implemented, its provisions and hence its efficacy cannot be tested. The August 2005 fires, although brief in nature, might serve as a trigger to ensure that this agreement is fully adopted and implemented.

CBFiM has been a significant step forward in the past five years and, if its impetus and continuance are pressed for by the international community, it will increasingly have positive impacts on the improved management of fire in the region. It is essential to incorporate the needs of all parties affected by fire – the legal fire users and those impacted by fire, irrespective of whether that impact is beneficial or not.

Although the underlying drivers for the use and application of fire is increasingly understood, whenever adverse fire weather conditions persist, it is almost a foregone conclusion that a severe air pollution/haze event, induced by fire-associated smoke, will ensue. To understand the likely impact and extent of fire under such circumstances, it is critical to understand the fire regime and the underlying fire load that persists through “benign” fire seasons, to know the likely starting point when adverse conditions occur. This knowledge can only accrue from first principles analyses. Despite the advances that have been made and the outputs from a significant number of donor projects across the region, there is still little collection and analysis of annual fire statistics either on a regional or a country-by-country basis, except perhaps for Thailand. The lack of baseline annual fire data will continue to hamper well structured fire management efforts in the region.

Without clear understanding of the linkages between fire cause and fire prevention actions, and more particularly, who causes them and why, it will remain a difficult task to effectively target sound fire management practices, particularly fire prevention.

There is a very strong need for fundamental analyses of fire situations on an ongoing basis – not only when disaster strikes. There is a strong perception that analyses only occur as a direct result of a

major event such as 1997-98, 1994 or 1982-83. When those events occur, an equally strong perception persists that the international community competes within itself to arrive at the “best” data set for that event. Seemingly this is where the analysis stops and the international community awaits the next event to post analyse. Fire management must be a daily, weekly and monthly programme of systematic management in any region of the globe if it is effective. The attention and effort on fire management in this region must achieve similar time regimes to take any effect in the longer term.

Fire is an inescapable part of the environment in this region. As is the case elsewhere on the globe, a box of matches remains as the simplest and least expensive tool available to fire users. Put simply, fire will remain as a crucial part of the ASEAN environment for the foreseeable future.

## **4. Country-by-country information**

### **4.1 *Brunei Darussalam***

Brunei Darussalam has a land area of 448 000 hectares (ha). Of the total land area, 78 percent are covered with forest as of 2000 (FAO, 2002). The management of the forest reserves is under the jurisdiction of the Forestry Department, an arm of the Ministry of Industry and Primary Resources.

The majority of forests are managed for conservation and ecological values. Production forest is managed for long-term timber supply, targeting self-sufficiency for wood-based products and non-timber forest products.

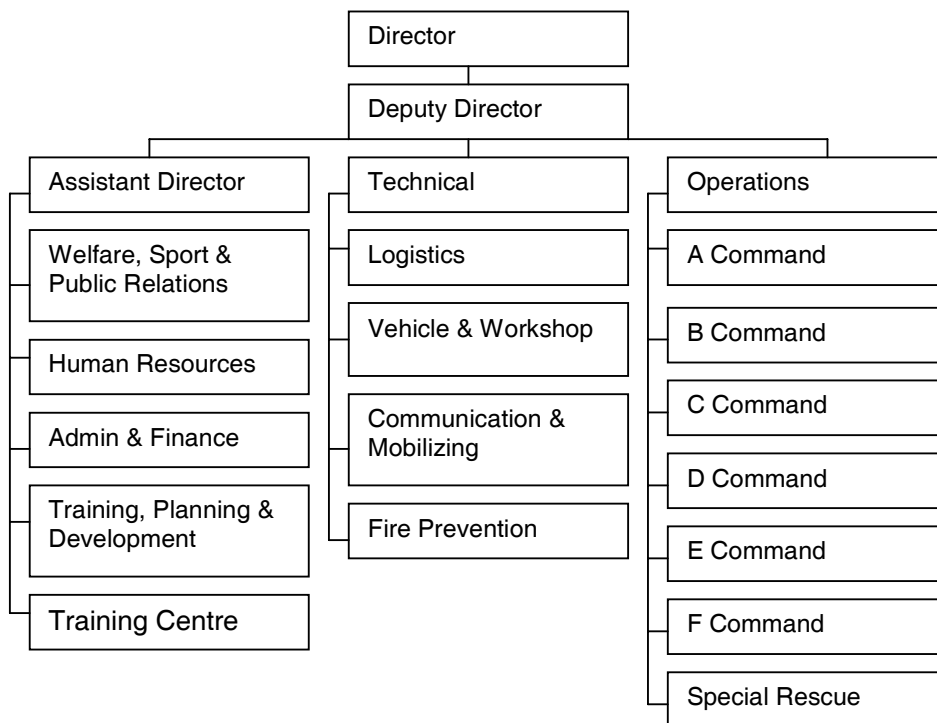
There is currently little or no data available for forest fire occurrence in Brunei. The major causes of forest fire are thought to be deliberate ignition (malicious intent), fire use for disposal of unwanted agricultural debris and forest conversion to agriculture.

Fire damages are not recorded, but in line with fire impact elsewhere in the region, damages probably include loss of peat soil, increasing fire frequency and impact on forests and air pollution. There is no available information on fire prevention programmes.

Brunei has a dedicated and equipped urban forest fire service. Details of its equipment and suppression techniques are not presently available. The “Brunei Fire Service” is a department within the Ministry of Home Affairs. Currently, Brunei Fire Service has more than 1 000 employees and 16 fire stations strategically located.

Brunei is constrained in managing fire on neighbouring lands and is more likely a net recipient of smoke and haze-related impacts from the larger neighbouring land bases of other countries.

The fire management organization is illustrated in Figure 1.



**Figure 1.** Management Structure of the Brunei Fire Service

## **4.2 Cambodia**

Recent observations regarding forest and land fire in Cambodia indicate that there is limited concern for fire management at Government level; however, there are increasing levels of awareness and concern among donor programmes involved in land management activities.

Some historical fire reports exist and fire behaviour studies have recently been undertaken and may assist in providing a suitable start point to effectively analyze and establish a sustainable fire management system in Cambodia.

There is little data available on forest fire numbers and area extent in Cambodia.

Forest fires are mostly caused by activities of people, in pursuit of livelihood, although some are used for illegitimate purposes. Causes are probably related to the following categories but there is no reliable data base available from which to draw these inferences:

- Land use change
- Forest access
- Shifting agriculture
- Land-mine clearing
- Grazing
- Non-timber forest product (resin, honey and hunting)

Anecdotal information lends support to the notion that the lowland dipterocarp forests are burned regularly (the percentage of the forest area burned annually is unknown, although it is suspected to be quite high). There is a perception that, increasingly, this forest type is lacking substantial areas of younger regeneration. Where an annual burning regime is applied to a forest type, it can easily lead to a circumstance in which the forest structure collapses by lack of regeneration with conversion to fire-tolerant shrub or grassland species as mature trees senesce and disappear.

A Forest Fire Control Unit was established in 2000 within the Department of Forestry and Wildlife, Royal Government of Cambodia. Its priorities include fire management prevention and suppression and development of a research capability to examine fire behaviour and fire danger rating systems. To date there is no published information available about prevention or suppression activities.

Recent observations on Cambodia's land management systems indicate little to no support for fire management at an institutional level (Rao, 2001; Limchhun, 2002). Ganz (2003) also reports a single lack of technical expertise, training and equipment. At community level, fire is widely used as a livelihood tool and forestry initiatives encourage local community participation in sustainable forest management (SFM). Community participation in SFM and community-based natural resource management may provide a suitable vehicle to assist development of community-based fire management strategies.

### **4.3 Indonesia**

Indonesia is the largest country within the region and fire occurrence is prevalent. Annually, fires occur on all the populated islands with major foci on Kalimantan and Sumatra.

A patchwork of fire-related institutions (national, provincial and district) and community-based fire case studies are present. Although a cohesive, balanced and capable fire management system effective across the entire country does not exist in Indonesia, there are institutional and community successes that could be used to model and build stronger management capabilities, applicable to the larger islands, if not to the whole nation.

Most fires are directly caused by human activity. The only natural cause of fire is ascribed to burning coal seams, some of which have been alight for up to 17 000 years (Goldammer and Seibert, 1989, 1990). Major causes are large-scale land conversion, shifting cultivation, disposal of agricultural residues for cropland preparation, social conflicts and transmigration.

Since 2000, there has been neither a significant drought year nor *El Niño* event in Indonesia, hence the level of fire activity and impacts experienced in 1997-98 have not been repeated. There are no fire statistics available since the 1997-98 event to quantify fires by number, intensity, vegetation type, land use, by area burned or to provide estimates of commercial damage. AID Environment Netherlands (2002) reported serious haze and pollution from forest fire in September 2002 following an extended dry period. Satellite information for August 2002 over Kalimantan revealed that the majority (75%) of fire activity was in plantation areas and forest concessions, indicating that most of the haze stemmed from forest conversion or exploitation. No estimate of fire areas was provided.

In the 5-year period between 1998 and 2002, annual area burned is listed as follows:

1998	515 026 ha
1999	44 090
2000	3 017
2001	14 330
2002	35 497

The source of these data is the Indonesian country report within the Global Forest Resources Assessment 2005 (FAO). The figure for 1998 is much higher than other years, reflecting the second year of the very severe 1997-98 event, but even so, the area quoted is very substantially less than the estimates of area burned derived from a number of studies after 1998, in which it was estimated upwards of 3 million hectares burned in Kalimantan alone during 1998 (Liew *et al.* 1998).

In August 2005, smoke and haze from Sumatran fires have been reported as impacting on Peninsular Malaysia with air pollution levels exceeding the emergency trigger, and reaching the highest levels since 1997-98. Indonesia accepted assistance from Singapore and Australia in mid-August 2005 and at the time of drafting this review, the magnitude of this event is not clear, but improving weather conditions toward the end of August 2005 averted what was looming as a major crisis.

Fire prevention programmes appear to be largely in the hands of donor-based aid projects conducted by organizations, including the Japanese International Co-operation Agency (JICA), Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation) (GTZ) and the European Union (EU). It is now recognized that the greater proportion of the fire prevention activities in some of the earlier projects have not been quantifiable and potentially were not targeted to the audience causing the fires (GTZ/IFFM Project Review, 2004). Continued drought monitoring and dissemination of drought information is a strong part of the ongoing prevention activities, within defined project areas.

Fire fighting stations, resourced for land and forest fire suppression, are in place in East Kalimantan (up to 12 district fire stations and a provincial station), and the Central Government is beginning a programme of fire brigade development in its highest priority localities. A programme of fire management capacity building is currently being undertaken by the EU project in South Sumatra (South Sumatra Forest Fire Management Project). JICA has continued to conduct fire fighter training through its training centers.

Several industrial forest plantation management companies have increased their capabilities to manage and suppress fires, employing local and international fire management staff to manage fire suppression activities.

The central Government has developed a concept for fire-fighting teams - "Manggala Agni". These teams will be resourced by central Government agencies for suppression responses at provincial and district levels. Manggala Agni is working to develop teams in the higher fire risk areas. In South Sumatra, for example, four stations will be established servicing approximately 90 villages with about 260 trained firefighters.

At the national level, four institutions hold responsibilities to manage forest and land fires:

- Ministry of Forestry
- Ministry of Agriculture
- State Ministry of Environment
- National Board for Disaster Management and Refugees

The decentralization process in the government, that is continuing to evolve in Indonesia, has created some complexity in managing fire as individual provinces and districts seek to involve additional authorities at local levels. A comprehensive review of the regulatory structures in Indonesia is described in Simorangkir and Sumantri (2002).

Communities have been using fire for millennia in Indonesia for livelihood, and significant areas of agricultural land are fired annually to dispose of unwanted crop residues and prepare for the next crop. So too are lands prepared for conversion to plantations of tree species or oil palm. Studies by the Asian Development Bank (ADB) Fire and Drought Management Project in 1998-99 ascribed 61% of all smoke and particulate production during the 1997-98 event to peat sources, with a further 18% to forest conversion burning, the inference being that routine agricultural burning contributed about 20% of the smoke from that event.

Fire use by communities is perceived as a problem when drought occurs, allowing fires to escape, perhaps masking to some extent the significant contribution created by large-scale industrial and forest conversion activities. The improved management of fire in Indonesia through cooperative involvement of local communities has the potential to significantly improve fire and smoke haze occurrence across the landscape; however the full exploration of community-based fire management has not fully taken hold in Indonesia.

The strongest human impacts from fires can be improved at local and community levels through community-based approaches, requiring support of government infrastructure and institutions in periods of strong drought when wanted fires are able to easily extend beyond their intended areas. Similarly fires can be managed on industrial plantation sites through sound management practice from owners.

Indonesia's periodic severe forest fire occurrence in the last twenty years has attracted a strong focus from international aid agencies with total expenditure in the region of US\$30 million (Kaimowitz *et al.*,



2003). These efforts have created different foci of attention - high technology solutions, equipment, institutional capacity, training, importation of fire management systems designed for elsewhere, and more recently, community-based fire management. As is the case elsewhere in the Region, no "single solution" will be effective without the careful and systematic development of an appropriate management structure matched to existing financial, social and cultural constraints.

#### **4.4 Lao PDR**

Forest cover in Laos is estimated at around 40% (Galt *et al.*, 2000). Forest products are the main source of foreign exchange in Laos, and accounted for 42% of foreign exchange revenue in 1998 (STEA, 2000).

Forest habitats in Laos can be divided into four broad types: dry dipterocarp lowland habitats, montane habitats, mixed-evergreen habitats, and pine forests. Of these, the dry dipterocarp forest types and possibly some pine forests may be actively maintained by fire. Additionally, there are 20 National Biodiversity Conservation Areas, most of which are forest habitat, comprising 13% of the total land area.

Presently there is no fire data available for Laos. This complete lack of information is acknowledged in the Forest Resources Assessment 2005 Country Report for Laos. Some statistics are maintained for agriculture and indicate that about 100 000 ha are burned annually. There is no distinction in these statistics as to whether such fire is unplanned, and probably undesirable, or whether it is planned fire used for site preparation and cleaning for new crops, and therefore desirable.

It is estimated that as much 90% of fires originate from shifting cultivation (Ganz, 2003), but at present there appears to be little appreciation of the levels of social, economic or environmental damage arising as a consequence from land and forest fire. No information is available for fire prevention and suppression activities.

Fire management is not perceived as an important issue for Laos in comparison with regional neighbours that suffer higher levels of problems associated with them. Consequently, there is no dedicated office or person responsible for the fire management at a central level.

There are officers who are assigned responsibility for fire management activities, as part of their routine duties, at provincial and district levels. These include Provincial and District Agriculture and Forestry Office Personnel to implement forest fire management activities and support the involvement of local communities in forest fire management, but there is no data available about the level and impact of community interaction achieved. No information is available about specific fire management funding.

Forest fires are not regarded as a major threat and few donor projects focus solely on fire. The project in Sayaboury Province, sponsored by *Cooperazione e Sviluppo* (Cooperation and Development [CESVI], a non-governmental humanitarian organization based in Italy), is an exception.

#### **4.5 Malaysia**

Malaysia is one of the most heavily forested countries in the region with more than 60% of the total land area covered by forest. Dipterocarp forests constitute the bulk of Malaysia's forest areas (89 percent), followed by peat swamp forest (7 percent), mangrove forest (3 percent) and planted forest (1 percent).

There are few statistics on the number and type of land and forest fires in Malaysia, although a fire information system was proposed for both Sabah and Sarawak to generate capability to collect reliable data. This proposal followed the Global Observation of the Forest Cover Workshop on 24 January 2003 (Ganz, 2003).

The Global Forest Resources Assessment 2005 records the following data in the Country Report for Malaysia:

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Area burned (ha)	690	116	418	56	156	25	18	26	1 646	27	6	297	1 350

It is not clear from the report whether these data refer only to Peninsular Malaysia or include Sabah and Sarawak. Satellite imagery analyses undertaken by the ADB Project ADB 2999 – INO in 1998-99 indicated substantial areas of fire had occurred in Sabah/Sarawak during 1997-98, far exceeding the figures quoted of 26 hectares and 1 646 hectares respectively

In general, fires occur sporadically in natural forest and more frequently in secondary forests, peat swamp forests, gelam forests on raised sand beaches on the East Coast, and in forest plantations.

The majority of fires are believed to be directly related to human activities - few natural fires are recorded. There are apparently more reports of fires in Sabah and Sarawak than on Peninsular Malaysia and the potential for forest damage here is greater than on the mainland.

It is perceived that the greater proportion of fires in Malaysia is caused by both small- and large-scale agriculture as well as plantation activities. Other minor causes include hunting and negligence by campers. Fire prevention activities appear to be limited in extent though groups such as the Global Environment Centre based in Kuala Lumpur have had an active focus on fire prevention activities on peat land in the region, much of which is centred locally around Malaysian peat forest.

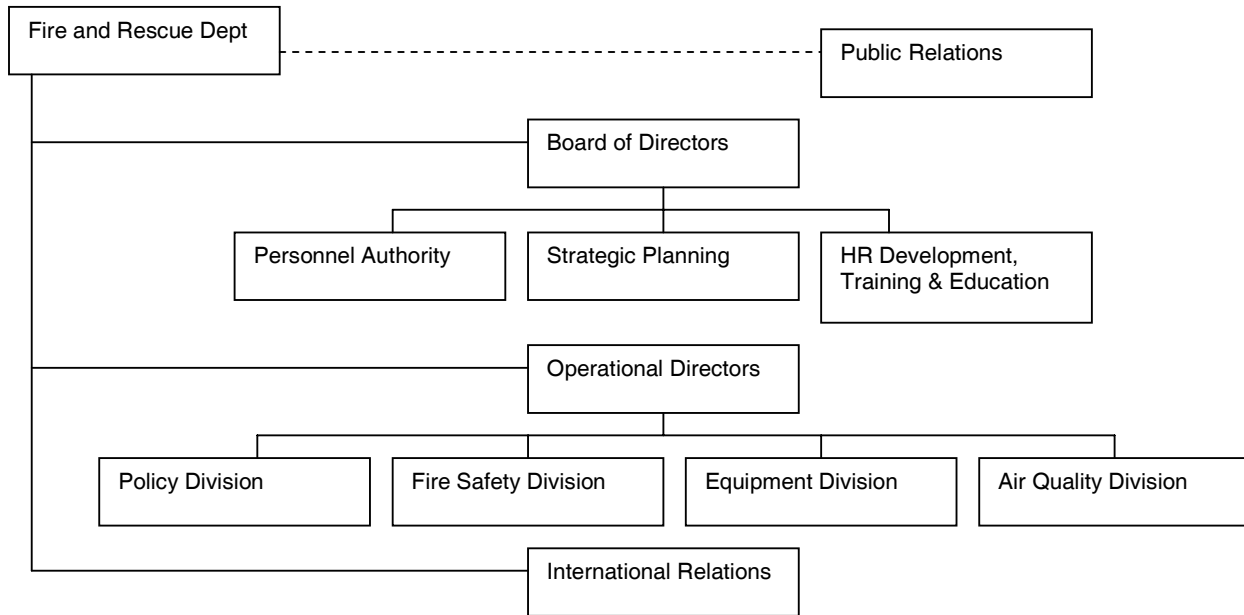
The Malaysian Center for Remote Sensing has developed a Total Forest Fire Management Plan utilizing remote sensing and GIS technologies to capture fire-related information. The information may be useful for informing authorities about drought. Some detection ability may accrue via time delayed hot spot information but it is unlikely that information from this source will be of practical value for strategic suppression purposes.

Malaysia has adopted and is attempting implementation of a zero-burning policy for plantation development, including some exceptional circumstances. This policy is in line with the ASEAN adoption of a “zero-burning” policy in April 1999, at which time ASEAN urged all Member countries to implement the necessary laws and regulations to enforce this major decision.

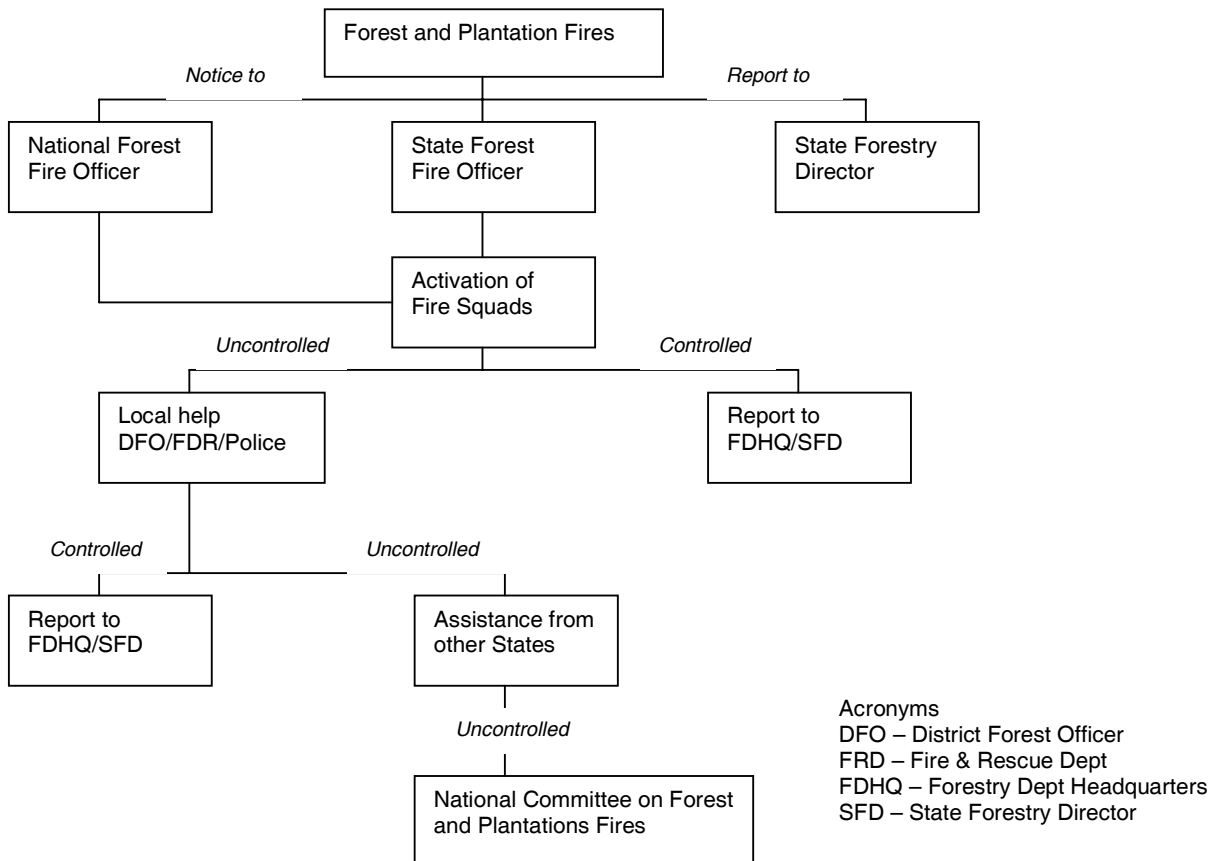
Subsequently the Malaysian policy was amended to include a complete ban on all burning on peat soils. Regionally, a number of other countries have adopted zero-burning policies or legislated to make open-air fire use illegal during defined periods of the year. Whilst the intent of zero-burning and fire prohibition is clear, practical outcomes suggest achievement of intended goals has yet to be attained, pointing to a need for greater understanding by, and education of, those parts of the community that have few options other than fire use for preparing land for cropping.

Malaysia has a full time Fire and Rescue Department, initially established for urban fire management but which is now partially equipped for forest and land fire suppression. This service works in combination with other designated government departments.

The Fire and Rescue Department-Malaysia (FRDM) is the primary agency responsible for combating all fire, including forest and land fires. The agency is assisted by the Forestry Department, National Security Division, Royal Police Malaysia, Armed Forces, Wildlife and National Parks Department, Drainage and Irrigation Department and local town councils. The structures of the Fire and Rescue Department and the forest fire management operational chain of command are provided in Figure 3.



**Figure 3.** Fire Management Structure of the Fire and Rescue Department in Malaysia



**Figure 4:** Forest fire management organization in Malaysia

The 8<sup>th</sup> Malaysian 5-year plan (2001-2005) outlines the Government programmes and project allocation for fire prevention and suppression. These include:

- New fire stations and facilities, upgrading of existing amenities, procurement of specialized equipment, training of multi-skilled personnel, research and development;
- Equipping the Fire and Rescue Academy with fire and rescue training simulation system;
- Additional operating bases for the Air Unit;
- Expansion of the Incident Command and Control System into all major towns;
- Development of an R&D center for fire safety and fire engineering;
- Enhance awareness of the public and owners of residential, commercial and industrial premises on fire safety, particularly preventative measures.

#### 4.6 Myanmar

Myanmar includes in its natural resources significant areas of teak (*Tectona grandis*) forest.

There is limited data available for forest fires in Myanmar and little published data are available since the 1997-98 smoke and haze event. The Myanmar Country Report in the FAO Global Forest Resources Assessment for 2005 indicates that an estimate was made in 1985 that 6.5 million hectares were burned. This is identical with the average annual areas listed as burned in 1990 and again in 2000. It seems that this 1985 estimate has been adopted as the most reliable figure in the absence of any other data. Although there is a reasonable consistency in the total fire numbers from year to year, it is unlikely that the annual average area burned would remain precisely at the same level between 1985 and 2000.

**Table 1.** Fire Numbers and causes in Myanmar

Year	No Fires	Cause of Fires				
		Accident & Negligence	Natural cause	Arson	Insurgency	Others
1985	1 255	996	136	57	10	56
1986	1 281	1 021	126	80	8	46
1987	1 243	1 035	107	66	19	16
1988	1 187	924	110	129	9	15
1989	1 394	1 149	145	84	10	6
1990	1 519	1 303	115	85	6	10
1991	1 815	1 541	162	94	7	11
1992	1 620	1 370	142	71	17	20
1993	1 464	1 282	92	83	3	4
1994	1 272	1 087	105	75	-	5

Source: Myanmar Fires Services Department website.

Myanmar has historically focused efforts on prevention over suppression. It is acknowledged that surface fires of moderate intensity do not kill teak or young seedlings and that annual occurrence of surface fires prevents the accumulation of surface litter, reducing the risk of intense fires. The priority focus of Myanmar's fire management has been on monitoring combustible fuel that is significantly reduced by annual application of deliberate fire. Forest fuel loads tend not to accumulate to high levels. Reduction occurs by rapid biological breakdown or by annual burning.

The Forest Services Department (FSD) is mandated to prevent and suppress fires. A Central Fire Services Training School was established to train Forest Services Department personnel in fire fighting techniques. FSD now has 3 403 Fire Brigade members and 131 765 Auxiliary Fire Brigade members. There are 217 fire stations and 328 auxiliary fire stations.

The Fire Services Department and the Forest Department work with Local Peace and Development Committees to enhance management and coordination. From the early 1930s, forestry recognized the importance of fire to maintain teak forests (Ganz, 2003). Public awareness campaigns are carried out during the height of the fire season (from mid-January to mid-May) through various media.

Forestry officers are keen to garner the support of the local populations and work with them to achieve mutually beneficial outcomes – permit harvesting of non-timber forest products, education about community benefits that can accrue from forests. People who live in and/or around Reserve Forests are asked to report forest fires and to suppress any fires so that the fires do not spread into the Reserve areas.

Residents holding permits to earn a livelihood within the forests, or practice shifting-cultivation (Taungya) are responsible to ensure safe fire use. In the event that they are found to be responsible for causing fires, forest use permits may be revoked.

#### 4.7 Philippines

There is little fire data on the Philippines. Data for 1995 provide a snapshot for one year only; however, there is some speculation that the figures provided are underestimates (Ganz, 2003).

Year	Number Fires	Area Burned
1995	290	10 710

The breakdown of the area into forest type burned included:

- plantation 7 285 ha
- grassland 2 055 ha
- natural forest 1 370 ha

An estimate of forest loss is provided by Pogeyed (2002), who reports that old growth forest has declined from 12 million ha to 0.8 million ha over 55 years, or about 0.2 million ha/annum.

The Philippines Country Report in the Forest Resources Assessment 2005 lists the following specific fire areas by years:

Year	1990	1998	1999	2000	2001	2002
Area (ha)	36 900	18 313	5 642	4 809	776	2 435

Sutherland *et al.* (2004) suggest the annual loss of forest due to shifting agriculture/fires is 3 million ha per annum. Their estimate is based upon the estimated number of families (2 million, FAO estimate) deriving livelihood from shifting cultivation, treating an average area of 1.5 ha per family/annum.

Given the decline in old growth forest reported by Pogeyed (2002), the estimate of 3 million ha lost per annum appears quite high.

Understanding the causes of fire in the Philippines appears to be in no better shape than do the statistics of fire occurrence. Fire causes are believed to be mostly from human ignition sources and include:

- Carelessness
- Negligence
- Accidental
- Incendiarism

Notably 52% of the fires for the 1995 data made available were attributed to unknown causes.

A mandate for fire prevention and suppression is provided to the Bureau of Fire Protection (within the Department of Industry and Local Government); however the management of the land and forest resources is under the Department of Environment and Natural Resources. The separation of land management and fire responsibility may cause confusion and future conflicting issues.

Currently the Department of Environment and Natural Resources has identified 10 out of 15 regions as fire-prone areas. It has organized and trained forest fire fighting teams with a total of 3 086 trained firefighters and 418 fire crew bosses (Ganz, 2003).

The role and responsibility of fire management in the Philippines was still being bedded down as at January 2004 (Sutherland *et al.*, 2004), to determine if it is plausible to connect the responsibility of fire management to the agency that is fulfilling the majority role of land and forest management. No further update is available at present.

Collaborative fire suppression has occurred in the past, and during the 1997-98 fire season the armed forces were utilized under a national disaster declaration.

The involvement of the community in fire management in the Philippines is difficult to ascertain. Fire is used for prescribed burning as a management tool (though the policies do not allow for such activities, the controlled use of fire is still prevalent for a variety of purposes).

Some community uses of fire include: burning to induce forage in pastures, burning for fuel reduction, burning to promote natural regeneration (pine forest) and debris burning in agricultural plots, especially by communities depending on forests for livelihood (Ganz, 2003).

#### **4.8 Singapore**

There are presently no available fire data for Singapore. The island of Singapore, including its 57 smaller islands, measures 42 kilometres by 23 kilometres and the total land area is less than 1 000 square kilometres. The terrain is primarily lowland with a gently undulating central plateau containing water catchments and small nature reserves.

The small area of forest and woodland in Singapore explains in large part Singapore's lack of fire statistics, forest and land fire legislation, infrastructure, and resources dealing with forest and land fire.

Much emphasis on fire data collection in Singapore is on hot spot fire monitoring in neighbouring countries. Singapore, the lead country responsible for the monitoring component of the ASEAN Regional Haze Action Plan, has been providing the satellite images indicating hot spot locations to Indonesia.

A specialist center (Center for Remote Imaging, Sensing and Processing [CRISP]) at the National University of Singapore has operated a remote sensing capability since 1995. A ground station receives data from SPOT, ERS and RADARSAT satellites. A daily fire monitoring operation is being implemented at CRISP, in collaboration with the Ministry of Environment, Singapore.

In addition to the roles it performs via CRISP, Singapore takes a prominent role for the ASEAN Regional Haze Action Plan Co-ordination and Support Unit (RHAP-CSU) by continuously monitoring regionally the haze situation on a daily basis, and by posting findings on a widely advertised website (ASEAN Haze Action Online).

The RHAP-CSU is linked to monitoring stations in Member countries including the ASEAN Specialized Meteorological Center (ASMC) in Singapore, the Indonesian Ministry of Forestry and Estate Crops in East and West Kalimantan, the National Board for Environmental Impact Control, the Indonesian National Institute of Aeronautics and Space (LAPAN), and other agencies. Information including satellite detected hotspots (not all of which are fires), weather forecasts, air quality, visibility, and routine meteorological parameters, is posted on a daily basis.

Singapore is unique in the ASEAN context. It generates almost no haze and pollutants from forest and land fires within Singapore, but it does suffer very severe indirect impacts from haze generated elsewhere in the region. It has made significant progress in monitoring severe fire events and resultant haze pollution. One of its undeniable positives is that countries with extensive forest and land fire activity have no option other than to now acknowledge the existence and extent of fire activity within their territory, a position that has not always been so.

While Singapore is by far the smallest contributor in ASEAN for fire cause, it suffers significantly from a fire impact perspective. It is severely affected by periodic smoke and haze events from neighbouring countries. Because of the impact of these events and the effect on health and trade, Singapore has become very active within ASEAN to improve the downstream effects of forest fire on its communities and commercial activities. It is an active participant in a number of regional programmes and has made major technological contributions, principally in remote sensing and monitoring.

Haze impacts from the last severe event in 1997-98 were estimated to be as much as US\$75 million. Those losses included substantial declines in tourism caused by cancellation or disruption of flights by airlines, withdrawal from pre-booked flights and tourist activities by people who were no longer prepared to visit severely haze-impacted areas. Health costs were significant with an estimated 36 000 working days lost due to illness and effects of haze.

The Singapore Fire Service and the Singapore Civil Defence Force were merged to form the Singapore Civil Defence Force (SCDF). The Force has a 3-tier command structure, which consists of the Headquarters (HQ) SCDF, four territorial Civil Defence Divisions, a Basic Rescue Training Camp, a Training Academy and 13 fire stations. The HQ also has a regulatory wing, the Fire Safety Bureau, which formulates and enforces fire safety regulations in all buildings and installations in Singapore.

The role of the HQ is to principally oversee the various functions of the SCDF's activities and development, including operations, logistics, training, communications, finance, medical, service quality and public affairs. Additionally, the HQ administers plans and controls all civil defence activities. The Divisions undertake the execution of civil defence operations. Each Division has similar supporting element, and all fire stations come under the command of a Division Commander.

The SCDF has developed a doctrine for the management of forest fires. This doctrine was developed through research on fire agencies in Australia, Sweden and the United States. The objective is to ensure that forest fire fighting skills are acquired and maintained, not from the perspective of dealing with on shore fires but to ensure that in the event of climatic change, a capability for this type of fire fighting is evident. Additionally, these skills will enable Singapore to play a greater role in this type of fire fighting within the region in the future.

Singapore makes significant contribution to regional land and forest fire issues and participates actively in regional haze bodies.

## 4.9 Thailand

Thailand maintains national level data on forest fire frequency, area burned and location of fires. Tables 2 and 3 provide data about recent extent of fire.<sup>6</sup>

**Table 2.** Annual areas burnt by forest fire in Thailand

Year	Area Burned (ha)
1998	1 145 452
1999	293 480
2000	93 324
2001	76 189
2002	139 389

Additional data drawn from the Global Forest Resources Assessment 2005 (Country Report 217 THAILAND) indicates that the average annual forest area burned by fire in the 5-year period 1998-2002 was 150 000 ha. This estimate was determined by analysis of satellite imagery (data for the same five-year period, obtained from the RFD website in the Table 2, suggests the annual average for the period was closer to 309 000 ha). The 2000 figure also represents a very significant reduction over the 1990 average annual area burned of 1 940 000 ha.

<sup>6</sup> [www.forest.go.th](http://www.forest.go.th)

Area burned by forest type is also analyzed. The analysis for 2000 is shown in Table 3.

**Table 3.** Forest type burned during 2000

Forest Type	Area burned	Percentage (%)
Mixed Deciduous	63 420	68.0
Dry Dipterocarp	20 279	21.7
Secondary Growth	3 628	3.9
Forest Plantation	2 193	2.4
Hill Evergreen	1 858	2.0
Dry Evergreen	1 021	1.0
Bamboo	835	0.9
Natural Pine	90	0.1
<b>Total</b>	<b>93 324</b>	<b>100</b>

Fire behaviour is well understood in Thailand and almost all fires are surface fires, but under very rare conditions, crown fires have been observed in pine plantations. Underground fires have also been noted in peat swamp forests.

Fuel conditions have been studied in Thailand but there is little published information available in English. In general, dry dipterocarp forests have more combustible fuel conditions with large leaves that tend to dry quickly. Several studies have investigated fire behaviour/fire effects in Haui Kakang, Uthaitani Province (Ganz, 2003). The series of studies is expected to continue until 2007.

Fire cause is well documented. Recent data from 1998 to 2002 is set out in Table 4.

**Table 4.** Fire causes 1998–2002

Fire cause	Percentage (%)
Gathering non-timber forest products	35
Agriculture debris burning	17
Incendiary	9
Carelessness	2
Hunting	22
Illegal logging	3
Cattle grazing	2
Unidentified	10
<b>Total</b>	<b>100</b>

According to a recent study (Makarabhirom *et al.*, 2002), communities living in or around forests use fire for many purposes in their daily lives, including:

- Rotational cultivation
- The promotion of mushroom species
- Promotion of leaf growth
- Cultivation and promotion of bamboo or grass shoot
- Promotion of seed germination of species such as teak
- Hunting small animals such as wild pig or barking deer and wild fowl
- Managing growth grasses for thatching and broom production

The impacts of forest fires in Thailand are well appreciated, as is the recognition of the difficulty in assessments. Evaluations have been undertaken to determine the forest re-growth and regeneration losses, including sapling and mature tree death, economic assessments of the commercial forest and



plantation species have been conducted, soil erosion studies, air quality studies and wildlife impacts are all acknowledged.<sup>7</sup>

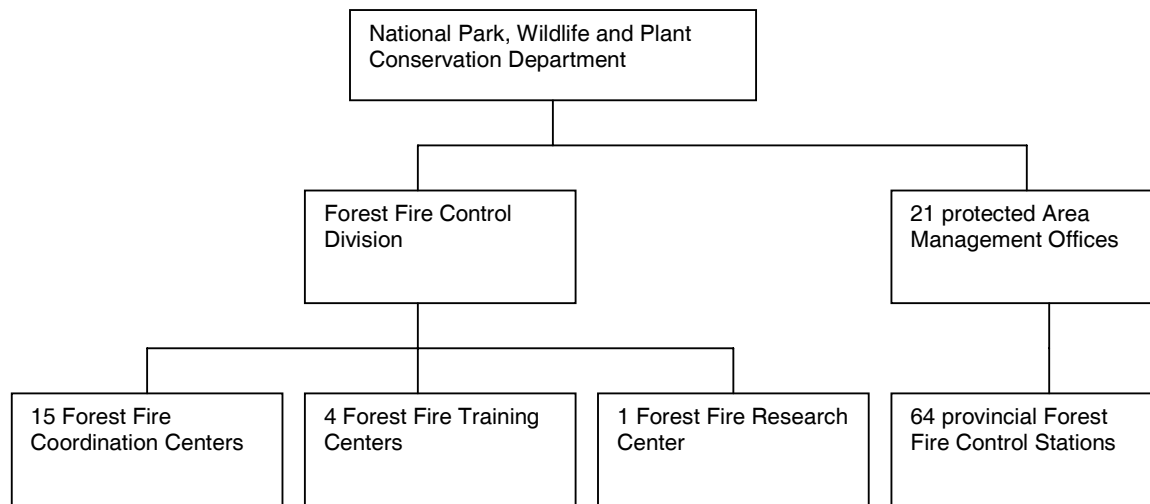
An attempt was made to estimate the economic impacts of forest fires. In 1992, the Faculty of Forestry at Kasetsart University performed an assessment of ecological and economic impacts of fires on dry dipterocarp, mixed deciduous, pine and tree plantations. The total estimate for 1990 damage from forest fires was set at US\$2.17 billion.<sup>8</sup>

In another study, Thai International Airways, in conjunction with the Royal Forest Department, provide finance for the “Community Forest Fire Control Project” in Mae Hong Son Province. Statistics maintained since 1993 indicate that significant disruption to airline schedules have occurred because of smoke impact on visibility. Between 1993 and 2002, almost 1 800 flights into Mae Hong Son were either diverted or cancelled prior to take off due to reduced visibility. Thai Airways and tourist agencies estimated that each diverted flight into Mae Hong Son results in a loss of potential income to the local community of about 7 million Baht.

Thailand’s Forest Fire Control Section was established under the Forest Management Division in 1976. In 1993, the agency was promoted to a full Forest Fire Control Division and finally to a Forest Fire Control Office in 1999. Since the early 1990s, the fire control programme has been expanding to enlarge its coverage over fire-prone areas.

In 2000, the Forest Fire Control Office comprised four regional Fire Control Divisions, 15 Forest Fire Control Centers, 64 Provincial Forest Fire Control Stations, and 272 Forest Fire Control Units, administering an “intensive fire control programme over 2.8 million hectares or 21% of the total forest land” (Akaakara, 2001).

In October 2002 the reorganization of the Royal Forestry Department into the National Park, Wildlife and Plant Conservation Department has discretely recognized fire management (Akaakara, 2003). In this process, forest fire control is being integrated into the 21 protected area management offices and 64 Provincial Forest Fire Control Stations.



**Figure 5.** Current Management Structure of Thailand’s Fire Control Division

The Forest Fire Control Division has set itself up to perform all the necessary fire management activities. Although heavily focused on preparedness and response (suppression), this Division also

<sup>7</sup> <http://www.dnp.go.th/forestfire/Eng/indexeng.htm>

<sup>8</sup> <http://www.dnp.go.th/forestfire/Eng/indexeng.htm>

has a strong educational and public awareness campaign for prevention. Some attention has been given to post-fire analysis, fire effects and recovery measures.

The Forest Fire Control Division has very advanced response capabilities. It has the ability to request military aircraft and helicopters in the event of an unwanted fire in sensitive areas. This Division has also trained a series of fire fighting teams, including the Fire Tigers, a helicopter dropped team for extremely remote locations. However, the majority of fire suppression in Thailand is performed with hand tools and water.

In Thailand, there has been a series of community-based initiatives for managing fire at the local level (Sukwong, 1998; Rakyutidharm, 2002; Makarabhirom *et al.*, 2002).

Some of these systems are quite advanced management structures with attention to prevention, preparedness, response (suppression) and recovery from fires. Within these initiatives, managing the forest with the full involvement of community members is more effective for managing fire if it is an entrenched social responsibility in the first place (Sukwong, 1998; Makarabhirom *et al.*, 2002).

Non-governmental organizations, such as the Northern Development Foundation, the Regional Community Forestry Training Center and the Northern Farmers Alliance, have promoted these initiatives and even tried to replicate them elsewhere in Thailand.

Thailand is poised for a position of leadership in the development of fire science, policy and management in the region. In the last decade, it has taken several steps that indicate its commitment to fire management structures, fire research centers, and international cooperation on the management of fires in the region.

In 2000, the Royal Forestry Department proposed the idea of a regional coordination center for fire management to the ASEAN countries. Although the notion was not adopted, it showed Thailand's forward thinking in this regard and its willingness to take on a leadership role. In addition, Thailand's Research Center in Hauy Kakang, Uthaitani Province, is one of the first fire science centers in the region. These are all positive steps.

Thailand is also committed to forest-related international cooperation, particularly concerning international agreements and conventions. Many of the international conventions have been ratified, including: International Tropical Timber Agreement (ITTA), CITES, and others. In addition, a number of development projects concerning fire have been proposed and implemented by AUSAID, DANCED, ITTO and other international donors. Lastly, the presence of international organizations in Bangkok, such as IUCN, RECOFTC and ADPC, has helped raise the profile of Thailand's fire management issues.

#### **4.10 Viet Nam**

There is currently very little data for fires in Viet Nam. However, there are estimates of an average of 50 000 ha per annum and up to 100 000 ha/year (Pham, 1999).

From 1998 to 2000, 2 108 fires were recorded covering 22 668 ha of natural forest, plantation savanna and bush (Hung, 2001).

Human-caused ignitions are the major cause of forest fires. Residents in or near forests often have no option but to reclaim land from the forest for cultivation by using fire as a land clearing tool. Burning forest for agricultural terraces in the mountains and burning straw in rice fields have been known to spread into unwanted fires (Hung, 2001). Grasslands are also burned to facilitate cattle husbandry, the hunting and capture of birds and small animals, and to clear land along railways, roads and highways. Fire is also used to aid the collection of honey and for smelting ore. Another cause of fire in Viet Nam is retaliatory action taken by forest squatters who have been fined or were driven out by legal action (Hung, 2001).

Forests are fast declining due to over-exploitation and frequent wildfires (Abdullah, 2002). The underlying causes of deforestation and forest degradation in Viet Nam have been identified as rural

poverty, insufficient arable land, limited and inappropriate institutional capacity, and land tenure. Immediate causes of forest loss and degradation have been identified as population expansion into forest areas, fuel wood collection, logging and harvesting of wood and non-wood forest products, fires, and infrastructure development such as the construction of dams and high voltage power lines.

Viet Nam uses a Forest Fire Danger Rating System specifically designed for its climate and fuel conditions to establish triggers and fire-related prevention and preparedness activities. The system is used across the nation to raise awareness of increasingly bad fire conditions. Several studies were involved in the design of the system and it has since stood up to scrutiny.

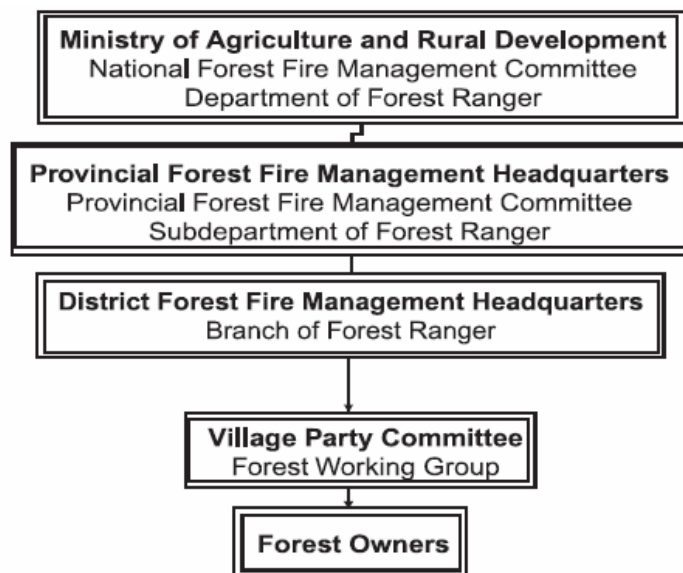
Viet Nam’s fire management approach has traditionally placed more attention on prevention than suppression. All of Viet Nam’s forest types are susceptible to fire during the dry season.

There are several governmental structures to manage fire. The Ministry of Agriculture and Rural Development (MARD) operates at a national, provincial and district level with several hundred staff.

There is a Central Fire Protection Committee at both provincial and district levels. Membership on this committee includes Police, MARD, Land Administration Department, Forestry Department and other government agencies with influence on fire management.

At the village level, there is a Forest Working Group, which has a fire team as one sub-group. The Forest Working Group deals with the full range of forest activities including operations, protection (insects, fire, etc) and management. It is a body that carries out the work required in the forest. These Working Groups are operational and vary in size depending on village size. They range from 12 to 15 people.

This system is broadly applied across the 58 provinces particularly where there are forests. Viet Nam has been proactive in developing measures to combat forest fires. The approach taken has focused on prevention.



**Figure 6.** Vietnam - Forest fire prevention and suppression structure

Viet Nam suffers from lack of accurate data and information on forest fires. In addition, accurate information on forest fires will serve the country well as outsiders weigh the potential of Viet Nam’s unique approach for comparison studies in the region to see how this regulatory structure may be transferred to a country with similar fire management objectives and fire regimes.

## REFERENCES

- Abdullah, A. 2002. A review and analysis of legal and regulatory aspects of forest fires in South East Asia. Project Firefight South East Asia, Jakarta, Indonesia, 51pp.
- ADB (Asian Development Bank) and BAPPENAS (National Development Planning Agency). 1999. Causes, extent, impact and costs of 1997-98 fires and drought. Final Report, Annexes 1 and 2. Planning for Fire Prevention and Drought Management Project. Asian Development Bank TA 2999-INO July 1998 – March 1999.
- Akaakara, S. 2001. Forest fire control and research in Thailand. South East Asia Forest Fire Scientist Network Meeting, 5-7 April 2001, Faculty of Forestry, Bogor Agriculture University, Bogor, Indonesia.
- Akaakara, S. 2003. Forest Fire Control in Thailand – Law and Regulation Aspects. In Fires, Laws and Regulations towards best practice for legal aspects of fire Workshop Report. 2-4 June 2003. Hanoi, Vietnam. Project FireFight South East Asia.
- AID Environment. 2002. Oil palm plantations and deforestation in Indonesia. A Project of WWF Germany in collaboration with WWF Indonesia. AID Environment, Amsterdam, The Netherlands.
- FAO. 2002. Community-based fire management: case studies from China, The Gambia, Honduras, India, the Lao People's Democratic Republic and Turkey. Food and Agriculture Organization of the United Nations. Bangkok, Thailand, 2003.
- Galt A., T. Sigaty, and M. Vinton (eds.). 2000. The World Commission on Protected Areas, 2nd Southeast Asian Regional Forum, Paske, Lao PDR, 6-11, December 1999. IUCN Vientiane, Lao PDR.
- Ganz, D. 2003. Framing Fires: A country-by-country analysis of forest and land fires in the ASEAN nations. Project FireFight South East Asia 2002.
- Ganz D., P. Moore, and B. Shields (eds.). 2001. International Workshop on Community-Based Fire Management. RECOFTC Training and Workshop Report Series 2001/1. RECOFTC. Bangkok, Thailand.
- FAO. 2005. Global Forest Resources Assessment 2005 (FRA-2005). Forestry Department. Food and Agriculture Organization of the United Nations. Country Reports  
Indonesia Report No. 050  
Lao PDR Report No. 182  
Malaysia Report No. 186  
Myanmar Report No. 107  
Philippines Report No. 202  
Thailand Report No. 217
- Goldammer, J.G., and B. Seibert. 1989. Natural rain forest fires in Eastern Borneo during the Pleistocene and Holocene. *Naturwissenschaften* 76, 518-520
- Goldammer, J.G., and B. Seibert. 1990. The impact of droughts and forest fires on tropical lowland rain forest of Eastern Borneo. In: *Fire in the tropical biota. Ecosystem processes and global challenges* (J.G. Goldammer, ed.), 11-31. *Ecological Studies* 84, Springer-Verlag, Berlin-Heidelberg-New York, 497 p.
- Hung, P.N. 2001. Assessment of the Forest Fire Situation (1998-2000) and Community-based Forest Fire Management for Biodiversity Conservation in Vietnam in Proceedings of Workshop on Minimizing the Impact of Forest Fire on Biodiversity in ASEAN, Brunei Darussalam. 22-23 March 2001. pp. 117-120.  
([www.arcbc.org.ph/new/workshops/regional/proceedings/sea\\_22\\_03\\_01.htm](http://www.arcbc.org.ph/new/workshops/regional/proceedings/sea_22_03_01.htm))
- Liew, S.C., O.K. Lim, L.K. Kwoh, and H. Lim. 1998. A Study of the 1997 forest fires in South East Asia using SPOT Quicklook Mosaics. Centre for Remote Imaging, Sensing and Processing (CRISP), National University of Singapore.
- Limchhun, H. 2002. Forest and Land Fire Prevention in Cambodia. First Meeting for the Promotion of Asia Forest Partnership (AFP), Monday, 11 November, 2002. Mita Kaigisho, Tokyo, Japan
- Makarabhirom, P., D. Ganz, and S. Onprom. 2002. Community involvement in fire management: cases and recommendations for community-based fire management in Thailand. In: *Communities in Flames: Proceedings of 1st International Conference on Community Involvement in Fire Management* (P. Moore, D. Ganz, L.C. Tan, T. Enters, and P. Durst, eds.), FAO RAP Publications 2002/25, 133pp.

- Moore P., D. Ganz, L.C. Tan, T. Enters, and P.B. Durst (eds.). 2002. Communities in flames: Proceedings of an international conference on community involvement in fire management. Food and Agriculture Organization of the United Nations and Project FireFight South East Asia, 2002.
- Murdiyaso, D., and L. Lebel (eds.). 2006. Forest and land fires in Southeast Asia: Local and global perspectives. *Journal for Mitigation and Adaptation Strategies for Global Change* (in prep.).
- Pham, N.G. 1999. Community-based forest fire management for biodiversity conservation in Viet Nam. Paper presented at the Proceedings of First International Workshop on National Guidelines on the Protection of Forests against Fire, March 1999, Bogor, Indonesia.
- Pogeyed, M.L. 2002. Fire Situation in the Philippines. *International Forest Fire News* No. 26, 92-95.
- Qadri, S.T. (ed.). 2001. Fire, smoke and haze. The ASEAN Response Strategy. Association of South East Asian Nations and Asian Development Bank, Philippines, 246 pp.
- Rakyatidharm, A. 2002. Forest fire in the context of territorial rights in northern Thailand. In: *Communities in Flames: Proceedings of 1st International Conference on Community Involvement in Fire Management* (P. Moore, D. Ganz, L.C. Tan, T. Enters, and P. Durst, eds.), FAO RAP Publication 2002/25, 133 pp.
- Rao, S. 2001. Forest fire management in Cambodia and its Prevention Remedies. In: *Community-Based Fire Management Regional Workshop* (D. Ganz, P. Moore, and B. Shields, eds.), 6-8 December 2000. Regional Community Forestry Training Center, Bangkok, Thailand. RECOFTC Report 19, 87 pp.
- Shields, B.J. 2004. A review of fire behaviour in tropical regions for the Gesellschaft für Technische Zusammenarbeit (GTZ) Integrated Forest Fire Management Project, East Kalimantan. Internal report (unpubl.)
- Simorangkir, D., and Sumanti. 2002. A review of legal, regulatory and institutional aspects of forest and land fires in Indonesia. Project FireFight South East Asia, Jakarta, Indonesia. 56 pp.
- STEA (Science, Technology and Environment Agency) (2000). Environmental Action Plan. Vientiane Lao PDR.
- Sukwong, S. 1998. Local Culture Khao Mor Kang Mor' for fighting forest fire. *Community Forest Newsletter* 5 (10), 13-15. RECOFTC.
- Sutherland, D., B. Arthur, R. Goze, and S. Batcagan. 2004. A review of forest fire management in The Philippines. Report prepared for the International Tropical Timber Organization under Decision 6 (XXXII) of the International Tropical Timber Council. ITTO, Yokohama, Japan.
- United Nations Office for the Coordination of Humanitarian Affairs (OCHA). 2005. Indonesia: Fires OCHA Situation Report No. 1, 16 August 2005  
<http://www.reliefweb.int/rw/RWB.NSF/db900SID/EGUA-6FBPLU?OpenDocument>
- Indonesia: Fires OCHA Situation Report No. 2, 19 August 2005  
<http://www.fire.uni-freiburg.de/GFMCnew/2005/08/0819/Indonesia%20Fires%20Situation%20Report%20No.2.pdf>

## PUBLICATIONS AVAILABLE ON FIRE MANAGEMENT

### *Fire Management Working Papers: Thematic Paper Series*

Note:

In Code "Working Paper FM/xx", "x" indicates the WP series number and a suffix E, F or S indicates: E = English, F = French, S = Spanish, in case of multilingual papers. No suffix indicates E only.

#### **Available at the Fire Management web site:**

Working Paper FPF/1	<i>Guidelines on Fire Management in Temperate and Boreal Forests.</i> November 2002.
Working Paper FM/2	<i>International Wildland Fire Management Agreements Template.</i> Tom Frey, Ricardo Vélez Muñoz. January 2004.
Working Paper FM/3	<i>Legal Frameworks for Forest Fire Management: International Agreements and National Legislation.</i> Fernando Fernández Arriaga, Frédéric St-Martin, Tom Frey, Ricardo Vélez Muñoz. March 2004.
Working Paper FM/4	<i>Community-Based Fire Management in Spain.</i> Ricardo Vélez Muñoz. April 2005.
Working Paper FM/5	<i>Report on Fires in the South American Region.</i> María Isabel Manta Nolasco. March 2006.
Working Paper FM/6	<i>Report on Fires in the North East Asian Region.</i> Leonid Kondrashov. March 2006.
Working Paper FM/7	<i>Report on Fires in the Baltic Region and adjacent countries.</i> Ilkka Vanha-Majamaa. March 2006.
Working Paper FM/8	<i>Report on Fires in the Mediterranean Region.</i> A.P. Dimitrakopoulos and I.D. Mitsopoulos. March 2006.
Working Paper FM/9	<i>Report on Fires in the Sub-Saharan Africa (SSA) Region.</i> Alexander Held. March 2006.
Working Paper FM/10	<i>Report on Fires in the South East Asian Region.</i> B.J. Shields, R.W. Smith and D. Ganz. March 2006.
Working Paper FM/11	<i>Report on Fires in the Balkan Region.</i> Nikola Nikolov. March 2006.
Working Paper FM/12	<i>Report on Fires in the Caribbean and Mesoamerican Regions.</i> A.M.J. Robbins. March 2006.
Working Paper FM/13	<i>Report on Fires in the Australasian Region.</i> P.F. Moore. March 2006.
Working Paper FM/14	<i>Report on Fires in the South Asian Region.</i> A.M. Benndorf and J.G. Goldammer. March 2006.
Working Paper FM/15	<i>Report on Fires in the North American Region.</i> R. Martínez, B.J. Stocks and D. Truesdale. March 2006.
Working Paper FM/16	<i>Report on Fires in the Central Asian Region and adjacent countries.</i> Johann G. Goldammer. March 2006.