



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

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

www.pffsea.org



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

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

www.iucn.org



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

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

www.panda.org/forests4life

Panda Symbol © 1986 WWF
® WWF Registered Trademark

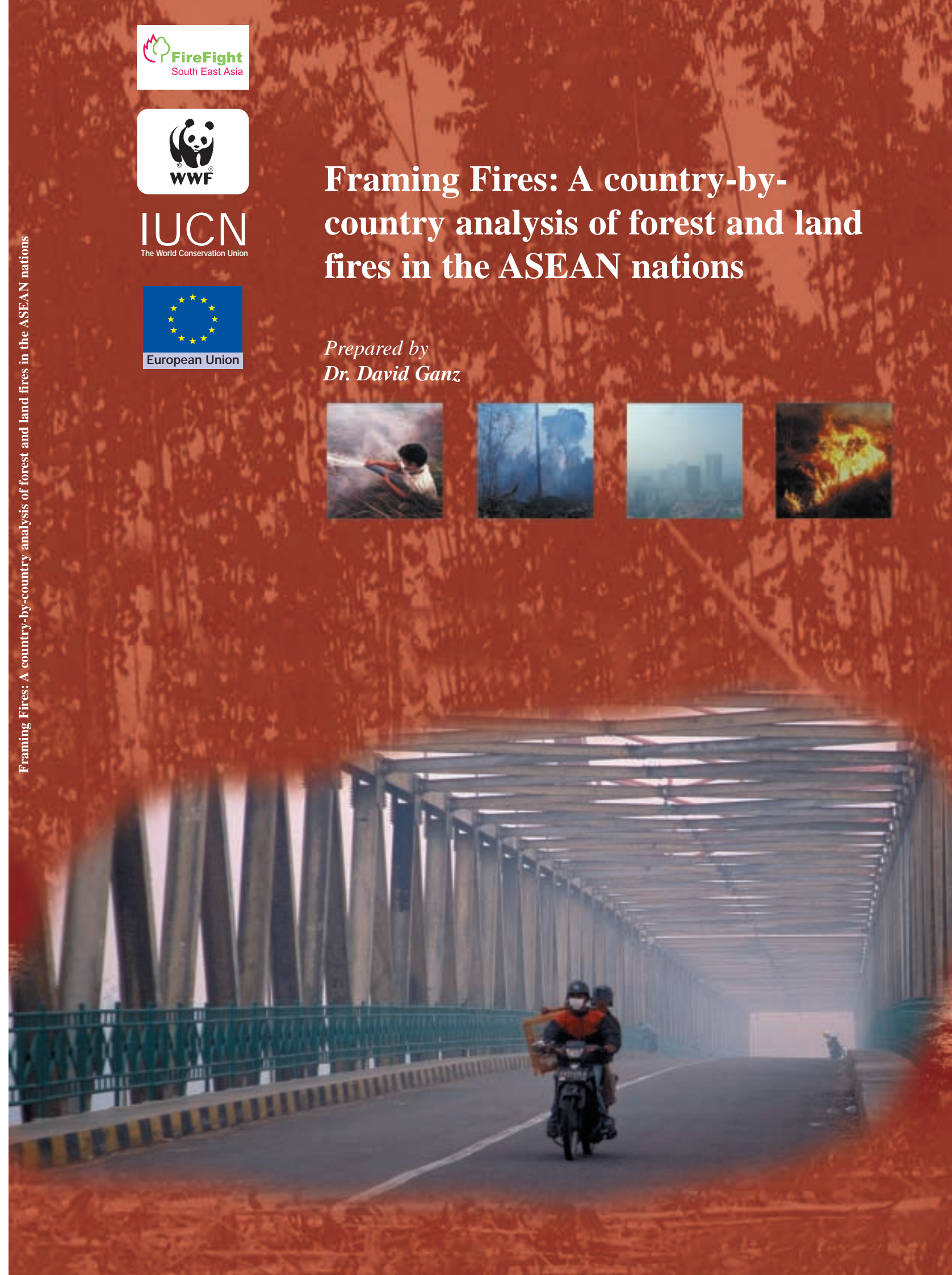


Framing Fires: A country-by-country analysis of forest and land fires in the ASEAN nations

Prepared by
Dr. David Ganz



Framing Fires: A country-by-country analysis of forest and land fires in the ASEAN nations



Framing Fires: A country-by-country analysis of forest and land fires in the ASEAN nations

Prepared by Dr. David Ganz

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, ACIDI-CIDA

Large cover picture:

Kahayan River Under Smoke (d) © WWF/ 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

This publication was prepared by staff and consultants of Project FireFight South East
Asia. The analyses and assessments contained herein do not necessarily reflect the
views of the Project FireFight South East Asia, or IUCN, the World Conservation
Union

and WWF, the World Wide Fund for Nature.

Project FireFight South East Asia does not guarantee the accuracy of the data
included in this publication and accept no responsibility for any consequences of their
use.

© Project FireFight South East Asia 2002

ISBN 979-3260-10-6

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.org>

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 catalyze 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 organizations to handle alone. This is why the project pursues a multiple stakeholder approach, working closely with WWF’s extensive network of National Organizations and Program 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 organized 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 behavior. 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 organized 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.

Acknowledgements

Dr. David J. Ganz prepared this report for Project FireFight South East Asia.

Members of Project FireFight South East Asia commented on the draft of this report. In addition, ASEAN and its country contacts were consulted for comments. Their inputs and comments have been integrated into this final version.

The author would like to thank the members of Project FireFight South East Asia who provided endless support, assistance, constructive advice and prepared the layout of this report.

Table of Contents

| | |
|-----------------------|------|
| Preface | iii |
| Acknowledgements | iv |
| Table of contents | v |
| List of figures | vi |
| List of tables | vii |
| List of abbreviations | viii |
| Introduction | 1 |
| Regional Overview | 2 |
| Brunei Darussalam | 6 |
| Cambodia | 11 |
| Indonesia | 18 |
| Lao PDR | 26 |
| Malaysia | 32 |
| Myanmar | 41 |
| Philippines | 48 |
| Singapore | 54 |
| Thailand | 57 |
| Vietnam | 65 |
| References | 74 |

List of Figures

| | | |
|-----------|--|----|
| Figure 1: | ASEAN Member countries | 4 |
| Figure 2: | Current Management Structure of the Brunei Fire Service | 8 |
| Figure 3: | Organization Chart of Department of Forestry and Wildlife, Cambodia | 15 |
| Figure 4: | Fire Management Structure of Malaysia's Fire & Rescue Department | 36 |
| Figure 5: | Forest fire management organization in Malaysia | 37 |
| Figure 6: | Monthly summary of fire occurrence and area burned in calendar year 1995 | 52 |
| Figure 7: | Types and area of ground cover burned in the Philippines in 1995 | 52 |
| Figure 8: | Current Management Structure of Thailand's Fire Control Division | 60 |
| Figure 9: | Vietnam's forest fire prevention and suppression structure | 69 |

List of Tables

| | | |
|-----------|---|----|
| Table 1: | Change in Forest cover by forest type between 1973 and 1993 | 12 |
| Table 2: | Causes of the 1997/1998 forest fire in Indonesia | 20 |
| Table 3: | Indonesia's Land Use Cover Types Affected by Fires in 1994 | 23 |
| Table 4: | Estimated extent of fire-affected forests and other lands in Indonesia, 1997-98 | 24 |
| Table 5: | Overview of area burned in East Kalimantan, Indonesia, in 1997-98 related to land-use classes and damage levels | 24 |
| Table 6: | Lao Government Laws related to forest fire management | 29 |
| Table 7: | Malaysian forest cover by region 2001 | 33 |
| Table 8: | Summary of Forest Fire Events in Peninsular Malaysia (1992-1998) | 34 |
| Table 9: | Aggregate incremental costs of the damage caused by smoke/haze in 1997 | 35 |
| Table 10: | Total burned area recorded in Peninsular Malaysia (1992-1997) | 39 |
| Table 11: | Emergency Calls to Malaysia's Fire and Rescue Department in 2000 and 2001 | 40 |
| Table 12: | Loss of Life and Property Due to Fires by Year in Myanmar | 45 |
| Table 13: | Loss of Property and Life Due to Fire in Myanmar and the Estimated Loss In Kyat | 46 |
| Table 14: | Natural disasters and their impacts on the people of Myanmar over the last century | 47 |
| Table 15: | Philippines' Forest Types, Area Covered and Percentage of Total Land Area | 49 |
| Table 16: | Proportion of Forest Types in Thailand | 58 |
| Table 17: | Legal Constructs in Thailand for Fire Prevention | 60 |
| Table 18: | Number of Fires and Area burned by Region in Thailand for Dry Period between October 1, 2001 to April 11, 2002 | 62 |
| Table 19: | Number of Fires and Area Burned by Region in Thailand for period October 1, 2002 – April 1, 2003 | 63 |
| Table 20: | Annual burnt areas from forest fire in Thailand | 63 |
| Table 21: | Land cover change from 1988 to March 2002 prior to the forest fire at U Minh Tong National Park | 71 |
| Table 22: | Area and Type of Habitat Loss from 2002 fire in U Mihn Tong National Park | 72 |

List of Abbreviations

| | |
|----------|--|
| ADB | Asian Development Bank |
| ALPAP | Air Line Pilots Association of the Philippines |
| AFN | Asia Forest Network |
| AOPAP | Aircraft Owners and Pilots Association of the Philippines |
| ASEAN | Association of South East Asian Nations |
| ATO | Air Transportation Office |
| B\$ | Brunei Dollars |
| BAPPENAS | Badan Perencanaan Pembangunan Nasional |
| CBNRM | Community-based natural resource management |
| CBFiM | Community-based fire management |
| CESVI | Cooperazione e Sviluppo |
| CGIAR | Consultative Group for International Agricultural Research |
| CIDA | Canadian International Development Agency |
| CIFOR | Center for International Forestry Research |
| CKN | Commonwealth Knowledge Network |
| CRISP | Center for Remote Imaging, Sensing and Processing |
| DANCED | Danish Cooperation for Environment and Development |
| DENR | Department of Environment and Natural Resources |
| DFW | Department of Forestry and Wildlife |
| DOST | Department of Science and Technology |
| DTC | Department of Transportation and Communication |
| EEPSEA | Economy and Environment Program for Southeast Asia |
| ENSO | El Niño-Southern Oscillation |
| EQA | Environmental Quality Act |
| EU | European Union |
| FAO | Food and Agriculture Organization |
| FDRS | Fire Danger Rating System |
| FFPCP | Forest Fire Prevention and Control Project |
| FIO | Forest Industry Organization |
| FIRES | Fire Information, Research and Education Service |
| FPD | Forest Protection Department, MARD |

| | |
|----------|--|
| FRDM | Fire and Rescue Department of Malaysia |
| FSC | Forest Stewardship Council |
| FSD | Fire Services Department |
| GFMC | Global Fire Monitoring Center |
| GIS | Geographic Information System |
| GNP | Gross National Product |
| GOFC | Global Observation of the Forest Cover |
| GTZ | Gesellschaft für Technische Zusammenarbeit |
| HPG | Haze Prevention Group |
| ICRAF | International Center for Research on Agroforestry |
| IFFN | International Forest Fire News |
| IFFM | Integrated Forest Fire Management Project |
| ITTA | International Tropical Timber Agreement |
| IUCN | The World Conservation Union |
| JICA | Japanese International Co-operation Agency |
| MARD | Ministry of Agriculture and Rural Development |
| MNCs | Multinational companies |
| MOF | Ministry of Forestry |
| MRC | Mekong River Commission |
| NBCAs | National Biodiversity Conservation Areas |
| NFAP | National Forestry Action Plan |
| NGO | Non-Governmental Organization |
| NVA/VC | North Vietnamese Army and Viet Cong |
| ODA | Overseas Development Agency |
| PAL | Philippine Air Lines, Inc. |
| PDR | Peoples' Democratic Republic |
| PFCS | Provincial Forest Fire Control Stations |
| PPFSEA | Project FireFight South East Asia |
| PM | Particulate Matter |
| RHAP-CSU | Regional Haze Action Plan Co-ordination and Support Unit |
| RM | Malaysian Ringgit |
| Rp | Rupiah |
| RS | Remote Sensing |
| R & D | Research and Development |
| SFEs | State Forest Enterprises |
| STEA | Science, Technology and Environment Agency |
| SPOT | Systeme Pour l'Observation de la Terre |
| TFFMP | Total Forest Fire Management Plan |
| UN | United Nations |

| | |
|-------|---------------------------------------|
| UNDP | United Nations Development Program |
| UNDRO | United Nations Disaster Relief Office |
| UNEP | United Nations Environment Program |
| USD | United States Dollars |
| WRI | World Resources Institute |
| WWF | World Wide Fund for Nature |

Introduction

As in other regions of the world, harmful forest fires in South East Asia have caused enormous human, environmental and economic damage in recent years. In addition to the negative impacts on biodiversity and ecosystem functioning, forest fires have caused loss of human life and major health problems, disrupted livelihoods and adversely affected regional and national economies. An additional concern is the contribution of fire to global warming.

WWF - The World Wide Fund for Nature and IUCN - The World Conservation Union joined forces to develop “Project FireFight South East Asia”. The project team has worked at the national and regional level across South East Asia to support and advocate the creation of the legislative and economic bases for mitigating harmful anthropogenic forest fires.

For three years the project team has worked with stakeholders, partners and governments in the three thematic areas of Community Based Fire Management, The Economic Aspects of Fires and The Legal and Regulatory Aspects of Fires in South East Asia. In undertaking these activities, the project and its collaborators have recognized that there is a need for a collation of available information on forest fires in the region. One factor restricting the capacity to respond constructively to the forest fire problem in the region is the lack of a basic framing of the fire situation for each country.

In South East Asia, there are very few statistics on the extent or type of forest fires. Most fires are attributed to shifting cultivation. Escaped fires from hunting, grazing, or clearing fields may actually cause more damage than shifting cultivation. Fires used as a weapon for combating social inequity or as a manifestation of inter-village conflicts are rarely distinguished from beneficial uses. Addressing the underlying causes of fires including inequitable tenure arrangements and policy distortions can improve the efficacy of fire management. A better accounting is necessary of wanted, beneficial fires compared with the unwanted, damaging fires.

This study reviews some issues relating to the current status of data collection, analysis and dissemination of information. Fire management issues are briefly studied for each of the ASEAN countries. The review characterizes current fire operations programs within each country. This is only intended as a ‘snap shot’, based on limited time and resources using literature review and web searches only. A regional overview with some common linkages between countries and some constructive recommendation for the future of fire management in the region is provided.

Regional Overview

Region-wide, rapid and profound changes are occurring in many social, institutional, and economic systems. Continued impoverishment of large parts of the South East Asian population, increased disparities both within and among nations, and rapid globalization, particularly through developments in information technology, transport, and trade regimes, are observed.

In many of the ASEAN countries, there are trends towards decentralization of fire management responsibilities from national to sub-national authorities, an increasing interest by transnational organizations, such as the European Commission, the World Bank, Asian Development Bank, UN Agencies, WWF, IUCN, The Nature Conservancy, Conservation International and others, in environmental stewardship and policy development and a move towards integrated environmental policies and management practices.

There is also an increased willingness by Governments to co-operate on fire management on a regional basis as witnessed by the efforts of ASEAN in the last decade (ASEAN Regional Haze Action Plan and Regional Haze Action Plan Co-ordination and Support Unit). Against this background of change, some regional trends are emerging from the diverse national accounts of fire management concerns, current and future, summarized in this review, Framing Fires:

- Fire, as a land clearing tool used for the expansion of agricultural land and human settlements, is contributing to the loss of natural areas and the biodiversity they contain.
- In the event of a large air pollution event, haze is contributing to significant financial losses for several of the ASEAN countries.
- Fires are seen as a negative environmental factor in most if not all of the ASEAN countries.
- The impacts of fire, both positive and negative, are rarely identified or assessed with any consistency and rigor
- Fire science and a basic understanding of the role of fire in natural ecosystems remain poorly understood or documented for the region.

Benchmark data and integrated assessments

Assessments are required continually to guide rational and effective decision-making for fire policy formulation, fire management implementation, and evaluation at local, national, and regional levels.

To improve the national and regional capability for keeping fires under continuous review, urgent action is required for the following:

- investment in new and better data collection, in the harmonization of national data sets, and in the acquisition of a regional data set on fires;
- improved understanding of the linkages among different fire issues as well as of the interactions between fire management, sustainable livelihoods and development;
- enhanced capabilities for integrated assessment, forecasting and impact analysis of fire management approaches and alternative policy options;
- meaningful, and useful methods for monitoring fire trends and evaluating policy impacts at local, national, and regional levels.

Fire science and inter-disciplinary studies

Continued scientific advancement is also required to guide rational and effective decision-making for fire policy formulation, fire management implementation, and evaluation at local, national, and regional levels. An increased understanding of fire-forest interactions is necessary for more effective science based management of forest ecosystems in South East Asia. To improve the national and regional capability for studying fires and understanding its role in forest ecosystems, support is required for:

- investment in new and better scientific methods and in the development of regional scientific standards;
- improved understanding of fire regimes in South East Asia (fire extent, fire intensity, fire return intervals, fire behavior, accumulation of fuel loads, etc.)
- increased understanding of the positive and negative impacts of fire as well as of the interactions between fire, forest ecology, soil ecology, hydrology, geomorphology, atmospheric chemistry and other biophysical aspects;
- better translation of scientific results into a format readily usable by policy-makers and the general public.

Institutional and Legal Frameworks

In theory, the region does not lack the legal and institutional tools to regulate and manage forest and land fires. Significant numbers of relevant laws and regulations targeting fire-use and irresponsible landowners exist at national and provincial levels. However, the institutional and legal infrastructure in many countries lacks consistency, clarity and enforcement is often compromised.

Within ASEAN, there is recognition that a regional framework, based on cross-border cooperation, will be required to address the issue of fire and haze.

The ASEAN approaches have, thus far, focused on ways to prevent and combat the fires. In 2002, its ten member states signed a legally binding ASEAN Agreement on Transboundary Haze Pollution. The treaty sets out clearly the obligations as well as

the preventative measures and responses expected of the member states. This agreement contains a framework for cooperation and coordination efforts. It includes measures for a regional coordination center to share and disseminate fire related information.

Although ASEAN member states (Figure 1) are obliged to observe the treaty, many lack the legal and regulatory clarity necessary for balanced fire management. The fire and haze problem is multifaceted with complex underlying causes. Forest and land fires have occurred increasingly with alarming intensity and scale indicating that the institutional, legal and regulatory elements are not functioning properly or are not present as of yet. Some reasons include: corruption, collusion between the private sector and officials, marginalization of local communities, incoherent legal and institutional frameworks, and the lack of financial and human resources, as well as a lack of research into the causes, extent and possible options for managing fires. Another important factor is that forest and land management regulatory frameworks often do not facilitate the development of a long-term strategy and plan for this multifaceted and complex issue of fires.

Figure 1: ASEAN Member countries



The Role of Civil Society and Communities

Communities and civil society can play a significant role in fire management, especially in South East Asia where people are the primary source of fires. Fire is not something that can be excluded from the daily lives of people and in some cases not from the ecology of landscapes (such as Dry Dipterocarp forests). In reality, communities are using fire to cultivate crops and non-timber forest products, hunt, create forage and manage pests and disease. Communities have a significant role to play in prevention and suppression of harmful fires that have a detrimental impact on their lives. In the region, there are many examples of local communities taking action to protect the resources not only within their vicinity but resources valuable to their nation. Many of these cases exist in remote locations where the government's fire control / suppression approaches would not be as successful in protecting the forest resource. However communities cannot do everything. It is not fair or feasible to expect communities to be involved in large fire suppression. This task requires significant resources organized, led and provided with appropriate equipment, often for significant periods at a time of year when attention to crops is critical. Communities and their members can be an important, perhaps pivotal, component but should not shoulder the entire burden for fighting fires.

One pertinent example of this potential was articulated in the lessons learned from the Cooperazione e Sviluppo [CESVI] project in Sayaboury Province, Lao PDR. This project learned that a suppression oriented approach was not appropriate in the Laotian context. The initial project which was geared on Westernized fire management training, public awareness campaign, and equipment and technology transfer, went through a full transformation by phase two. After several years with minimal results, the project's second phase recognized the need to work through Lao PDR's decentralized structures and emphasized on training of government officials to work collaboratively at the village level. Although this project ended abruptly, CESVI believes that its final efforts to build the capacity with local officials for community-based fire management will be a more sustainable effort than its original suppression oriented approach.

There are a number of practical steps, which should be further adopted to promote community-based fire management. Firstly, there are ample opportunities from which to learn, both within community forestry and other associated disciplines.

There are likely to be more examples of where local communities can and do manage fires in many situations and for many different reasons. Secondly, there is a need for each interested country to experiment itself, to try out new approaches of user-centered fire management and regulation, and to evolve workable examples of experience at the local scale. Elsewhere it has been argued that in the same way as legal frameworks cannot be satisfactorily amended without the guidance of policy, policies themselves will be most productively reconstructed on the basis of experience, not hypothesis. As with community forestry, community-based fire management is lacking in the number of well-documented cases for supporting this kind of policy change.

Brunei Darussalam

I. Background

The Sultanate of Brunei' was at its peak between the 15th and 17th centuries, when its control extended over coastal areas of northwest Borneo and the southern Philippines. In 1888, Brunei became a British protectorate; independence was achieved in 1984. Brunei benefits from extensive petroleum and natural gas fields, the source of one of the highest per capita GDPs in the less developed countries. The same family has now ruled in Brunei for over six centuries.

Brunei Darussalam is situated on the northwest coast of the island of Borneo with a coastline of about 130 km. Its terrain is mostly comprised of flat coastal plain, which rises to mountains in the east and hilly lowland in the west. Brunei Darussalam is administered by a constitutional sultanate. Its total land area of 576 000 hectares is divided into 4 districts; Belait, Brunei and Muara, Temburong, Tutong. The population in 1998 was 0.3 million people with 33.9 percent of this population living in rural areas. The population in 2001 was 343,653 and the growth rate was 2.11%. The population is comprised of the following ethnic groups: 67% Malay, 15% Chinese, 6%, indigenous and 12% other. The official religion is Muslim (67%) however there are other religious beliefs in Brunei (Buddhist 13%, Christian 10%, indigenous 10%).

Economically, Brunei is still heavily dependant on the production of crude oil and natural gas. The country is known to be the third largest oil producer in Southeast Asia with a production of 163,000 barrels per day. It is also the fourth largest producer of liquefied natural gas in the world. Apart from crude oil and natural gas revenues, rents, royalties, taxes and investment dividends also support the country's economy. The GNP per person in 1998 was USD 14,935.

Brunei Darussalam has a tropical climate with high humidity and rainfall. The average daily temperature is about 28°C and the annual rainfall ranges from 2,790 mm in lowland areas to more than 3,810 mm in many parts of the interior. The majority of this precipitation takes place from November to March.

The country of Brunei is endowed with extensive forests. Of its total land area of 448000 hectares, 78 percent is covered with forests as of 2000 (FAO 2000). Brunei's forest resources are classified into two types of gazetted forest resources, which cover an area of about 235,520 hectares, or approximately 40% of the total land area and State-land forests. The management of the forest reserves is under the jurisdiction of the Forestry Department, one of the arms of the Ministry of Industry and Primary Resources.

Most of the forest reserves are made up of primary forests, which can be divided into six subcategories: mangrove, freshwater swamp, peat swamp, kerangs or tropical heath, mixed Dipterocarp and montane.

The forests of Brunei Darussalam are mostly managed for their inherent protection and conservation values. However, some of its forests are managed with the goals of attaining long-term self-sufficiency in timber production and the supply of other essential forest products. Some of its management objectives include the tapping of forest resources for industrial biotechnology, boosting ecotourism, and developing a competitive forestry niche in the international market. All of these are geared toward maximizing the contribution of the forestry sector in the Government's national economic diversification program.

II. Fire information

Forest fires and the resultant haze are still generally considered new problems facing Brunei. In 1997/98, one of the worst episodes of haze struck this region, engulfing Malaysia, Indonesia, Singapore and Brunei. The main source of the haze was attributed to the forest/bush fires that occurred in various parts of Sumatra and Kalimantan magnified by the El Niño phenomenon, although there were also forest and bush fires reported in Brunei.

Brunei's forest fires occur during a similar season to that of its neighboring countries, Malaysia and Indonesia. Under normal conditions, the undisturbed tropical moist forests of Brunei, Malaysia and Indonesia do not burn easily and even if they do, the fire will not be widespread. With an average annual rainfall of about 2 540 mm, humidity exceeding 75 percent and the rate of litter decomposition on the forest floor relatively fast, the climatic conditions are generally humid and fuel build-up on the forest floor is minimal. Unless these conditions are changed, there is very little chance of the forest catching fire. However, when the forest is disturbed and degraded with debris available and canopy cover opened, the forest becomes more vulnerable to forest fires (especially after a prolonged dry spell). Particularly for the peat swamp forests, the soil is always moist. However, when water in these areas is drained during development projects, the peat becomes completely dry and is very prone to fire. Under these conditions the fire may burn underground and remain smoldering for a long time.

Arson and the use of fires on agricultural land and for land conversion are the major causes of forest fires in Brunei (Hassan and Manila 1997)

A. Government

Brunei Fire Services is a department under the Ministry of Home Affairs. In the early 1920s, fire services, which appear to cover both urban and rural fires in Brunei, were organized under the authority of the Police Force, despite a full complement of available fire fighting equipment and able men. It was only in the 1960s that the full legal status of a fire department had been achieved (Fire Brigade Enactment of

1966). A year after the process of institutionalization, the country’s fire department had become complete and a new name was adopted - the Brunei Fire Services.

At present, Brunei Fire Services has more than 1,000 employees and 16 modern fire stations strategically located around Brunei Darussalam. Its operations cover both urban, land and forest fires. The organization’s management structure is given in Figure 2:

Figure 2: Current Management Structure of the Brunei Fire Service

| Director (DFS) | | |
|---|---------------------------------|---------------------|
| Deputy Director (DDFS) | | |
| Assistant Director (ADFS) (Admin/Planning/Training & Manpower) | Teknikal | Operational |
| Welfare, Sport & Public Relation Unit | Logistics Unit | "A" Command |
| Human Resources Unit | Vehicle & Workshop Unit | "B" Command |
| Admin & Finance Unit | Communication & Mobilising Unit | "C" Command |
| Training, Planning & Development Unit | Fire Prevention Section | "D" Command |
| Training Centre | | "E" Command |
| | | "F" Command |
| | | Special Rescue Unit |

Under section 277A of the Emergency Order (Penal Code Amendment, 1998), open burning is prohibited during dry seasons and prolonged drought. A stiffer penalty of USD 57,971 (B\$100,000.00) fine is imposed on offences relating to open burning. Where such offences cause pollution to the atmosphere or endanger human life or property the punishment is a fine of an unlimited amount and or imprisonment for a term of up to five years.

In June 2000, Brunei’s Ministry of Development hosted a training workshop on Monitoring toxic constituents generated from Peat Fire. A recommendation from this workshop proposed a research institute and a knowledge network to provide a Fire Information, Research and Education Service (FIRES) to monitor peat forest fires and their effects on habitation for the South East Asian region. This network would “aim to increase and improve the information and expert base of the region whilst providing a platform for seamless interaction within the broader framework of the Commonwealth Knowledge Network (CKN)”. It is unclear whether this network has progressed since its proposed formulation, as there is no follow-up evidence in the literature.

B. Private Sector

There is very little information available on the private sector and its involvement in fire management. Given the Government's national economic diversification program, the role of the forestry sector is due to increase. Subsequently fire management may become of greater interest to the private sector.

C. Civil Society

Civil society's perception towards fire is predominantly negative with strong statements against the use of fire as a land management tool. As the Penal Code of 1998 is enforced, this perception is likely to increase. Although volunteerism is one component of the Brunei Fire Services, the public image of this organization is one that mimics Western models of fire management. That is, it is government's role to manage fire for civil society.

Fire Data

There is currently no data available for fires in Brunei.

There was a research proposal in 2000 to start a three-year project entitled "Biodiversity impacts of climatic change, fire and forest restoration techniques and the watershed roles of conservation areas in SE Asia". This project was to take place in Danum Valley Conservation Area and the Yayasan Sabah Sustainable Forestry Concession Area, which lies in Sabah, Malaysia. The research was to be performed by University Brunei Darussalam, Gadjah Mada University (Indonesia) and researchers in Thailand. This proposal put forth by Brunei researchers would provide data on fires. The current status of this work is unknown.

Discussion

Brunei's economy is heavily dependant on natural resources, although its government has initiated a national economic diversification program. If land and forest management is part of this diversification effort, fire management will be more important and the role of Brunei Fire Services may intensify to manage more land and forest fires.

Brunei is a wealthy country with government resources for research and development. A brief search of the literature determined that Brunei has a strong role in fire research amongst the South East Asian countries. Its proposal to ASEAN to develop a Fire Information, Research and Education Service (FIRES) in 2000 demonstrates Brunei's potential leadership role in research and development in the fire sector.

Brunei has always been gracious to its ASEAN neighboring countries with its collaborative efforts and sharing of resources. However, it seems that fire is an area where the government is also willing to impose its economic will on its neighboring countries in the event that fires are impacting its country. In July 1999, Brunei threatened to sue neighboring Indonesia if it did not control forest fires on Borneo island and the Western Sumatra provinces. According to officials, Brunei was willing to press charges against Indonesia if Jakarta failed to contain the forest fires, which were affecting the Southeast Asian Games that Brunei was hosting at the time.

Cambodia

I. Background

Although Cambodia had a rich and powerful past under the Hindu state of Funan and the Kingdom of Angkor, by the mid-19th century the country was on the verge of dissolution. By 1884, Cambodia was a virtual colony; soon after it was made part of the Indochina Union with Annam, Tonkin, Cochin China, and Laos.

Although France recognized Cambodia as an autonomous kingdom within the French Union, the drive for total independence continued. Full independence came on November 9, 1953, but the situation remained uncertain until a 1954 conference was held in Geneva to settle the French-Indochina war. Neutrality was the central element of Cambodian foreign policy during the 1950s and 1960s. By the mid-1960s, parts of Cambodia's eastern provinces were serving as bases for North Vietnamese Army and Viet Cong (NVA/VC) forces operating against South Vietnam. Throughout the 1960s, domestic politics polarized. Opposition grew within the middle class and among leftists (insurgents called the Khmer Rouge). The next thirty years saw Cambodia's tragedy unfold with war, internal strife and genocide. Still today, corruption and destructive political factions are disrupting stability for the country.

Cambodia has a total area of 181 248 km² and is located between 10° and 15° north latitude and longitude 102° and 108° east, sharing borders with Thailand, Laos and Vietnam. The country consists of 21 provinces, 2 towns (Keb and Sihanoukville) and the Capital City (Phnom Penh). The total population of Cambodia was 11.43 million in March 1998, with a growth rate of 2.49 percent *per annum*. At the time of that census, population density averaged 64 persons/km². The population is highest in the plains (235 persons/km²) and lowest in the plateau and mountains (17 persons/km²).

Cambodia is one of the world's poorest countries. About 85% of the population is dependent on subsistence agriculture for their livelihoods. The average size of landholding for an individual family is about one hectare, which provides food for the family for the whole year. Complementing their livelihood are forestry and fishery resources. Based on 1999 statistics, agriculture, forestry and fisheries contribute about 36 percent to the gross domestic product. The forest sector alone accounts for about 6.2 percent. Per capita, annual income amounts to USD 268.

Some 15% of the population is landless (Savet and Sokhum 2003, Cambodia Environment News Update 1999).

Cambodia's climate is greatly influenced by the tropical monsoon circulating system and its topography. There are two well-defined seasons, namely the rainy and dry seasons. These seasons are more pronounced in Cambodia's central plains. The raining season from May to October is followed by the dry period from November to April. The average annual rainfall ranges from 1,000 mm to 3,000 mm. The average annual temperature ranges from 25° C in late December to 29° C or over in early

May, with humidity ranging from 65 to 70% in the early part of the year, rising to 85-90% in August and September.

The forests of Cambodia cover more than half of the country's total land area and are a significant natural resource. The latest estimates of forest cover, assessed by the GTZ/MRC Forest Cover Monitoring Project based on 1996/1997 satellite imagery, showed a further reduction to 10.6 million hectares, or 58 percent of the total land area. The reduction in forest cover over the last two decades amounted to about 2 million hectares, which in percentage terms is about 0.56 percent per annum compared to about a one percent average for neighboring countries. There are three main natural forest types: evergreen, mixed evergreen and deciduous. Distributions of these forest types and other forest types and their reductions over the last two decades are given in Table 1 below:

Table 1: Change in Forest cover by forest type between 1973 and 1993

| Forest Type | 1973 | 1993 | Change over last two decades (hectares) | Change over last two decades (%) | Annual change (%) |
|------------------------|-------------------|-------------------|---|----------------------------------|-------------------|
| Dry land forest | 11,678,600 | 10,568,600 | -1,110,000 | -9.50 | -4.8 |
| Evergreen | 6,876,400 | 4,763,300 | -2,113,100 | -30.73 | -1.5 |
| Mixed | | 977,300 | 977,300 | | |
| Deciduous | 4,792,900 | 4,301,200 | -491,700 | -10.26 | -0.51 |
| Coniferous | 9,300 | 9,800 | 500 | +5.38 | 0.27 |
| Secondary | | 517,000 | 517,000 | | |
| Edaphic forest | 1,032,500 | 715,600 | -316,900 | -30.69 | -1.53 |
| Flooded | 937,900 | 370,700 | -567,200 | -60.48 | -3.02 |
| Flooded secondary | | 259,800 | 259,800 | | |
| Mangrove | 94,600 | 85,100 | -9,500 | -10.04 | -0.50 |
| Total | 12,711,100 | 11,284,200 | -1,462,900 | -11.23 | -0.56 |

FAO/UNDP Land Cover Atlas (1994).

Since late 1998, the Royal Government of Cambodia has been implementing a forest reform program and trying to bring order to the sector. A crackdown on illegal logging has been implemented and the logging rights to 22 forest concessions (covering an area slightly exceeding three million hectares) have been withdrawn from 15 companies. The cancelled concession areas have been proposed as protected forests and forest estates. Currently there are 14 legal forest concession agreements that cover an area of 3.87 million hectares or 21.39 percent of the country's total land area (Savet and Sokhum 2003).

II. Fire information

According to the Department of Forestry and Wildlife, Royal Government of Cambodia, fires are not widespread and are thus not considered a threat to the forests of Cambodia. This Department does however state that unwanted fires could become a greater threat if forest degradation continues at its current rate. Forest degradation, as it is currently taking place in Cambodia, is creating favorable conditions for large-scale forest fire.

Unwanted fires occur frequently in the deciduous, pine and bamboo forests during the dry season. Most of the species that constitute the deciduous forest shed their foliage during the dry season that lasts from December to August. This foliage builds up a flammable fuel load on the ground. In addition, the deciduous forest during this leaf shed opens the ground surface to greater sun exposure leading to conditions conducive to a higher fire hazard.

As with other countries in Indochina, people start the majority of fires for a variety of reasons which include; creating better grazing for species that will be hunted or for domestic livestock, driving out wildlife species from undergrowth to make hunting easier, to clearing land for agriculture, and to make it easier to find land terrapins and cast-off deer antlers. According to other recent reports (Rao 2003, Rao 2001, Savet 1999), 95% of the fires in Cambodia are caused by humans for the following reasons:

- Clearing of agricultural plots for shifting cultivation
- Clearing of ox cart roads and footpaths for ease of access
- Promoting new foliage for grazing
- Promoting resin production for extraction
- Hunting
- Collecting honey

In addition to these wanted fires, there are unwanted fires from carelessness. Most of these are attributed to machinery fires and campfires that were not put out.

There is also some recognition of fire's beneficial role in forest ecology. In the Dry Dipterocarp forests of the Eastern Plains, "For maintenance of all elements of the lowland mosaic forest, presumably no burning is bad, some burning is good, but too much burning is once again bad" (McLellan 2003).

A. Government

Cambodia has a Forest Law that states that those who set fires intentionally will be arrested and sent to prison for 5-10 years. Prohibitions for preventing forest fires are set within the New Forestry Law of 1999 on Articles-36 and 37 specified below:

Article-36:

- A. It is prohibited to set fires in the Permanent Forest Estate, except by the Forest Administration to benefit silviculture or forest maintenance.
- B. Ministry of Agriculture, Forestry and Fisheries shall issue Declaration on guidelines to determine sectors of forest fire control, forest fire prevention and creation of Forest Fire-Fighters Committees in forest areas.
- C. People, armed forces and authorities of all levels shall be jointly responsible for forest maintenance and protection, fire prevention and fighting against fires.

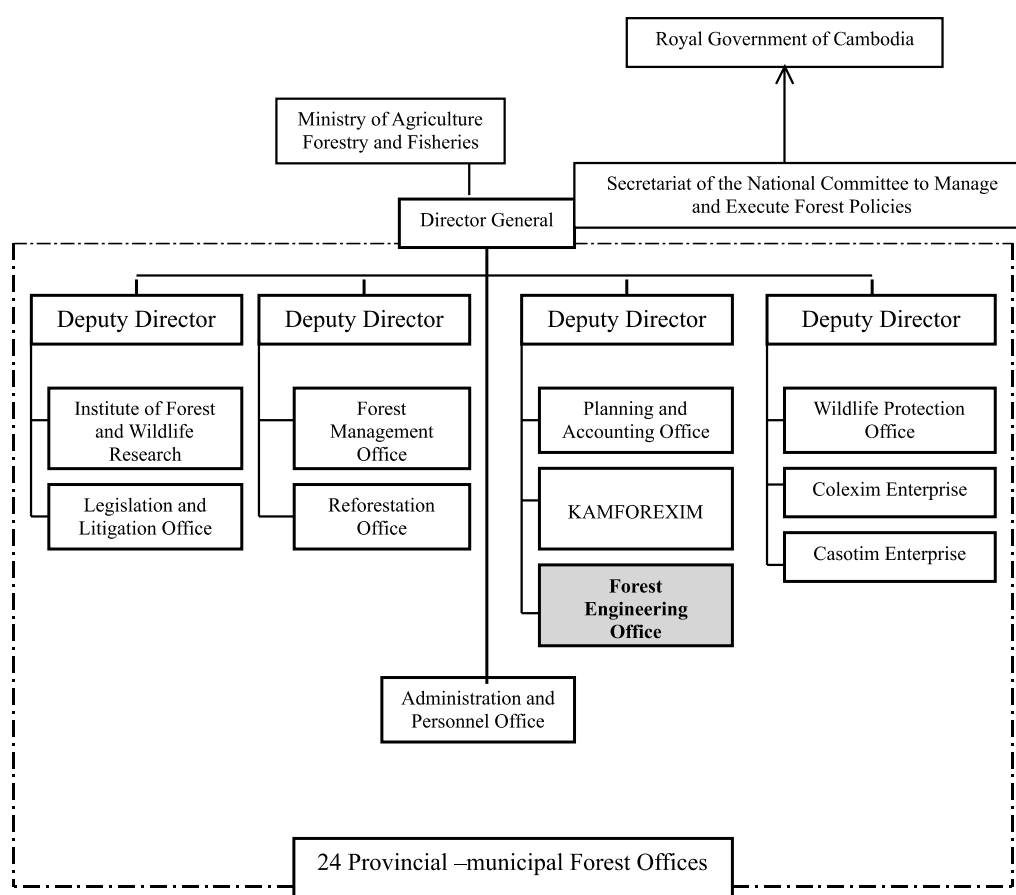
Article-37:

- A. For those communities that traditionally practice slash and burn agriculture, such practice shall be permitted to continue on community land having been registered with the State and in other areas where the division level of the Forestry Administration authorizes the activity as part of a community forest management plan. Unless otherwise stated in this law, all other slash and burn practices are prohibited in natural intact forest in the Permanent Forest Reserves.
- B. Forest reserved for slash and burn practice shall be identified by Sub-decree.

A Forest Fire Control Unit was established under the Department of Forestry and Wildlife (DFW), Royal Government of Cambodia in 2000. The current structure of this Unit under the Forest Engineering Office, DFW is provided below (Figure 3).

The Unit has recently taken on the jurisdictional role for general prevention and suppression of forest fires as well as developing research on fire behavior and fire danger rating systems for Cambodia.

Figure 3: Organization Chart of Department of Forestry and Wildlife Royal Government of Cambodia



B. Private Sector

Unwanted fires could become a greater threat if private companies/ forest concessionaires continue to degrade forests without taking into consideration the fire management implications of their forest management practices¹. According to the Department of Forestry and Wildlife, forest degradation, as it is currently taking place in Cambodia, is creating favorable conditions for large-scale forest fires.

C. Civil Society

At this juncture, it is hard to ascertain civil society's role in fire management or even their perception towards fire. Since 85% of the population are farmers, one can speculate that the use of fire is probably not perceived as detrimental to civil society. There is no information to indicate otherwise.

¹ This report does not imply that all forest concessionaires are actively involved in forest management that degrades forest and leads to extreme fire hazard.

There are some recent developments in Cambodia that are encouraging for promoting community involvement in fire management. A sub-decree on community forestry to increase the number of community forests and to encourage local communities to participate in sustainable forest management and the conservation of forest resource has recently been drafted. In the context of community forestry and community-based natural resource management (CBNRM), this development may allow community-based fire management strategies to develop in Cambodia.

Fire Data

There is currently no data available for fires in Cambodia. There is also no information on fire history, fire frequency and/or extent for Cambodia.

Discussion

According to several reports (Rao 2001, Limchhun 2002), there is little support for fire management in the country and assistance is needed in the technical aspects of fire training, and equipment.

According to these reports, there are several mechanisms that Cambodia could adopt to begin to develop a prevention program strategy against future wildfire occurrences. Some of these mechanisms include:

- Forming provincial level commissions to manage fire. These commissions would function to establish cooperation and active involvement with local communities.
- Strengthen and improve forest law, regulations and guidelines related to fire prevention and suppression
- Public education campaigns
- Provide rewards and incentives for fire detection and suppression activities.
- Prioritize protection/sensitive areas and use appropriate tools to minimize impacts in the event of a fire.

Since fire is not widespread and is considered non-threatening to the forests of Cambodia, it is understandable why there is little available information on fire. However, as forest structure changes and land-use pressures increase, fire management may become of greater importance to its efforts to protect Cambodia's forest resources. Until then, it will be important to improve the knowledge base on which to manage fire. Relatively little is known about the nature of fire in the Cambodian context. Future efforts to study fire in Cambodia should begin with the basics of fire history, fire frequency, and fire extent. That way if fire is indeed going to increase, as some have speculated, then there is some baseline information on how it behaved prior to further deforestation and forest degradation.

In its efforts to address the causes of deforestation and forest degradation, the Royal Government of Cambodia has articulated the desire to form policies and implement programs that focus on:

- The development of forest management plans consistent with international standards of sustainable forest management
- Local community participation in forest management
- The eradication of illegal logging activities and
- The development of land-use management procedures for utilizing previous forest concession lands

Indonesia

I. Background

Indonesia achieved independence from the Netherlands in 1945. Geographically, Indonesia is an archipelago that stretches from the Indian Ocean to the Pacific, and includes over 13,000 islands. Indonesia is home to over 300 different ethnic groups, scattered throughout the Outer Islands (Aragon 1997), while the majority of the nation's population resides on the densely populated island of Java.

The population of Indonesia is 203.5 million (Statistical Year Book of Indonesia 2000). The distribution of the population between Java, as the main island, and the outer islands is unbalanced. The average population density is 106 persons/km² but in Java it reaches 945 persons/km². Since 1980, the population growth rate has decreased, from 1.98 (1980 to 1990) to 1.35 percent (1990 to 2000). Approximately 60 percent of the people live in rural areas. Population expansion is increasing pressure on all natural resources including forests.

Indonesia's GNP per capita was about USD 700 at the end of 1995 (County Brief IFAO 1997). After the regional economic downturn, the national income per capita declined to about USD 600 in 2000 (Statistical Year Book of Indonesia 2000). In 2000, Indonesian economic growth had a better performance than 1999. The growth rate in 2000 was 4.77 percent, valued at USD 46.7 billion (Chrystanto & Justianto 2003).

Situated astride the equator, Indonesia experiences a tropical climate. The wet season is typically from November to April and the dry season is from May to October. Temperatures tend to be hotter along the coast and more moderate at higher elevations. Humidity remains high with a yearly average of 70-90%. Rainfall can occur at any time of the year but is higher in the mountainous areas where there is very little distinction between the wet and dry seasons. Central Kalimantan, Jakarta, Java, Sumatra are the wettest regions of Indonesia, primarily due to the elevation of much of the land. Rain is common year round with no real distinction between the wet and dry seasons. Temperatures remain constant throughout, although in the mountainous regions temperatures can drop well below the average. Bali, East Timor, East & South Kalimantan, Lombok, Sulawesi tends to remain hot and humid all year round, with temperatures around 30°C. The western monsoon brings the heaviest rain between December and March - rain normally falls in intense showers for a short period only.

In 1999, forests covered about 120.35 million hectares or 62.6 percent of Indonesia's total land area (Chrystanto & Justianto 2003). The accelerated destruction of Indonesia's vast forests has created growing national and international concern (Poffenberger 1999). Estimates of Indonesia's existing forest cover vary considerably. Indonesia's sixth five-year plan (REPELITA VI, 1994/95-1998/99) cites 92.4 million hectares as retaining forest cover, while the National Forest Inventory, based on 1986-

91 satellite data, estimated upwards of 120.6 million hectares remaining. Poffenberger (1997), quotes figures similar to the REPELITA VI, stating that forest cover in Indonesia has declined from approximately 152 million hectares to 109 million hectares between the 1950s and 1990s, with less than 92 million hectares in relatively 'good' condition.

Since the mid-1960s, Indonesia has been experiencing extremely rapid economic growth as the nation's government has aggressively pursued industrialization premised upon the centralized control of natural resource extraction and development. While the export of oil has been the engine of economic growth, export-oriented commercial timber extraction has also played a significant role.

The policy and legal framework implemented by Indonesia's government has been instrumental in the development of Indonesia's forestry sector. The current crisis in forestry reflects the fundamental failure of management policies and practice, inherited from the Dutch colonial government in 1870 (Poffenberger 1999). The principle of state ownership of forestlands was established during this colonial era, and was reaffirmed in 1945 when the Indonesian Constitution was written. The legal and regulatory framework adopted for forest management in Indonesia includes The Basic Agrarian Law (1960), the Foreign Investment Act (1967) and the Basic Forestry Law (1967), and the recently issued Forestry Law (2002).

II. Fire Information

Indonesia's fire season occurs during the period June to October, which is traditionally the dry Southwest Monsoon season in the region. Specifically, when dry weather conditions prevail, such as during the El Niño-Southern Oscillation (ENSO), periods of increased fire activities can be expected. Severe fire episodes have occurred during the El Niño-Southern Oscillation (ENSO) events of 1982-83, 1986-1987, 1991 and 1994 and then a well documented, prolonged and extremely severe fire season occurred during the last ENSO of 1997-98. The strong ENSO periods in 1982-83, 1986-87, 1991, and 1994 burned approximately 3.5 million hectares, 100,000 hectares, 500,000 hectares, and 4,866,500 hectares, respectively. The latest event in 1997-98 burned about 9.5 million hectares of land and forest (ADB 1999).

Fire in Indonesia is almost entirely caused by people. Only in some limited areas of East Kalimantan are burning coal seams, ignited in the first instance by people, active as ignition sources. These 'natural' sources account for only one percent of the fires in Indonesia (World Bank 2001). Some studies and reviews have discovered that forest and land fires are basically caused by forest conversion and land clearing (Glover, D. & T. Jessup 1998 and 1999). Forest fires are not a new issue to Indonesia. It was not until the 1997 event and the prompt outcry from the international community that the government of Indonesia and its neighboring countries took such an interest in the causes of forest fires. The World Bank (2001) further assessed the causes of the 1997/1998 fires as shown in Table 2.

Table 2: Causes of the 1997/1998 forest fire in Indonesia

| Cause | % |
|--------------------------------------|----|
| Large scale land conversion | 34 |
| Shifting cultivation | 25 |
| Permanent agriculture | 17 |
| Social conflict with local community | 14 |
| Transmigration | 8 |
| Natural causes | 1 |

The 1997 fires in Indonesia drew worldwide attention as the haze impacted Malaysia, Singapore, southern Thailand and the Philippines and lasted from June through until November. During this event, large fires occurred in Sumatra, West and Central Kalimantan and West Papua. In 1998 the greatest fire activity occurred in East Kalimantan. These widespread fires resulted in dense haze across Southeast Asia, causing respiratory health problems as well as transportation delays and accidents on land, air and sea. As early as the beginning of May, air quality began to deteriorate in Singapore 24-hour average concentrations peaked at approximately $230 \mu\text{g}/\text{m}^3$ ($\text{PSI}=140$)² on 19 and 29 September (Nichol, 1998). In Sarawak, however, 24-hour average PM10 peaked as high as $930 \mu\text{g}/\text{m}^3$ on 23 September (Nichol, 1998), which represents a value more than 15 times the normal levels (Brauer & Hashim-Hisham, 1998). Due to the location of fires and direction of the wind, Sumatra and Kalimantan in Indonesia were the most severely affected areas (Pinto et al., 1998). Daily averaged concentrations of PM10 reached as high as $3546 \mu\text{g}/\text{m}^3$ ($\text{TPM}=3940 \mu\text{g}/\text{m}^3$) in Sumatra at the end of September (Heil, 1998). The concentrations were even higher in Kalimantan, on the island of Borneo, with a 24-hour maximum of $3645 \mu\text{g}/\text{m}^3$ ($\text{TPM}=4050 \mu\text{g}/\text{m}^3$) (Heil, 1998). Even at the beginning of November in Palembang when the air quality was improving, daily PM10 and PM2.5 still exceeded the National Ambient Air Quality Standards (Pinto et al., 1998). Economic costs were estimated at over USD 9.3 billion (ADB 1999) and the smoke-haze resulting from the fires led to disagreements with neighbouring countries (i.e. Malaysia, Brunei, and Singapore). In the forest concessions of East Kalimantan, the estimated loss of 23 million cubic meters of harvestable timber due to the 1997-98 fires was calculated to be worth approximately two billion dollars (USD) (Hinrichs 2000). The carbon emissions from this event elevated Indonesia to one of the largest polluters in the world at that time (ADB 1999, Barber & Schweithelm 2000).

2

| PM10 Concentration | PSI | Air Quality Description |
|----------------------------------|-----------|-----------------------------|
| 0-150 $\mu\text{g}/\text{m}^3$ | <100 | Good to Moderate |
| 151-350 $\mu\text{g}/\text{m}^3$ | >100 <300 | Unhealthy to very Unhealthy |
| 351-600 $\mu\text{g}/\text{m}^3$ | >300 <500 | Hazardous |

(Adapted from: Angelica Heil 'Haze Guide-Information and recommendations to deal with haze from forest and land fires.' first version February 98, updated September 98, in: *How to Cope with Haze from Forest and Land Fires* – Information Guidelines.

Indonesia is one of the few countries in the region that has evidence of ancient wildfires, in East Kalimantan (Goldammer and Seibert 1990). ¹⁴C-dates of soil charcoal recovered along an East-West transect between Sangkulirang at the Strait of Makassar, and about 75 km inland, showed that fires had occurred between ca. 17,510 and ca. 350 before present. Early explorers to island of Borneo documented haze in the region at the turn of the century.

A. Government

Indonesia's decentralization is an ongoing process that still needs to formulate general policies defining task, authority and responsibility to all parties and at all levels of the fire management system (Abdullah 2002). At the national level, four institutions deal with forest and land fires- the Ministry of Forest, Ministry of Agriculture, State Ministry of Environment and National Board for Disaster Management and Refugees. Many provinces have several other institutions involved including the Provincial/District Forest Service, Provincial/District Environment Impact Management Office, Civil Defense Office, Provincial Forest and Land Fire Control Center or Executing Co-ordination. These many institutions and agencies that deal with or are responsible for the management of forest and land fires can be placed into three national level categories:

- 1) the Forestry sector, mainly the Ministry of Forestry and Pusdalkarhutnas
- 2) the Environmental sector, mainly Bapedal and TKNKL/TKNPKHL
- 3) the Disaster Management sector, mainly Bakornas PBP

A comprehensive review of these three sectors and the regulatory structures in Indonesia has been recently performed (Simorangkir and Sumantri 2002). The structure of the Ministry of Forestry has changed several times making it difficult to ascertain the structure of its Fire Section. The latest structure based on the Forestry Ministerial Decree No. 123/Kpts-II/2001 on Organization and Work System can be found in this recent review.

The main functions of the Directorate of Forest Fire Control, Ministry of Forestry are to lead the policy formulation on forest fire management, supervise and co-ordinate its implementation, including technical extension. It is supported by four Sub-Directorates each with similar activities but with a slightly different focus. These four sub-divisions are:

- 1) Sub-Directorate of Fire Control System Development (supports the development and implementation of policy, standards, norms and guidelines as well as preparation of extension and evaluation of the forest fire control system).
- 2) Sub-Directorate of Fire Detection and Evaluation (detection of forest fires, emphasis on monitoring and dissemination of hot spot information)
- 3) Sub-Directorate of Fire Prevention and Suppression (prevention and suppression including planning, procurement and dissemination of fire-fighting equipment)
- 4) Sub-Directorate of Fire Impact (assesses impact of forest fires especially the environmental impacts but also the legal implications of these impacts).

In general, there is a lack of incentive for government officers to conduct their tasks. Low salary, career uncertainty and undervalued skills and knowledge have led to the demoralization of the natural resource management professions in Indonesia. As a result, many government workers are unmotivated and passive. The common practice of rapid transfers distracts staff and reduces the emphasis on innovative approaches to fire management. All of these factors perpetuate a fire management system, which is more reactive than proactive.

B. Private Sector

In Indonesia, it is the private sector, which has been identified as the major offender in breaking anti-burning regulations. These private actors have long relied on fire to clear large tracts of land for plantation purposes. While such fires can be effectively contained, their sheer scale does mean that unwanted impacts of pollution and haze can have provincial, national and international ramifications. Although recent research has indicated that under certain circumstances, the use of fire may not be the most financially sound nor rational decision, it is unlikely that the private sector is going to change its current land-use practices without some initiatives by the national government (Simorangkir & Sumanti 2002). While more research on the economics of fire use is needed, it is clear that the persistent use of fire for commercial land-clearing can be attributed to habit and historical use. Efforts to change these long-held commercial land clearing practices will need to be supported by appropriate laws and regulation, effective law enforcement and adequate governance capacity. The private sector lacks incentives for good land management practices. Increasing pressure from the international community for the concessionaires to adopt sustainable land and forest management practices has had little impact yet. When concession rights are limited to one rotation period, there is very little inclination to undertake long-term investments and the tendency is to reap short-term benefits. Under such conditions, laws and regulations cannot be implemented effectively and fire will continue to be the preferred commercial land-clearing practice.

C. Civil Society

In Indonesia, small local communities have been using fire for centuries as an economically viable way of land clearing. Despite Indonesia's 1999 anti-burning laws, these subsistence farmers, sometimes alongside plantation owners, would prepare fields for cultivation by burning during the dry season. This type of burning is on a much smaller scale in comparison to the large commercial land-clearing by the industry. Most estimate that the burning of land as part of subsistence agriculture is not a significant source of fires and haze (ADB 1999, Simorangkir and Sumantri 2002, Abdullah 2002). Generally fire used by local communities becomes a problem only when it is uncontrolled, or when it is used as a weapon to resolve land-use conflicts. Uncontrolled fires can be attributed to changes in local culture and practices, such as when traditional forest management is stopped and knowledge is subsequently lost to the younger generation (Ganz & Moore 2000). Related to this in Indonesia is the migration of people. New migrants who are unfamiliar and unattached to the new environment, unaware of traditional societal rules have allowed fires to escape. This was evident during the financial crisis of 1997 when numbers among the urban poor were forced to migrate back to the countryside and to illegally clear farmland. Fire may also be a weapon for the economically and politically marginalized. In Indonesia,

the expropriation of lands that communities traditionally used and the environmental degradation (flooding, air pollution, soil erosion) caused by large conglomerates in the natural resource sector have led to conflicts with local communities. As a result, aggrieved villagers would sometimes set fires on plantations or forests in revenge, or as a form of protest against the authorities.

Fire Data

The Indonesian Ministry of Forestry has compiled several statistics on the extent of burning in the country but it is inherently difficult to find a clearing house with all of this information in one place. The majority of the fire data in Indonesia has an emphasis on the extent of fires and their impacts. There is very little work on the characteristics of these fires (fire behaviour, fire regime, etc.). Statistics for 1994 (Table 3) revealed that a total land area of 5.1 million hectares had been affected by fire. Statistics for 1997-1998 (Table 4) compiled by the Asian Development Bank Project (ADB 1999) provides a general estimate of 9.7 million hectares impacted by forest and land fires. Due to the severity of fires in Kalimantan during this event (covering 25% of the province) there is also a plethora of information compiled on the fires in the province. An overview data table shows that the majority of the area impacted was in natural forest concession land (Table 5).

In addition to these national level impact studies, the Forest Fire Laboratory situated in the Faculty of Forestry of Bogor's Agricultural University, has initiated a series of fire science investigations. These research studies have included research on the best-case scenarios of controlled fire use and impact studies on the biological/ecological impacts of fire on overstory and understory species, soil and invertebrates. This Forest Fire Laboratory also initiated and facilitated the first meeting of the South East Asia Forest Fire Scientist Network Meeting held April 5-7, 2001 at the Agriculture University in Bogor. This science network has met several times since this initial meeting in Bogor but there is no indication that it is still active.

Table 3: Indonesia's Land Use Cover Types Affected by Fires in 1994

| Vegetation / Land-Use Type Affected by Fire | Area Burned (hectares) |
|--|-------------------------------|
| Traditional dryland farming | 2,800,000 |
| Shifting cultivation | 1,500,000 |
| Transmigrant farming | 260,000 |
| Plantations | 221,000 |
| Transmigrant settlements | 39,500 |
| Reforestation areas | 20,500 |
| Timber estates | 17,000 |
| Natural forests | 8,000 |

Global Fire Monitoring Website (2000)

Table 4: Estimated extent of fire-affected forests and other lands in Indonesia, 1997-1998

| Land use/ Land cover | Lowland Forest | Peat and Swamp Forest | Dry Scrub and grass | Timber Plantations | Agriculture | Estate Crops | Total (hectares) |
|-------------------------|-------------------|-----------------------------|------------------------|-----------------------|------------------|-----------------|---------------------|
| Island | | | | | | | |
| Kalimantan | 2 375 000 | 750 000 | 375 000 | 116 000 | 2 829 000 | 55 000 | 6 500 000 |
| Sumatra | 383 000 | 308 000 | 263 000 | 72 000 | 669 000 | 60 000 | 1 755 000 |
| Java | 25 000 | | 25 000 | | 50 000 | | 100 000 |
| Sulawesi | 200 000 | | | | 199 000 | 1 000 | 400 000 |
| West Papua | 300 000 | 400 000 | 100 000 | | 97 000 | 3 000 | 900 000 |
| Total (hectares) | 3 283 000 | 1 458 000 | 763 000 | 188 000 | 3 844 000 | 119 000 | 9 655 000 |

Source: BAPPENAS (1999)

Table 5: Overview of area burned in East Kalimantan, Indonesia, in 1997-98 related to land-use classes and damage levels

| Land Status | Total Area in East Kalimantan [hectares] | Burned Area [hectares] | % Burned | Damage Classes * | | | |
|--------------------------------------|--|------------------------|----------|------------------|------------------|-----------------------------------|---|
| | | | | 25-50 % | 50-80 % | >80 % (Dead Trees still standing) | >80% (without standing large trees: pre-fire degraded or converted) |
| Natural Forest Concession area (HPH) | 9,771,384 | 2,347,717 | 24% | 767,629 | 1,234,413 | 237,719 | 107,956 |
| Forest Plantation (HTI) Area | 1,393,074 | 883,987 | 64% | 209,498 | 429,623 | 111,935 | 132,931 |
| Estate Crop (Perkebunan) Area | 746,603 | 382,509 | 51% | 83,731 | 198,151 | 11,966 | 88,661 |
| Total Protected Area (HL) | 4,562,059 | 440,381 | 10% | 84,146 | 263,656 | 23,656 | 68,923 |
| Undefined Land Use | 3,275,441 | 1,161,174 | 36% | 106,684 | 69,650 | 233,088 | 753,876 |
| Total | | 5,215,768 | | 1,249,564 | 2,195,493 | 618,364 | 1,152,347 |

Source: BAPPENAS (1999)

* The damage classes 3 and 4 represent two different conditions of severely damaged forests. Damage class 3 represents the conditions prevailing in the (peat-) swamp forests of the Middle Mahakam lake area where almost the entire area was affected by fire. The dead trees are still standing. This condition provides a high future fire risk given the high fuel loads remaining after the fires. Damage level 4 includes forest plantations, degraded forest, bush and grassland as well as farmland.

Discussion

There is a growing consensus among the political levels of the government, the NGO community and the broader community, that the forestry sector must transform from the presently highly centralized bureaucracy and large-scale commercial forest operations (to the exclusion of other interest groups) to a decentralized system of decision-making and management, focusing on strong participation, access and ownership by forest dwelling and adjacent communities. According to a recent report (Chrystanto & Justianto 2003), forestry needs a major institutional reform, utilizing assistance and inputs from community stakeholders and other interest groups, to restructure the mandates of MOF, provincial and district forest agencies and other administrative units for forest and fire management.

Structured implementation and monitoring of fire policy implementation have not been put in place. Linkage of planning and budgeting within the government and between the government and the private sector has been unstructured and unclear and will likely remain so. For the future it will be necessary to:

- Formulate a monitoring system for policy implementation, budget realization and investment by the government and the private sector, including industries and communities.
- Establish monitoring systems or mechanisms among all parties concerned
- Improve cooperation
- Formulate clear “sub-policies” linked organically to the “parent policy” which define tasks, authority and responsibility to all parties and at all levels of the fire management system (Including the Ministry of Forest, Ministry of Agriculture, State Ministry of Environment and National Board for Disaster Management and Refugees, Provincial/District Forest Service, Provincial/District Environment Impact Control Office, Civil Defense Office, Provincial Forest and Land Fire Control Center or Executing Co-ordination)
- Complete government regulations related to fire/forestry and other respective sectors immediately and improve coordination for enforcing these regulations.

Lao PDR

I. Background

In 1975 the communist Pathet Lao took control of the government, ending a six-century-old monarchy. Initial closer ties to Vietnam and socialization were replaced with a gradual return to private enterprise, an easing of foreign investment laws, and the admission of Lao Peoples' Democratic Republic (Lao PDR) into ASEAN in 1997.

Lao PDR is the only landlocked country in Southeast Asia and is situated between 13°54'N and 22°31'N and 100°05'E and 107°42'E in the center of the Indochina Peninsula. The land area covers 23,680,000 hectares of which more than 80% consists of mountainous terrain with steep valleys (Rundel, 1999). The Mekong River flows for 1700 km along the length of Lao and human population is mostly settled in the broad fertile valleys along the Mekong River and its tributaries. The largely rural population is primarily engaged in agriculture with an estimated per capita income of USD 330 in 1998 with 46 % of the Lao people living below the poverty line. The incidence of poverty is generally higher in remote areas, especially in the northern and southern provinces.

The climate is dominated by the monsoon and, as such, has pronounced wet and dry seasons (Duckworth, 2000). The rainy season lasts from May to September when the prevailing wind is from the southwest. Average rainfall varies between 1 000 mm in the north to 3 000 mm in the South. The dry season which runs between October and April is characterized by winds from the northeast. Daily mean temperatures range from 10°C in January to 38°C in July with the north of the country generally cooler than the south. Lowland areas are classified as tropical, whilst the higher elevations and mountainous areas in the north are considered sub-tropical.

Lao PDR is a country rich in natural resources and culture with a population of 5.09 million people, and a growth rate in 2000 of 2.8% per year (National Statistical Center, 2000), one of the highest in Asia. Approximately 80% of the population lives in small villages (average about 300 inhabitants) in rural areas (National Statistics Center, 2000). Ethnic groups are broadly divided into three categories: 'Lao Loum' (Lao of the lowlands), 'Lao Theung' (Lao of the mountain slopes), and 'Lao Sung' (Lao of the mountain summits). The Lao government census reports 48 different ethnic groups in Lao PDR (National Statistics Center, 1997), while social scientists report up to 230 ethnic groups (ADB, 2000).

The cultural diversity of Lao can be divided into four major language groups: Mon-Khmer, Hmong-Mien, Tibeto-Burmese and Tai-Kadai. All four ethno-linguistic groups occur both in the lowlands and the highlands. However, the Tai-Kadai groups dominate in the lowlands and cultivate paddy rice. The Mon-Khmer, Hmong Mien and Tibeto-Burman groups occur more commonly in the uplands and practice swidden agriculture. These latter groups live primarily in rural areas and are forest dependent for their basic needs.

Most of the Lao population is Buddhist, Animist, or a combination of the two. Both of these religions hold great respect for elders and for working collectively. Community cohesion is very strong in Lao PDR. A village headman is usually leader of the community, and family ties are very strong.

Forest cover in Lao is estimated between 40% (Galt *et al.*, 2000) and 47% (DoF) at present. Forest products are the main source of foreign exchange in Lao PDR, and accounted for 42% of foreign exchange revenue in 1998 (STEA, 2000). Forest habitats in Lao PDR can be divided into four broad types: dry dipterocarp lowland habitats, montane habitats, mixed-evergreen habitats, and pine forests. Of these, dry dipterocarp forests, and possibly pine forests, may be actively maintained by fire. Additionally, there are 20 National Biodiversity Conservation Areas (NBCAs) composing 13% of the total land area, most of which is forest habitat.

II. Fire Information

There are no firm statistics on the extent or type of forest fires in Lao. It is estimated that 90% of the forest fires originate from slash-and-burn cultivation practice of upland farmers. However, a distinction between fires due to careless shifting cultivation and forest fires is not made when these statistics are generated. Also, the area of mature forest that burns is not distinguished from the area of previously degraded shrub and grasslands that have been used for numerous previous cycles of shifting cultivation. Fires are more common during March, April and May during the hot and dry season.

The impact of war-caused forest fire is another key element in Lao PDR. During the Indochina War, much of the forest along the legendary Ho Chi Minh Trail, on the Lao–Viet Nam border, was bombed by United States forces. In 2000, natural resource surveys of the villages in and around Hin Namno NBCA in the Annamite Chain found that the forest is healthier now than it was immediately following the war because it has had time to recover. It is not known how much forest was permanently damaged by fire from bombs and by exfoliants used during the war. Forest fire management is not an important issue for the country, especially since the health and environmental problems associated with fire are minimal when compared with those in other countries in the region. The perceived importance of fire management is reflected in the structure of the Department of Forestry. Nowhere in the system, from district to province to the central office, is there an official whose sole purpose is fire management. However, at all these levels, there are officials who carry out fire management as one responsibility within a larger land management context.

A. Government

Present initiatives in Lao PDR related to forest fire management are primarily from government or donor-initiated projects and focus on fire prevention and preparedness. As forest fires are not seen as a major threat, few projects are based solely on forest fire management (except for the Cooperazione e Sviluppo [CESVI] project in

Sayabouri Province), but rather are part of larger forest management initiatives. Forest fire management can also be found in National Biodiversity Conservation Area (NBCA) management planning, in some development project initiatives where forest fires are considered a constraint, and in land-use planning, particularly at the village level.

Starting in 2000 Department of Forestry (DoF) officials increasingly asked NBCA managers to include forest fire management in their quarterly work plans. Plans for Hin Namno NBCA, for example, included discussing the dangers of forest fires when conducting land allocation or socio-economic surveys in villages around the protected area. Other NBCAs, such as SIDA funded projects at Phou Song He NBCA and Dong Hua Sao NBCA also encouraged fire management discussions with villagers when visiting villages for other development initiatives. Phou Hin Boun NBCA even has an entire chapter in its management plan devoted to forest fire management (Claridge, 2000). Though not specifically ordered by law or government decree, NBCA managers and external advisers have found that Department of Forestry officials encourage the following five items in NBCA management plans:

- Forest fire prevention; (particularly in the form of village visits and the purchase of tractors to build breaks and other infrastructure)
- Land and forest allocation;
- Forest inventories and boundary demarcation;
- Tree planting; and
- Community development (with an emphasis on stabilizing shifting agriculture).

There are several laws pertaining to land management that have relevance to how forests and fires are managed in the Laotian landscape (Table 6). Order 2094 is the only law directly related to forest fires. It first gives authority to Provincial Agriculture and Forestry Office (PAFO) and District Agriculture and Forestry Office (DAFO) officials to implement forest fire management activities, and then supports the involvement of local communities in forest fire management. NBCAs have the clearest mandate for forest fire protection, particularly in the form of Order 2094 and Decree 164, which declares no burning in NBCAs. More recently, there has been legislation drafted for the decentralization from the top levels of the Lao government. In March 2000, the Lao Prime Minister signed an instruction, which called for “a conscious effort to empower provincial and district authorities to achieve and defend a vision and to identify dynamic elements and to ensure coherence in their undertakings”. The plan would make villages, districts and provinces “the masters of their own development and destinies, by empowering the grassroots level to participate in their own socio-economic development, thus lessening their dependence on the central level” (London, 2003).

Table 6: Lao Government Laws related to forest fire management

| Laws | Key Provisions |
|--|---|
| <p>Decree of the Prime Minister No. 164, 29 October, 1993</p> <p>Decree of the Prime Minister No. 169, 1993</p> | <p>A. Established protected area system of Lao PDR, composed of 20 NBCAs</p> <p>B. Forbids burning or planting in protected areas (Article 4.7)</p> <p>A. Gives local people the right to use forest resources according to their customs and village regulations (customary rights)</p> <p>B. States measures will be taken against offenders who burn or destroy the forest</p> <p>C. Establishes Village Forestry Officers for the protection of the natural environment within each village (Article 50)</p> |
| <p>Order 54/Ministry of Agriculture and Forestry (MAF) on the Customary Rights and Use of Forest Resources, 7 March 1996; followed by recommendations 377/MAF on the Customary Use of Forest Resources</p> | <p>A. Secures legal right for local people to use forest resources for subsistence</p> <p>B. Limits customary rights that negatively affect collectives or individuals, or are not consistent with government policy such as “undifferentiated slash and burn” and forest fire for hunting</p> |
| <p>Forestry Law 1996 (Amendment to Decree 164)</p> | <p>A. States the prevention and control of forest fire is the responsibility of all people</p> <p>B. Gives PAFO and DAFO responsibility to educate local pole about the “serious danger of forest fire” and to “work out necessary rules and measures to prevent forest fire”</p> <p>C. In case of fire, DAFO and local community leaders should find or borrow equipment, vehicles and labor (which should be returned and compensate promptly)</p> <p>D. Individuals and organizations (including the army) should cooperate with authorities in case of fire</p> |
| <p>Order 2094/MAF on Fighting Forest Fires During the Dry Season of 1999- 2000, 31 December 1999</p> | <p>A. PAFO/DAFO responsibility to fight forest fires</p> <p>B. PAFO/DAFO responsibility to educate local communities about forest fires (including managing, putting out and reporting fires in their area)</p> <p>C. Staff should target areas of: shifting cultivation, poor soil, deforestation, at least 500 m away from streams</p> <p>D. Prohibits shifting cultivation in evergreen forests, NBCAs, watershed protection areas, forests on steep slopes which can cause landslides</p> <p>E. Advises PAFO/DAFO staff to tell local people:</p> <ul style="list-style-type: none"> - the proper technique for cutting before setting fires - to burn before sundown and when there is no wind <p>F. Prohibits burning trees, burning wild grass for hunting, littering cigarette butts, making campfires with out shelters, or leaving campfires without putting them out</p> |
| <p>Prime Minister Decree, Instruction No. 01/PM 11 March 2000</p> | <p>A. Implements country-wide decentralization</p> <p>B. Declares provinces as strategic units, districts as planning and budgeting units and villages as implementing units</p> |

London (2003)

A Lao government report (Bouaket 1999) summarizes the laws in Lao PDR (Table Six 6) and suggests the following plans to manage fire in Laos:

- Provide sustainable land-use and job opportunities for shifting cultivators
- Motivate the shifting cultivators to understand how to prevent, detect and control fires
- Prepare standard working groups and set up an organization for coordination of regional fire control organization or other government agencies
- Prepare materials/guidelines for forest fire prevention and suppression.
- From these suggested plans, it is obvious that forest fire management is on the agenda of the Lao government, though other issues of basic livelihood may be more pressing.

B. Private Sector

There is no information available on the private sector and its involvement in fire management in Lao PDR.

C. Civil Society

According to government reports, the forests of Lao PDR are under pressure by people lacking alternatives for meeting their livelihood needs other than shifting cultivation. The statistics of 1992 reveal that 277,000 families practiced shifting cultivation on 1.6 million hectares. In 1998 this number was reduced to 142,745 families and 132,500 hectares³. In 1999, the government plans to reduce shifting cultivation to 130,000 families on a total area of 128,000 hectares. In their Strategic Vision, the government of Lao (GoL) takes credit for reducing the area of shifting cultivation, but states that more than 100,000 hectares/yr are still burnt (DoF 2000).

Fires, which escaped from shifting cultivation to nearby forest, were recognized to cause more damage than the actual shifting cultivation fire, especially in the northern provinces (DoF 2000). This is probably because villagers have been using fire for centuries and know how to control it. When villagers in Luang Prabang Province were asked to identify threats to upland crops, they did not even mention fire, possibly an indicator swidden fires are under control.

Fire Data

There is currently no data available for fires in Lao PDR. The statistics kept on shifting cultivation estimate a yearly average of more than 100,000 hectares burned. However, it should be re-emphasized that these statistics do not differentiate between wanted and unwanted fires. A distinction between controlled shifting cultivation fires, fires due to careless shifting cultivation and unwanted forest fires needs to be

³ It is not clear how the number of families or the estimated area under cultivation were derived for these statistics. There may have been a change in definition of what is shifting cultivation. Regardless, the statistics between 1992 and 1998 are dramatic.

generated for these statistics to be useful to fire management. For example, escaped fires for hunting or clearing permanent agricultural plots may actually cause more damage than shifting cultivation, but currently these are all considered shifting cultivation fires. More research needs to be conducted before any cause and effect can be determined.

Discussion

The Lao PDR Government policies of decentralization and land allocation, which encourages *participatory* land management, have a similar potential to what is being seen in Vietnam. That is, the recognized right to manage fire and administer fire management at the village level. Since it has already committed itself to developing local community participation, the development of community-based fire management (CBFiM) strategies will be one necessary component of the Laotian decentralized approach. Incorporating CBFiM into forest management will require sincere commitment from all stakeholders, particularly the Lao Government, the donor community and the local people involved. Fortunately, many of the key elements necessary for establishing CBFiM in Lao PDR already exist or are in the process of being established. Strategies should be encouraged that incorporate existing government law, support indigenous knowledge and clearly explain why forest fire management is necessary. More research is needed about the implications of Lao Government policy for CBFiM, the indigenous usage of fire, fire ecology and the overall impact and extent of forest fires in Lao PDR.

Malaysia

I. Background

Malaysia was created in 1963 through the merging of Malaya (independent in 1957) and the former British Singapore, both of which formed West Malaysia, and Sabah and Sarawak in north Borneo, which composed East Malaysia. The first three years of independence were marred by hostilities with Indonesia. Singapore separated from the union in 1965.

Malaysia is a tropical country, which comprises Peninsular Malaysia, Sabah and Sarawak. Malaysia has a total land area of 33 million hectares. The population in 2001 was 22 million. At that time, the population was comprised of Malay and other indigenous 58%, Chinese 27%, Indian 8%, and others 7%. The population growth rate in 2001 was 1.96%. The major religions in the country are: Islam, Buddhism, Daoism, Hinduism, Christianity, Sikhism and Shamanism is practiced in East Malaysia. Peninsular Malaysia consists of eleven states and the federal territory of Kuala Lumpur. 79 percent of the population is located in Peninsular Malaysia.

The climate of Malaysia is typically humid tropical or wet equatorial and is characterized by year round high temperatures and seasonally heavy rain, especially during the North-east Monsoon from October/November to February/March. The mean temperatures during the day and night are 32°C and 22°C respectively. The average rainfall is about 2,540 mm per year with a maximum of 5,080 mm and a minimum of 1,650 mm. Humidity is always high and ranges from 70% to 98%. Skies are mostly cloudy throughout the day, especially during the monsoon season.

The Malaysian GDP grew at 8.6% in 2000, mainly on the strength of double-digit export growth and continued government fiscal stimulus. As an oil exporter, Malaysia also benefited from higher petroleum prices. An economic slowdown in key Western markets, especially the United States, and lower world demand for electronics products has slowed GDP growth to 3%-6%. The forestry sector remains an important sector with significant contribution to the socio-economic development of the country. The total exports of timber and timber products is the third highest among commodities after petroleum oil and palm oil products.

Malaysia is one of the few remaining heavily forested countries with 20.06 million hectares of natural forest (61 percent of the total land area). 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).

Of the total forest area 5.97 million hectares are in Peninsular Malaysia, 4.25 million in Sabah and 9.84 in Sarawak (Table 7). In addition to natural and plantation forest, Malaysia has another 5.27 million hectares of agricultural tree crops, mainly rubber, oil palm and cocoa. These tree crops, particularly rubber trees, are of increasing importance as alternative sources of raw material and vegetation cover. If these areas are taken into account, forest cover in Malaysia is 25.33 million hectares or 77 percent of the total land area.

Table 7: Malaysian forest cover by region 2001

| Region | Area (millions hectares) | | | | Forest Area as % of land area |
|---------------------|--------------------------|----------------|-------------------|-------------------|-------------------------------|
| | Land Area | Natural Forest | Plantation forest | Total forest Area | |
| Peninsular Malaysia | 13.16 | 5.90 | 0.07 | 5.97 | 45.40 |
| Sabah | 7.40 | 4.10 | 0.15 | 4.25 | 57.40 |
| Sarawak | 12.44 | 9.81 | 0.03 | 9.84 | 79.10 |
| Malaysia | 33.00 | 19.81 | 0.25 | 20.06 | 60.80 |

Source: FAO (2002)

II. Fire Information

Most of the forest fires in Malaysia take place during the prolonged dry spells between the months of January to March, and June to August. The first period corresponds to the season in which the north-east monsoon dominates while the second period is in the middle of the south-west monsoon season. 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. As with other parts of the region, the majority of fires are caused by human activities and negligence. There are more reports of fires in Sabah than Peninsular Malaysia. There is a fairly good record of fires since the early 1990s (Table 8). Prior to that, very few of the fires in Malaysia were documented.

Table 8: Summary of Forest Fire Events in Peninsular Malaysia (1992-1998)

| Year | Location | Forest Type | Area (hectares) | Probable Causes |
|--------------|------------|-------------------|--------------------|-----------------------------------|
| 1992 | Terengganu | Forest plantation | 265 | Land clearing by farmers |
| | Johor | Forest plantation | 3 | Unidentified |
| | Selangor | Forest plantation | 10 | Maintenance of transmission lines |
| | | Forest plantation | 16 | Land clearing by farmers |
| 1994 | Perak | Forest plantation | 333 | Land clearing by farmers |
| 1995 | Selangor | Peat swamp forest | 155 | -do- |
| | Perak | Secondary forest | 24 | cigarettes |
| 1996 | Perak | Natural forest | 22 | Land clearing by farmers |
| 1997 | Pahang | Natural forest | 202 | Land clearing by farmers |
| | | Peat swamp forest | 202 | Land clearing by farmers |
| Total | | | 1,232 | |

Source: Adapted from (Thai 2000)

The threat of forest fires in Sabah and Sarawak is more serious than Peninsular Malaysia. In Sabah, about 1 million hectares of secondary forests were burnt between 1983 and 1985 (Thai 2000). Most of the documented fires were caused by negligence or misuse. The fires in Sarawak tended to be confined to plantations, and are started mainly from agricultural activities in adjoining farms. There are minimal occurrences in the natural forests (Thai 2000).

In Malaysia negligence and agricultural activities are considered to be the most important causes of fire (Hassan & Manila 1997). According to a recent report (Bin Tambi 2002) there is no recorded evidence to show that there has been a lightning caused fire in Malaysia. All sources of fire are either human caused or instances of carelessness. According to this report, the most likely causes are: open burning to clear land for agriculture, clearing for cultivation in peat forests, cigarette stubs, and campfires by anglers and game hunters.

The overall impacts of fires in Malaysia can be quite large. According to the Economy and Environment Program for Southeast Asia (EEPSEA) study, the estimated incremental cost of the haze damage, most of which was transboundary smoke from neighboring countries during the months of August to October in 1997 was USD 214 million or RM 816 million (Table 9).

The largest component is the productivity losses during the declaration of a 10-day state of emergency in Sarawak. The health impacts contributed only 4.4 percent (Mohd Shahwahid & Jamal 1999).

Table 9: Aggregate incremental costs of the damage caused by smoke/haze in 1997

| Type of Damages ⁽¹⁾ | US \$ Million | RM Million | Percentage |
|--|---------------|---------------|---------------|
| Adjusted cost of illness | 9.51 | 36.16 | 4.43 |
| Productivity loss during the emergency | 103.54 | 393.51 | 48.19 |
| Tourist arrival decline | 83.82 | 318.55 | 39.02 |
| Flight cancellations | 0.12 | 0.45 | 0.06 |
| Fish landing decline ⁽²⁾ | 10.71 | 40.72 | 4.99 |
| Cost of fire fighting | 6.58 | 25.00 | 3.06 |
| Cloud seeding | 0.55 | 2.08 | 0.25 |
| Total | 214.83 | 816.47 | 100.00 |

Source: Adapted from Mohd Shahwahid & Jamal (1999)

(1) Cost to Malaysian multinational companies (MNCs) of RM 2.5 million is not included as this amount might have been used by the Government to pay for various expenditures.

(2) Only declining consumer surplus is taken into account as the gain in producer surplus is not a cost.

A. Government

After the 1997/1998 fires and resultant haze, the Malaysian government proposed a National Contingency Plan to Combat Forest and Plantation Fire in Malaysia with the following objectives:

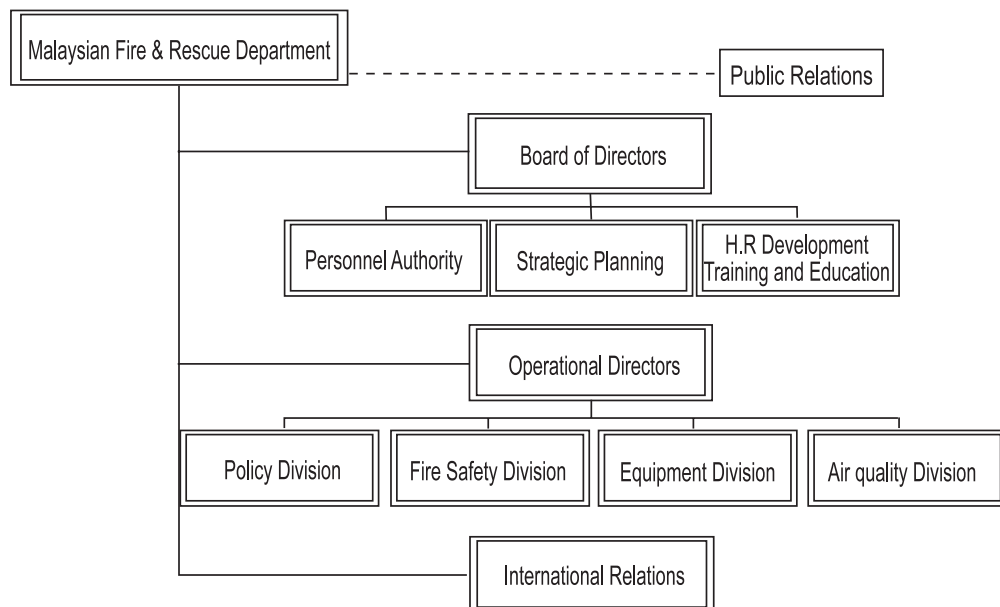
- Establish an immediate and coordinated response system on forest plantation fire in Malaysia;
- Enhance response with the existing resources in terms of equipment, manpower and training;
- Alleviate or minimize adverse impact on the environment resulting from forest plantation fire; and
- Establish an early warning system to alert authorities at national and regional levels.

In 1998, the Malaysian government also directed the National Disaster Coordinating Committee to include forest fire under its jurisdiction in addition to its existing responsibilities for flood, urban fires and other natural disasters. A Standard Operating Procedure (SOP) for forest and plantation fires was also formulated in line with the Malaysian National Haze Action Plan, which is a component of the ASEAN Regional Haze Action Plan. The SOP provides guidelines for the responsibilities and chain of command in response to large-scale forest fires for various government agencies.

The Fire and Rescue Department of Malaysia (FRDM) is the primary agency responsible for combating all kinds of fire including forest fires. However, during the combating of forest fires the agency is assisted by other relevant agencies such as the Forestry Department, National Security Division, Royal Police Malaysia, Armed Forces, the Forestry Department, Wildlife and National Parks Department, Drainage and Irrigation Department, and the local town councils. The responsibility for preventing and combating forest fires is thus shared by these various agencies under the Environmental Quality Act (EQA) 1974, which was amended in 2000 to ensure that Malaysia’s zero burning policy is implemented. The provisions of this Act include imposing maximum fines of USD 131,561.64 (RM 500,000) and five year imprisonment. Neither the Forestry law nor the EQA have provisions to reward any person for assisting the authorities or offering information on occurrences of forest fires or open burning. Interestingly enough, the EQA amendment in 2000 also abolished the Department of Environment’s powers to issue licenses for burning and provided a specific list of authorized prescribed activities for open burning.

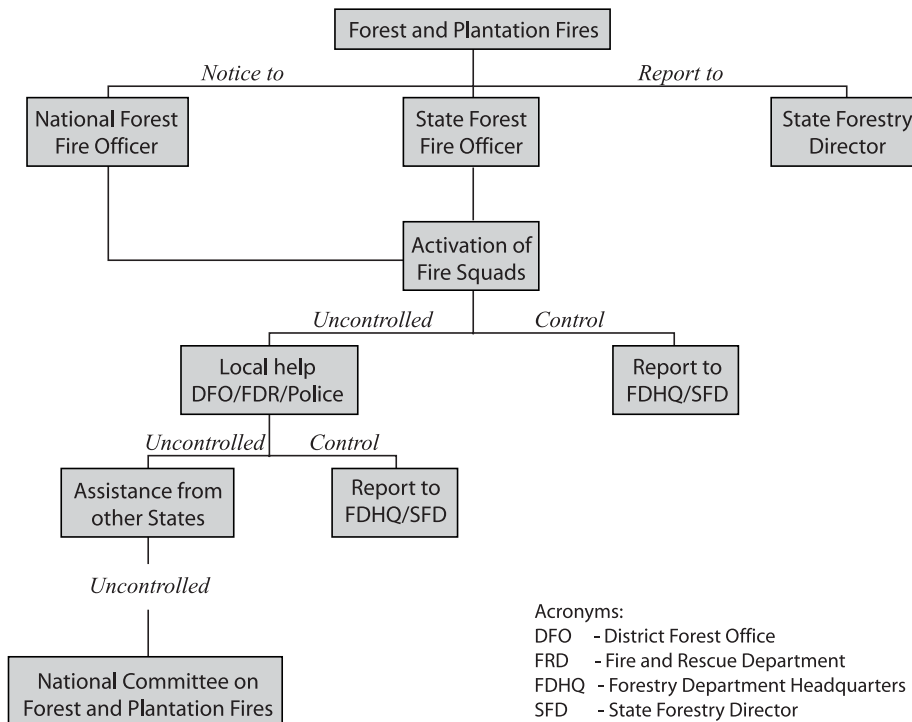
The structure of the Fire and Rescue Department and the forest fire management operational chain of command are given in Figure 4 and Figure 5. As one can see from Figure 5, there is an intricate jurisdictional balancing act between the Forestry Department (and its responsibility under the National Forest Act of 1984), the Fire and Rescue Department and State and District Forestry Offices depending on whether a fire is perceived as controlled or uncontrolled.

Figure 4: Fire Management Structure of Malaysia’s Fire & Rescue Department



Source: Translated and Adapted from Fire and Rescue Department website

Figure 5: Forest fire management organization in Malaysia



Source: Wan M. Shukri Wan Ahmad (2001)

The FRDM is in the process of developing and introducing new programs in line with advancement of technology and need for increased levels of safety. Greater emphasis is being placed on performance based design principals and review of standards to circumvent some missing ingredients of fire safety legislation.

The 8th Malaysian 5-year (2001-2005) plan outlines the Government’s major programs and project spending for FRDM’s procurement requirements for fire prevention and fire fighting. These are:

- 240.9 million USD for the development of new fire stations and facilities in strategic locations, upgrading of existing amenities, procurement of more specialized equipment, training of multi-skilled personnel and relevant research and development;
- Completion and equipping of the Fire and Rescue Academy with the latest technology and sophisticated fire and rescue training simulation system;
- Build additional operating bases for the Air Unit in strategic locations for countrywide coverage;
- Expand the installation of the Integrated Command and Control System in fire and emergency services in all major towns;
- Intensify R&D activities with the development of a R&D center for fire safety and fire engineering; and
- Enhance the awareness of the general public and owners of residential, commercial and industrial premises on fire safety, particularly requirements and preventive measures.

The Malaysian Center for Remote Sensing has also initiated a Total Forest Fire Management Plan (TFFMP), which utilizes remote sensing and GIS technologies to assist the relevant authority to manage the disaster. The general objective of TFFMP is to provide an operational system for an integrated management of forest fires and haze. TFFMP consists of three major components: Early Warning, Detection and Monitoring and Mitigation Measures. This center's fire information system for Malaysia is designed to feed into regional plans for a comprehensive ASEAN early warning system, which includes prediction and detection of fire and haze using remote sensing and ground monitoring technologies and mechanisms.

B. Private Sector

In April 1999, ASEAN adopted a "zero-burning" policy and urged all ASEAN Member Countries to implement the necessary laws and regulations to enforce this major decision. Following this, ASEAN convened a number of dialogue sessions with plantation companies as part of the effort to promote the zero burning policy among plantation owners and timber concessionaires.

ASEAN has encouraged the private sector, especially plantation companies to undertake voluntary initiatives to control fires. Malaysia has held dialogue sessions with their respective plantation companies to provide more information on zero burning policies and practices. Recognizing that successful examples of plantation companies practicing zero-burn mechanical land clearance have not been well documented, ASEAN, led by Malaysia, has recently developed guidelines for the implementation of the policy on zero burning.

C. Civil Society

According to the Director of the FRDM, the awareness among the public, especially in rural areas, on the dangers of open burning during dry periods is lacking. People are not aware that using burning to facilitate land preparation for agriculture can be extremely dangerous to the nation. The Director has recommended that these farmers consult with the FRDM before any burning is undertaken, especially during the dry periods.

In a recent report (Wan M. Shukri Wan Ahmad 2001), it was also found that the public is more concerned with haze than the destruction of forests by fires. If forests could be burned without causing too much haze in the economic centers of the region, then the outcry would have been far smaller. This is the perception of the urban portion of civil society. Since Malaysia is heavily forested and heavily dependant on forest resources and tree crops, one can speculate that the use of fire is perceived as less detrimental to the interests of rural civil society.

The National Forestry Act does not assign responsibility for forest fire prevention and control to people living in the forests. The private sector, particularly plantation owners and developers are not legally responsible for ensuring that their land clearance burning does not cause forest fires. This act reinforces that forest fire management is the sole responsibility of the government.

Fire Data

At the wrap-up session of the Global Observation of the Forest Cover (GOFC) - Fire S.E. Asia Regional Workshop on January 24, 2003 an on-line fire information system was proposed for both Sabah and Sarawak. This online system would include daily fire data valuable to the operational users. This system envisions daily reports containing fire hazard maps and hot spot imagery could be generated for Sarawak. Although this system has been proposed there is no indication that it is being applied to date.

In 1997, four incidences of forest fire, with a total burnt area of 425.27 hectares, were reported in Peninsular Malaysia (data for Sabah and Sarawak not yet available). Of the total area, 21.5 hectares was under plantation, while the remaining 404.77 hectares was in natural forests. Compared to the hectares of area affected by fire since 1992, 1997 was the most severe fire season (Table 10). The latest fire statistics in the literature (Bin Tambi 2002) are from 2000 and 2001 documenting the number of emergency calls to the Fire and Rescue Department (Table 11). Malaysian government officials in February 2002 reported that fires have burnt more than 15,000 hectares (37,000 acres) of land (Nampa-Reuters, Sunday, March 10, 2002).

Table 10: Total burned area recorded in Peninsular Malaysia (1992-1997).

| Year | Area Burned (hectares) |
|--------------|------------------------|
| 1992 | 294 |
| 1993 | None |
| 1994 | 333 |
| 1995 | 155 |
| 1996 | 24.3 |
| 1997 | 426.3 |
| Total | 1232.57 |

Source: Ahmad Ainuddin Nuruddin (1998)

Table 11: *Emergency Calls to Malaysia's Fire and Rescue Department in 2000 and 2001*

| Year | Total Fire Calls | Forest, Bush, Scrub and Lalang Fire Calls | Percentage |
|------|------------------|---|------------|
| 2000 | 15,445 | 6,045 | 39.1 |
| 2001 | 15419 | 6,560 | 42.5 |

Source: Bin Tambi (2002)

Discussion

Malaysia is in a position to lead its ASEAN neighboring countries in the development of guidelines for the implementation of the policy on zero burning and for a comprehensive ASEAN early warning system. Both of these developments are important contributions to a more concerted and collaborative effort to manage fire (i.e. haze) across the region.

The oil palm industry in Malaysia is under pressure to achieve zero burning in their land clearing operations since amendment of the EQA 1974 effectively banning open burning on vast plantation areas. The zero burning policy applied by the Malaysian government is not literal since exemptions allow open burning. The amendment however, places a complete ban on burning on any peat soil area.

Understanding that the zero burning policy does not address the need to recognize the potential beneficial applications of fire, the government made necessary amendments to its EQA in 2000. The government's recognition that zero burning is unrealistic demonstrates its willingness to evaluate the social implications of a complete ban. The amendments to EQA 1974 give 15 specific instances where authorized prescribed activities for open burning are allowed. These include the burning of diseased and noxious plants, agricultural residues, paddy stalks, sugar canes leaves, and for reforestation.

In the next planning period from 2001-2005, fire management in Malaysia is receiving a substantial budgetary increase. The government's planned investment of 240.9 million USD for the development of new fire stations, facilities equipment, training and R & D is large in proportion to the economy. Such expenditure may set a precedent for the fire management system to rely on fire suppression equipment and fire fighting training when the core issues are social and need to be address with land-use planning.

Myanmar

I. Background

Britain annexed what was then called Burma in the course of three wars: the first in 1824 (when Rakhaine, Taninthayi, Assam and Manipur were taken), the second in 1852 (Lower Burma including Pegu and Yangon) and the last in 1886 (when all Burma became a province of British India). During World War II, Japan occupied Myanmar from 1941 until 1945. On 4 January 1948, Myanmar received independence from Britain. In March 1962, a military-led Revolutionary Council led the country to “the Burmese Way to Socialism”. In 1991, the official name of the country was changed from Burma to the “Union of Myanmar”.

Myanmar is a country rich in culture, traditions and natural resources. Its population is estimated at just over 44 million and population growth is 1.8 percent. According to government publications, Myanmar is inhabited by many ethnic nationalities, as many as 135 national groups with Bamas (ethnic Burmans) forming the largest group - comprising 70 % of the population. The remaining population is comprised of Shan 9%, Karen 7%, Rakhine 4%, Chinese 3%, Mon 2%, Indian 2%, and other 3%. Only 25 % of the population live in urban areas.

The country is endowed with substantial arable land, an expansive coastline, mineral resources (tin, tungsten, lead, zinc, copper, silver and gems), and commercially viable gas deposits. In addition, the country is the world’s prime supplier of natural teak (*Tectona grandis*), which is one of the pillars of the country’s economy and may remain so for years to come. Myanmar has a mixed economy with private investments dominant in agriculture, light industry, and transport, and with substantial state-controlled activity, mainly in energy, timber, heavy industry, and rice trade.

Myanmar is the largest country in mainland Southeast Asia, with a total land area of 676,553 km². Myanmar is divided into seven states and seven divisions based on the geography, administrative character and the density of ethnic minorities. Each of the 14 regions is controlled by a State Peace and Development Committee (SPDC) chaired by a military commander. There are 320 townships, administered by states and divisions. Some small towns are placed under the administration of nearby townships. The village tract is the lowest government administrative structure in rural areas and three, four or more nearby villages are clustered to become a village tract. Villages are administered by Local Peace and Development Committees composed of three locally elected members, unpaid, and a clerk appointed and paid a salary by the township authorities.

The country’s length from North to South is approximately 2090 km; and the width is up to 805 km. The country has four important river systems, flowing in the north-south direction, of which the Ayeyawady River, the main waterway, is navigable for about 1,450 km. Myanmar possesses a broad spectrum of ecosystems, ranging from snow-capped peaks to tropical rain forests, the semi-arid belt and coastal marine ecosystems. It has a total coastline of about 2,832 km.

Myanmar possesses several variant climatic zones. Its climate is influenced by the seasonal Southwest Monsoon with three distinct seasons: the Hot Season from mid-February to mid-May; the Rainy Season from mid-May to mid-October; and the Cool Season from mid-October to mid-February. The country's mean temperature ranges from 32° C in the Coastal and Delta areas and 21° C in the inland lowland areas. Maximum temperatures reach up to 40° C in the central Dry Zone during the peak Hot Season. Annual rainfall ranges from 500 mm to 1000 mm in the central part of the country, to 5000 mm and above in the coastal and wetter regions. The highest precipitation is during July to September, with the monsoon tailing off around mid-October. Rainfall does occur occasionally in November, as fall-out from storms that come in from the East. Myanmar does not receive rainfall all the year round. It has instead a wet period that lasts for about five months and a dry spell for the remaining seven months.

Influenced by a wide range of latitudes, topography and climatic factors, the forests are diverse and vary in composition and structure; and constitute invaluable ecosystems that conserve a wide range of plant and animal species, genes and micro-organisms. The forested area is about 344,237 km² or 50.87% of the total land area, of which 43.34% comprises closed forests and 7.53% degraded forests. The remaining 49.13 % comprises 22.82% forests affected by shifting cultivation, 2.01 % water bodies and 24.30% non-forested areas. Of the forested area, 16% is Tropical Evergreen, 26% Hill and Temperate Evergreen, 34% Lower Mixed and Moist Upper Mixed Deciduous, 10% Dry, 5% Deciduous Dipterocarp, 5% Dry Upper Mixed Deciduous and 4% Tidal, Beach and Dune Type forests. Forested areas are predominantly natural.

I. Fire Information

Myanmar has traditionally placed more attention on prevention than suppression of forest fires. The government has understood the incidence and effects of forest fires on the vegetation vary with forest types and climatic conditions. It is widely acknowledged, and recorded in the literature, 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. However dry forests also need effective fire protection. The priority focus of Myanmar's fire management has been on monitoring combustible fuel, normally reduced by prescribed burning in situations where surface fires had not consumed them.

The forests of Myanmar are mainly tropical evergreen, hence the forest floor is naturally damp and the undergrowth moist and green. The litter fall each year is either consumed by annual surface fires or decomposed by the moist conditions. Therefore, fuel loads do not accumulate enough to pose a threat and the annual fires are usually slowly running surface fires causing little to no adverse impact to soil or forests.

The forest fires that do occur are mostly localized and the fuel conditions are such that fires tend to burn into moister surroundings. It has recently been recognized that

climate change and abnormal climatic occurrences could bring about changes to the forest and change the intensity of fires in Myanmar. The Forest Divisions have recently been instructed to conduct detailed inventories of their forests, so that forest management and Fire Conservancy Operations can be reappraised and redesigned to suit prevailing situations.

A. Government

There are government structures for fighting fire for both the urban and the rural context. Since the late 1880s, it has been decreed that the Forest Department was obligated to liaise with local government, now the Local Peace and Development Committees, in order to coordinate Forest Fire Prevention Instructions for compliance by forest officers. Based on those instructions, the Local Peace and Development Committees issue general instructions for officials from other ministries to comply with, and support the Forest Department's efforts at fire protection.

Since 1944, when the Control of Fire Conservancy Operations was published and formed the basis for future Fire Protection Measures, forest officials in Myanmar were held responsible for the prevention of fires in the fire-protected areas within their domain. They were also to be directly responsible for fires that encroached from adjoining areas and were obligated to construct fire lines and defensible zone as necessary.

A new Forest Law was enacted in 1992. This law has provisions for fire protection, prevention and suppression measures in natural forests. Section 40 of the Act prohibits the 'kindling, keeping and carrying any fire, or leaving any fire burning which may set fire to the forest in a reserved forest'. In addition, Section 42 states that whoever causes injury to any tree in a forest reserve will be fined the maximum of \$ 3,278.69 [Kyat 20,000] (6.10 kyat to USD 1) or a 2-year imprisonment. This new law sets out Departmental instructions and jurisdictions for the protection of tree plantations against fires and also covers community forestry and public participation in forest management. Shortly after its enactment, Forest Conservation Committees were formed at the National, State/Division, District and Township levels, thus involving the related ministries, the Chairmen of the State/ Division, District and Township Administrative bodies as well as the local military commanders in forest management and forest fire conservancy responsibilities. In 1996-97, a new directorate called the Dry Zone Regreening Department was formed and it is to be solely responsible for the rehabilitation of once forested areas of the Central Dry Zone, and fire protection measures.

In what appears to function under more urban context and mandates, the Fire Services Department (FSD) was formed under the Ministry of Social Welfare, Relief and Resettlement. This Ministry was established in 1953 and since then, more social welfare activities are being expanded and undertaken by the governmental sector, in close collaboration with non-governmental organizations. The Ministry is also responsible for rendering relief and resettlement services to victims of natural disasters such as earthquakes, storms, floods and fire disasters. The Central Committee for Natural Disasters Prevention, Relief and Resettlement is systematically implementing disaster preparedness and protective measures.

The organizational set-up of FSD was extended personnel to participate more in social activities in addition to their normal tasks. The fire brigade law was enacted in accord with the developing and changing national situation and articulated three objectives:

- 1) to safeguard the lives and property of the nation's population from the danger of fires,
- 2) to cooperate with the national races and other organizations in saving the people and the nation from the dangers of natural disasters
- 3) to become the reserve force for ensuring peace and stability in the nation.

A Central Fire Services Training School was established to train FSD personnel to be skilled in advanced fire fighting techniques. FSD now has a strength of 3,403 Fire Brigade members and 131,765 Auxiliary Fire Brigade members. There are now 217 fire stations and 328 auxiliary fire stations in the entire nation.

Recently, the Secretary State Peace and Development Council Lt-Gen Khin Nyunt urged that the FSD strive to become a reserve force for maintaining the national peace and stability including performing activities;

- to enhance the organization of auxiliary fire brigades in accord with the five principles and policies and seven tasks of the Fire Brigade in safeguarding the lives and property of the people;
- to strive to win the love of the people by safeguarding and maintaining the already achieved national peace and stability and progress by rendering assistance to the people;
- to unitedly ward off all the dangers of destructive elements who want to destroy the nation and the Union together with other reserve forces for national peace and stability.

To date, it is unclear how these different Departments are coordinated for a national fire management program in both rural and urban contexts.

B. Private Sector

All forest estates, apart from those on private lands and community forests, are owned by the State, Forest Fire Brigades are not organized by the private sector as is the case in many countries; but protection measures are instead undertaken solely by the Forest Department, in cooperation with other ministerial departments and the local people.

C. Civil Society

Fire management in Myanmar greatly benefits from the awareness and willingness of civil society to take part. Foresters have been instructed to do their utmost to win the support of the local people. According to some reports this entails; refraining from restricting the people unnecessarily, or obstructing people from going into the forest to harvest non-timber forest products. It also means avoiding any action that would cause the people to want to harm the forests and to work with people to understand the multiple benefits that can be accrued from the forests. In situations where Divisional Forest Officials feel that certain rules laid down are too stringent, they are obligated to report their observations to their superiors in writing.

People who live in and/or surrounding Reserve Forests are asked to report incidences of forest fires and to suppress any fires so that the fires do not spread into the Reserve areas. People who have permits to earn a livelihood within the forests, or practice shifting-cultivation (Taungya) are likewise responsible. In the event that any of the above individuals are found to be responsible for causing fires for any reason, they are likely to have their permits revoked.

Finally, it is clearly stated that any responsible persons found lacking in their duties can be legally prosecuted.

Fire Data

There is currently very little data available for fires in Myanmar. The data that is available is from the time frame 1985 to 1994 primarily on the impacts of fire. The following two tables (Tables 12 and 13) summarize the causes of fires and the loss of life and property in Myanmar. These statistics have been adapted from the Fire Service Department (Myanmar Data on Internet 1995).

Table 12: Loss of Life and Property Due to Fires by Year in Myanmar

| Year | Total # of fires | Causes of Fires | | | | |
|------|------------------|-------------------------|----------------|--------|------------|--------|
| | | Accident and negligence | Natural causes | Arsons | Insurgency | Others |
| 1985 | 1255 | 996 | 136 | 57 | 10 | 56 |
| 1986 | 1281 | 1021 | 126 | 80 | 8 | 46 |
| 1987 | 1243 | 1035 | 107 | 66 | 19 | 16 |
| 1988 | 1187 | 924 | 110 | 129 | 9 | 15 |
| 1989 | 1394 | 1149 | 145 | 84 | 10 | 6 |
| 1990 | 1519 | 1303 | 115 | 85 | 6 | 10 |
| 1991 | 1815 | 1541 | 162 | 94 | 7 | 11 |
| 1992 | 1620 | 1370 | 142 | 71 | 17 | 20 |
| 1993 | 1464 | 1282 | 92 | 83 | 3 | 4 |
| 1994 | 1272 | 1087 | 105 | 75 | - | 5 |

Source: Myanmar Data on Internet 1995

Table 13: *Loss of Property and Life Due to Fire in Myanmar and the Estimated Loss in Kyat (6.10 kyat to USD 1)*

| Year | Loss of Life and Property | | | | | | Estimated Loss in USD [Kyat](both in millions) |
|------|---------------------------|---------|--------------|-----------|------------------|---------|--|
| | # of Persons | | # of Animals | Buildings | | | |
| | Dead | Wounded | | Residence | Office / Factory | Godowns | |
| 1985 | 29 | 33 | 11977 | 7884 | 36 | 64 | 177.12 [1080.43] |
| 1986 | 19 | 44 | 5078 | 11471 | 21 | 38 | 502.92 [3067.81] |
| 1987 | 37 | 78 | 3564 | 5820 | 46 | 24 | 155.07 [945.95] |
| 1988 | 168 | 118 | 11020 | 12541 | 25 | 103 | 446.17 [2721.62] |
| 1989 | 65 | 63 | 8609 | 13259 | 34 | 49 | 1056.43 [6444.23] |
| 1990 | 36 | 84 | 2951 | 8377 | 40 | 88 | 341.64 [2084.03] |
| 1991 | 47 | 43 | 9564 | 16711 | 56 | 120 | 130.44 [795.67] |
| 1992 | 44 | 95 | 13948 | 12004 | 34 | 50 | 403.97 [2464.22] |
| 1993 | 46 | 82 | 3189 | 11811 | 61 | 42 | 529.1 [3227.51] |
| 1994 | 40 | 71 | 5094 | 8089 | 96 | 49 | 337.12 [2056.41] |

Source: Myanmar Data on Internet 1995

The local term “godowns” is used to describe agricultural plots. A distinction between controlled shifting cultivation fires, fires due to careless shifting cultivation and unwanted forest fires needs to be generated for these statistics to be useful to fire management. Table 14 depicts the four major natural disasters and their relative frequency and impact on the people of Myanmar over the last century.

Table 14: Natural disasters and their impacts on the people of Myanmar over the last century (1901 - 2000)

| DisTypes | Count of DisNo | Sum of Killed | Sum of Injured | Sum of Homeless | Sum of Affected | Sum of TotAff | Sum of DamageUS\$ ('000s) |
|------------|----------------|---------------|----------------|-----------------|-----------------|---------------|---------------------------|
| Earthquake | 6 | 1,342 | 136 | 0 | 160 | 136 | 37,100 |
| Epidemic | 2 | 10 | | | 800 | 800 | |
| Flood | 12 | 317 | 0 | 313,739 | 1,901,528 | 2,197,697 | 553,915 |
| Wild fire | 2 | 8 | | 20,000 | 58,588 | 78,588 | 11,000 |
| Wind storm | 14 | 5,982 | 200 | 274,200 | 896,289 | 1,170,689 | 21,700 |

Source: Myanmar Data on Internet 1995

Discussion

Myanmar appears to have a strong administrative structure for managing fires in both rural and urban settings. The structure of the Fire Services Department and the Forest Department through its liaisons with the Local Peace and Development Committees are well situated to manage fires within both settings and at multiple scales (Local, Division, District and Township). These structures have strong support from the local people. The functionality of this fire management system is complimented by its mandate to protect its citizens' lives and livelihoods and an apparent awareness of fire's role on the landscape. From the early 1930's, foresters recognized the importance of fire to maintain "the Teak in the moist forests of Burma" (U Myat Thinn 1999). Public awareness campaigns are carried out during the height of the fire season (from mid-January to mid-May) through various media. As a result, local involvement takes place in fire monitoring as well as in various pre-emptive activities such as construction of fire lines and fire traces, prescribed burning, and so on. These locally initiated fire management systems may be very old and Myanmar would therefore be of particular interest to anyone studying community-based fire management.

Although fires are not considered a serious threat to Myanmar's economic interests, Table 14 above indicates that Myanmar has suffered two serious fire events. One of these fires took place on March 24, 1984 in Mandalay. UNDRO and UNDP monitored the situation and reported that over 2,700 houses were destroyed, rendering 23,250 people homeless. Loss of property was estimated at 33 million US dollars for this event. The local estimates of economic losses from this event were much lower (Table 13). Regardless of the estimate that one chooses for the monetary impact of fire, of the five natural disasters facing Myanmar fire is placed relatively low on the list of losses. This would indicate that Myanmar's Central Committee for Natural Disasters Prevention, Relief and Resettlement will allocate more attention and resources to these other more hazardous events when designing and implementing disaster preparedness and protection measures.

Philippines

I. Background

The Philippines were ceded by Spain to the US in 1898 following the Spanish-American War. They attained their independence in 1946 after being occupied by the Japanese in World War II. The 21-year rule of Ferdinand Marcos ended in 1986 when a widespread popular rebellion forced him into exile. The Philippines has had two electoral presidential transitions since Marcos' removal by "people power".

The Philippines has a total land area of 29.817 million hectares. The agricultural sector plays a dominant role in the economy of the country. The terrain is mostly mountainous with narrow to extensive coastal lowlands. The country is administered through 72 provinces and 61 chartered cities. The Philippines is home to ten major cultural groups and many ethnic minority groups. The population of the Philippines in 1998 was 78 million.

The climate is tropical marine; northeast monsoon (November to April); southwest monsoon (May to October). The country can be split into four climatic zones by the relative distribution of precipitation: 1) six months dry and six months wet; 2) no definite dry season, wet from November to January; 3) dry from November to April, wet during the rest of the year; and 4) rainfall evenly distributed throughout the year.

Forests are regarded as an important resource for development in the Philippines. Its vast expanse provides a vital economic base for a large portion of the population. It is also home to a wide range of flora and fauna, provides raw material for forest based industries and furnishes the people and the economy of the Philippines with recreation areas, ecotourism opportunities and a host of other associated benefits. As a result of the government's conservation policy, the Philippines is now a net importer of wood products, having previously an export - oriented forestry sector for many years (FAO 2002).

As of 2000, forestlands in the Philippines comprised 15.8 million hectares or 53 percent of the total land area (29.8 million hectares). The latest statistics estimate the country's forest area at 8.93 million hectares or roughly 30 percent of the total land base (FAO 2002). Table 15 shows the latest breakdown of the national forest area by forest type.

Table 15: Philippines' Forest Types, Area Covered and Percentage of Total Land Area

| Forest Type | Area (hectares in millions) | Percentage of Total Land Cover |
|---------------------|-----------------------------|--------------------------------|
| Dipterocarp forest | 3.54 | 11.87 |
| Old growth | 0.80 | 2.68 |
| Secondary | 2.74 | 9.19 |
| Pine forest | 0.23 | 0.77 |
| Mangrove forest | 0.11 | 0.37 |
| Mossy forest | 1.04 | 3.49 |
| Sub marginal forest | 0.47 | 1.58 |
| TOTALS | 8.93 | 29.95 |

Source: FAO (2002)

II. Fire Information

Fire is considered a serious problem that threatens the few remaining forests of the Philippines. From 1993 to 1997 showed that fires impacted almost 50% of the forest types, averaging 7,800 hectares annually (Pajarillaga and Lansigan 2000)⁴. According to a report by Igso (1999), the causes of forest decline are kaingin, or shifting cultivation, forest fires, illegal encroachment and squatting, conversion to other uses, clearing in the process of logging, pests and diseases. Humans have caused most of the reported forest fires, either intentionally for economic gains such as kaingin, charcoal production, etc., or unintentionally through negligence or carelessness.

Prior to massive land-use changes (1960s-1970s), fire protection efforts were concentrated in the pine forests, predominantly in *Pinus kesiya* and *Pinus merkusii* stands. These pine forests are regarded as the most fire-prone forest ecosystems in the Philippines, although grasslands, plantations and agricultural areas are also vulnerable. Large fires in the pine forest often burn for weeks and are difficult to control due to the rugged mountainous terrain, lack of appropriate equipment and the unavailability of trained manpower.

The montane “mossy forest” stretching above the pine forest belt is not usually prone to fire. Regular burning of the pine forests in the lower slopes is slowly reducing the mossy forest area at its edges, causing the intrusion of pine and grassland vegetation. This situation threatens the valuable mossy forest with its biodiversity-rich vegetation.

In 1983, the first large drought induced fire was experienced in the dipterocarp rainforest in the southern part of the country. Drought, heavy fuel loading, and a large number of ignition sources resulted in an unprecedented fire situation in the Philippines. Since the fire season of 1983, several severe fire years have been experienced, especially that of the 1997-1998 drought. The major factors contributing to this situation are:

⁴ The fire related data for the Philippines appears to be incomplete and raises as many questions as it answers. Fires are noted as a considerable problem with a range of actions undertaken to address them. Data to hand does not necessarily support this. Apocryphal information suggest that the area of land affected by fire in the Philippines is much larger than the data gathered for this review.

- Land-use changes brought about by forest resource exploitation;
- Agricultural expansion due to the survival needs of an ever-increasing population; and
- Erratic climatic changes with prolonged droughts.

A. Government

Due to its tendency to burn, operational experiences in fire management are more developed for the pine forest area. By the 1970s and 1980s, a fire control council for this pine forest area was developed. All interested organizations were invited by the Bureau of Forest Development to join this council and give input into fire management of this forest type. The reorganization of the Department of Environment and Natural Resources (DENR) in the late 1980s resulted in this council being discontinued.

DENR's reorganization in 1988 also meant that the Forest Protection and Law Enforcement Division became obsolete. This meant that there was no longer an Office or Division whose mandate it was to oversee, coordinate, monitor and evaluate forest fire management on a national level. Fire protection was thus decentralized and relegated to DENR's field units. These forest protection units of DENR have had to contend with insufficient government funds and limited personnel. While the communities in the field were enlisted to help, the organizational requirements, operational facilities and equipment were not maintained. This has discouraged volunteerism (which was intended to supplement the organizations labor constraints).

The large fires that occurred during the 1997-1998 drought highlighted the need for a national fire organization. During this season, the Armed Forces were involved in the suppression activities and the large acreage impacted led to the declaration of forest fires as a national disaster.

The DENR has recently identified ten (10) out of 15 regions as fire-prone areas. According to recent reports, DENR has organized and trained forest fire fighting teams with a total of 3,086 trained firefighters and 418 fire crew bosses. Moreover, regional offices have tried a 24-hour monitoring of these forest fire-prone areas. Also, according to a news report in January, 2003, DENR will reactivate the *barangay* fire brigades throughout the province of Ilocos Norte where grass fires are common (Ilicos Times Online 2003).

According to a report by Igsoc (1999), the forestry policy in the Philippines is outdated with a bill on sustainable forest management yet to be passed by Congress. According to this report, the discouragement of private ownership of forest resources puts additional pressure on DENR as the sole responsible party for fire protection and management.

B. Private Sector

The private sector is actively involved in fire management in the Philippines. There are several cases where industries have contributed to fire management or built up their own capabilities to manage fire. On several occasions, DENR has provided training at the request of private industry. The decentralization of power to local governments has also fostered innovation in isolated cases, depending on priorities. In a case from three Mountain Province, a fire prevention incentive mechanism was successfully implemented with the local political leadership (Bartolazo 1997).

Another example involves the cooperation of multiple agencies and the private sector for surveillance. The project called Oplan “Matang Lawin” (Eagles Eye) is a Memorandum of Agreement entered into by DENR, the Department of Science and Technology (DOST), Department of Transportation and Communication (DTC) through the Air Transportation Office (ATO), Philippine Air Lines, Inc. (PAL), Federation of Aviation Organization (FAO), Air Line Pilots Association of the Philippines (ALPAP) and Aircraft Owners and Pilots Association of the Philippines (AOPAP). This MOU underlines a series of collaborative actions for the protection and conservation of the country’s natural resources through aerial monitoring and surveillance of any environmentally destructive activities and natural disasters.

C. Civil Society

As with other countries in the region, it is difficult to ascertain how the civil society in the Philippines views fire. Similar to many agricultural economies, the use of prescribed burning as a management tool is widely used. Although the policies in the Philippines do not allow for such activities, the controlled use of fire is still prevalent for a variety of purposes. Some of civil society’s use 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 forest dependant communities.

Fire Data

The most current fire data on the Philippines is from 1995.

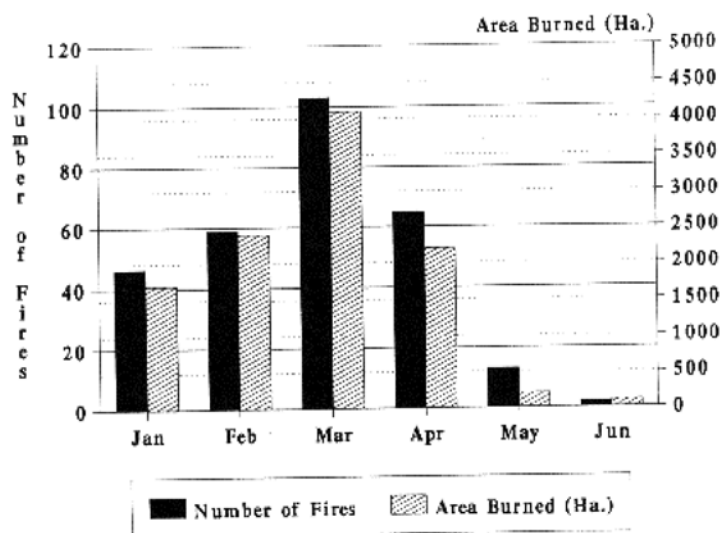
It appears that the fire related data for the Philippines is incomplete and raises as many questions as it answers. Fires are noted as a considerable problem with a range of actions undertaken to address them. However, the data on hand from this limited literature review does not necessarily support this. As suggested earlier, the area of land affected by fire in the Philippines should be much larger than the data gathered for this review.

Forest wildfires in the Philippines are all human-caused (carelessness, negligence, accident and incendiary). There have been no known wildfires caused by lightning. There were 290 forest fires (Figure 6) which occurred during the calendar year 1995, the majority or 52% of them being of undetermined origin or unknown cause. About 197 forest fires or 68% occurred in the central and northern part of the country (Bartolazo 1997).

A total of 10,710 hectares were burned/damaged by wildfires from January to June 1995 (Figure 6). Mostly plantation forests were damaged/burned, which accounted for 7,285 hectares; grasslands, 2,055 hectares; and natural forest stands, 1,370 hectares (Figure 7). The month of March is the peak of the fire season. There were 104 fire incidents with 4,127 hectares burned/damaged (Bartolazo 1997). Followed by April, which registered 65 fire incidents with 2,279 hectares burned/damaged (Figure 6).

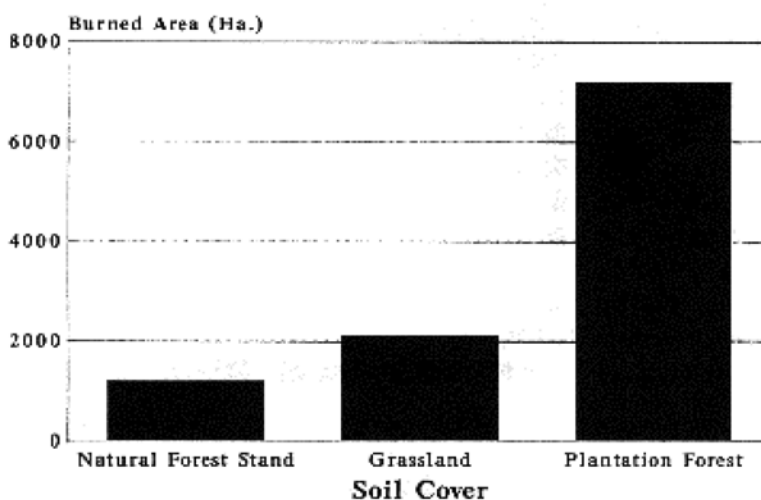
Normally, the dry or fire season starts from January up to June or six months every year except when an “El Niño” phenomenon or other drought occur, thus prolonging the dry spell that may enable wildfires to ignite, persist or become larger. For the data from 1995, the early onset of the rainy season greatly reduced the occurrence of wildfires and gave relief to fire management officers and firefighters.

Figure 6: Monthly summary of fire occurrence and area burned in calendar year 1995



(Bartolazo 1997)

Figure 7: Types and area of ground cover burned in the Philippines in 1995



(Bartolazo 1997)

Discussion

Officials working for DENR indicate there is still a need for fire management training and improved operational capability especially in parts of the county where drought and wildfires are expected (such as in the pine forests). Some have suggested that a conventional structure for national coordination is still needed. According to these reports, research activities are needed to improve fire management capabilities and draw up a national program to address the following areas:

- An appropriate fire danger rating system in various forest vegetation types;
- Fuel assessment at various locations and forest vegetation types;
- Development of appropriate technologies;
- Impact assessments;
- Development of burning prescription guidelines.

According to one report (Igsoc 1999) the government and DENR have demonstrated willingness to make appropriate revisions of forest policies to address community needs and long-term resource sustainability. One of the basic lessons learned by the government documented in this report is one of promoting decentralization for effective fire management. This report states that when local people possess secure land and resource tenure, they strive to maintain the productive capacity of their land's resources, which includes managing fire. Similarly, the government has concluded that local people can effectively manage forests by granting them tenurial instruments under a community-based forest management program on public forestlands that need rehabilitation and protection. Another report by Castillo (2001) concurs with this assessment that DENR's decentralization has led to the development of community-based fire management strategies. All of these reports and decentralization trends are encouraging signs for fire management in the Philippines.

Singapore

I. Background

Founded as a British trading colony in 1819, Singapore joined Malaysia in 1963, but withdrew two years later and became independent. It subsequently became one of the world's most prosperous countries, with strong international trading links. Singapore's strategic location at the entrance to the Strait of Malacca has helped it to become one of the most important shipping centers in Asia. Singapore also is a leader in new biotechnologies, petroleum refining, and the manufacturing of computer components.

The main island of Singapore and its 57 islets lie about 85 miles (137 km) north of the Equator. The main island is 26 miles (42 km) long and 14 miles (23 km) at its widest point. The country's land area, including the offshore islands, is 246 square miles (637.5 sq km). This figure is increasing as land reclamation continues. Singapore's terrain is primarily lowland with a gently undulating central plateau containing water catchments and some small nature preserves.

A large percentage of Singapore's population, 85%, lives in high-rise apartments under fairly affluent conditions. The population as of 2001 was 4,300,419 with a literacy rate just under 94%. The population is comprised of Chinese (76.7%), Malay (14%), Indian (7.9%), and other ethnic groups (1.4%). Singapore is blessed with the fifth highest per capita GDP in the world. Exports, particularly in electronics, chemicals and services are the main drivers of the economy. The Singapore tourism industry is valued at \$11 billion

Located close to the Equator, Singapore has a tropical climate. It is hot, humid, rainy and has two distinct monsoon seasons - northeastern monsoon from December to March, southwestern monsoon from June to September. Between the monsoons there are frequent afternoon and early evening thunderstorms. Daytime temperatures average between 85 and 90 degrees Fahrenheit. Evening temperatures average between 76 and 80 degrees.

II. Fire Information

Singapore has very little land for nature reserves and therefore the issue of forest fires does not impact the nation directly. Small-scale fires occur on the fringes of the nature reserves, mainly from fire outbreaks at installations and facilities of satellite stations, utility facilities and developing private residential estates. Singapore's forest fire management is therefore geared towards handling small-scale events in nature reserves.

For the most part, Singapore's involvement in forest fire management is the engagement that it has with its neighbors over the haze issue. As a major trading and distribution hub, Singapore needs to maintain its ports and airports open to retain investors and maintain its strategic advantage in the region. In addition, haze has

impacted Singapore's tourism industry and health services. According to an IDRC report (Glover & Jessup 1998), Singapore suffered losses of about USD 75 million during the 1997 event. These losses are largely the result of a 10% decline in tourism. All told, more than 36,000 working days were lost due to illness. The health care costs in Singapore and Malaysia combined were about USD 18 million (Glover & Jessup 1998). Singapore Airlines and Silk Air had to cancel over 80 flights and a total of 120 were in some way disrupted because of the haze. The loss of the two carriers was estimated by the airlines at approximately US \$6.9 million (Hon 1998). A Singapore Airlines study documented a high number of cancellations (14000) during the period from late September to the end of October and estimated that this may have cost the airline an additional US \$6.4 million above and beyond the initial figures (Hon 1998).

A. Government

Fire and haze management are clearly of concern to government structures in Singapore, mainly with respect to neighboring nations. There is little information on the structures for governing forest fires within Singapore's boundaries since forest fires are of relatively minor concern.

B. Private Sector

Most of the private sector involvement in Singapore has not been directly with fire management per se but rather with haze management. Within countries like Singapore, which were affected directly by the haze, the major haze management issue has been the challenge of convincing markets that the haze did not affect particular key tourist destinations (Lebel 1998). There are a number of lessons learnt from the 1997/1998 haze episode by the tourism sector (Lebel 1998):

- They should be able to provide haze-free guarantees/refunds more effectively and timely
- They should be able to learn to manage media relations better
- Improvement on crisis management skills is needed
- Provision of timely and accurate information on haze conditions at key tourist destinations should be made possible
- Communications between central agencies and overseas agents (*i.e.* ASEAN Communications Team for Tourism) should be improved
- Improve cooperation (as against competition) among ASEAN National Travel Organizations to market ASEAN as a region (TravelAsia, 1997)

C. Civil Society

Given the health and economic impacts of haze events in the region, the civil society is keenly aware of fire and haze management issues. With 85% of the population being urban there is probably little awareness of the beneficial uses of fires for livelihood interests in other parts the region. There is no readily available information on the perspective of civil society in Singapore on fires.

Fire Data

Most of the emphasis of fire data collection in Singapore is on hot spot fire monitoring in neighboring countries. Singapore, the lead country responsible for the monitoring component of the ASEAN Regional Haze Action Plan, has been providing the satellite pictures indicating hot spot locations to Indonesia. There is little to no information on forest fires within Singapore's nature reserves.

The Center for Remote Imaging, Sensing and Processing (CRISP), National University of Singapore, has operated a remote sensing ground station since September 1995. This ground station receives data from the SPOT, ERS and RADARSAT satellites. A daily fire monitoring operation is being implemented at CRISP, in collaboration with the Ministry of Environment, Singapore. SPOT images over hot-spot areas in Southeast Asia are analyzed on reception and reports and annotated images of fires are transmitted to the Ministry with minimum delay.

The high resolution SPOT images (down to 10 m) are visually inspected to detect smoke plumes and burn scars associated with fires, to provide the exact locations of fires and to assess the extent of fires and types of land cover on fires. It is possible to tell whether the fires are in forests, peat swamps, or plantations, and whether they are associated with such activities as clearing of agricultural land or timber logging (Innovation science magazine Vol. 3. Number 3, 2003). The information is then disseminated to the relevant authorities in the neighboring countries. Recently several SPOT satellite images showing fires in oil palm plantations together with the details of the fire locations were delivered to the forestry law enforcement authority in Indonesia as evidence in order to prosecute the liable parties (Innovation science magazine 2003).

In addition to CRISP, Singapore has a prominent role in data collection for ASEAN's Regional Haze Action Plan Co-ordination and Support Unit (RHAP-CSU) which continuously monitors the haze situation on a day-to-day and region-wide bases and shares its findings through its website called the ASEAN Haze Action Online. The RHAP-CSU is linked up with monitoring stations in member countries including the ASEAN Specialized Meteorological Center in Singapore, the Indonesian Ministry of Forestry and Estate Crops in East and West Kalimantan, the National Board for Environmental Impact Control and the Indonesian National Institute of Aeronautics and Space (LAPAN) and other agencies. Information such as satellite imagery of hotspots, weather forecasts, air quality, visibility, humidity, and wind blows are monitored on a daily basis. A weekly summary of information gathered is available from the website.

Discussion

Singapore has a distinctive characteristic out of the ASEAN countries because it has very limited impacts from direct fire events nationally but prominent indirect impacts of haze from elsewhere in the region. Singapore is also distinctive because of its small land area and prominent economic role in the region.

Thailand

I. Background

A unified Thai kingdom was established in the mid-14th century; it was known as Siam until 1939. The first Thai recognition of Western power in the region was the Treaty of Amity and Commerce with the United Kingdom in 1826. The Thais believe that the diplomatic skills of these monarchs, combined with the modernizing reforms of the Thai Government, made Siam the only country in South and Southeast Asia to avoid European colonization.

In 1932, a bloodless coup transformed the Government of Thailand from an absolute to a constitutional monarchy. Although nominally a constitutional monarchy, Thailand was ruled by a series of military governments interspersed with brief periods of democracy from that time until the 1992 elections. Since the 1992 elections, Thailand has been a functioning democracy with constitutional changes of government.

Thailand is divided into four administrative regions: North, Northeast (also known in Thailand as Esan), Central and South. There are 76 Provinces and 716 Districts. The North is mainly mountainous with average altitudes rising above 200 m above sea level. The Central Plains are the alluvial basin of the country's principal river, the Chao Praya. The Southern Peninsula consists of a narrow strip of land where mountain ranges run north and south. Thailand has a coastline of 2,500 km.

Thai society comprises many ethnic tribes with the Thai in the majority and Chinese, Khmer, Laotian and hill tribe as minorities. About 70% of the population are farmers. According to a national census in July 2001, the population reached 62 million. According to 1998 estimates, 12.5% of the population lives below the poverty line. The average population density of Thailand is about 125 persons/km² and about 21.8 percent (1999) of the population is urban-based.

Population growth was above 3 percent during the 1960s and slowed to 1.8 percent during the 1980s. According to the latest data (2000) it has dropped to below one percent in recent years. Thailand's economy is predominantly agricultural. After enjoying high annual growth rates (above eight percent growth), the financial crisis of 1997 hit Thailand hard.

Growth in 2002 stood at 4.8 percent and recent indications by Thailand's National Economic and Social development Board (NESDB) show that Thailand has some of the highest growth in the region (BizAsia website 2002).

Thailand is vulnerable to severe weather events such as tropical storms, flooding and drought. The majority of Thailand's precipitation falls during the wet season from June until early November with the heaviest downpours typically in late June and July. The dry season which occurs from December until May of each year sees temperatures of above 40°C and localized wind patterns.

As of 2001, 25.28% of Thailand's land base was covered by forest (12,972,228 hectares). These forests are classified into two main types: Evergreen and deciduous forests. Evergreen forests cover an area of about 5.84 million hectares (11% of the country). Evergreen forests are further defined as forests that grow in permanent humid conditions while deciduous forests grow under a climate, which has significant seasonal changes in precipitation. Deciduous forests, which lose their leaves in the dry season, cover 7.13 million hectares (14% of the country's land base). These forest types are further subdivided into more descriptive ecological types in Table 16.

Table 16: Proportion of Forest Types in Thailand (25.28% of total land base)

| FOREST TYPE | % |
|-----------------------------|--------------|
| Evergreen Forest | 46.54 |
| - Tropical Evergreen Forest | 43.3 |
| - Pine Forest | 31.3 |
| - Mangrove Forest | 81.83 |
| Deciduous Forest | 53.46 |
| - Mixed Deciduous Forest | 21.6 |
| - Dry Dipterocarp Forest | 731.2 |
| - Scrub Forest | 50.54 |
| TOTAL | 100 |

Source: Adapted from Akaakara (2001)

Forests and forestland are state property and under the responsibility and management of the Royal Forest Department (RFD) and the National Park, Wildlife and Plant Conservation Department (split from RFD in 2002). The Forest Act (1941), Section 4, defines "forest" as land that has not been taken up or acquired by any other means according to land law. There are and have been several land use conflicts between governmental agencies over the definition and the application of the land law.

II. Fire information

Thailand's forest fires occur during a dry season, which extends from December to May with a peak in fire frequency in February and March. Almost all of these fires are surface fires. Given the ecological types described in Table 16, these surface fires occur mostly in Dry Dipterocarp Forest, Mixed Dipterocarp Forest and Forest Plantations, and to some extent in Dry Evergreen Forest, Hill Evergreen Forests and in some parts of Tropical Evergreen Forest. Under very rare conditions, crown fires have been observed in pine plantations. Ground fires have also been noted in swamp forests of the south.

Fuel conditions have been studied in Thailand but there is very little published information available in English. In general, Dry Dipterocarp forests have more combustible fuel conditions with large leaves that tend to dry quickly. A promising

rigorously designed fire behavior/fire effects study has been initiated by a Ph.D. student from Kasetsart University in Hanyu Kakang, Uthaitani Province.

In Thailand, some attempts have been 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 2.17 billion USD, which seems dramatically high. It is unclear how this study performed its monetary losses/ hectare for each of these forest types. In another study by the Airport Authority Organization and the Forest Fire Control Office, it is stated that during the period of 193-1999 the 1,794 cancelled Thai Airways flights to Mae Hong Song cost the airline an estimated 20 million USD (Ploadpliew et. al. 2001). Many forest fire experts have indicated that forest fires may not be entirely responsible for all of these cancelled flights (personal communication, Smith 2003).

A. Government

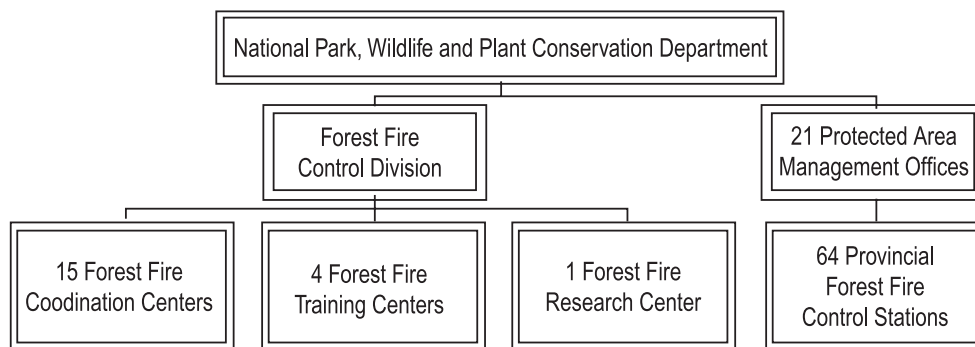
In 1976, Thailand's Forest Fire Control Section was established under the Forest Management Division. A few years later this Section was upgraded to the Forest Fire Control Subdivision. A cabinet resolution on November 24,

1981 gave this Subdivision its national mandate to undertake forest fire control activities. 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 program has been expanding to enlarge its coverage over fire-prone areas.

In 2000, the Forest Fire Control Office was composed of four regional Fire Control Divisions, 15 Forest Fire Control Centers, 64 Provincial Forest Fire Control Stations (PFCS), and 272 Forest Fire Control Units administering an "intensive fire control program over 2.8 million hectares or 21% of the total forest land" (Akaakara 2001). According to this report, fire suppression equipment, including fire tenders, fixed wing aircraft and helicopters, has been introduced, modified and applied.

In October, 2002 the reorganization of the Royal Forestry Department into the National Park, Wildlife and Plant Conservation Department has meant that Forest Fire Control is once more a Division according to the Bureaucracy System's restructuring Act 2002 (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 (PFCS). The new department and Forest Fire Control Division is organized as follows (Figure 8):

Figure 8: Current Management Structure of Thailand's Fire Control Division



Source: Forest Fire Control Division (2003)

There is no specific forest fire control Act in Thailand but there are four existing acts, which contain sections stating penalties for setting fires (Table 17). The National Forest Policy No. 18 (1985) stated that a substantial plan should be created with a series of actions for tackling the deforestation issues in Thailand. Shifting cultivation and forest fires are some of the issues that were to be addressed under this forest policy. Suppression measures were to be clearly set.

Table 17: Legal Constructs in Thailand for Fire Prevention

| Act and Year of Enactment (section) | Maximum fine and/or Prison Term |
|--|--|
| Forest Act 1941 (section 54) | Not to exceed 50,000 Bahts fine or 5 years imprisonment or both fine and imprisonment |
| National Forest Reserve Act 1964 (section 14) | 5,000-50,000 Bahts fine and 6 months-5 years imprisonment |
| National Park Act 1961, (section 16:1) | Not to exceed 20,000 Bahts fine or 5 years imprisonment or both fine and imprisonment |
| Wildlife Conservation and Protection Act 1960 (section 24) | Not to exceed 30,000 Bahts fine or not exceed 5 years imprisonment or both fine and imprisonment |

Adapted from Akaakara 2001

The Forest Fire Control Division has set itself up to perform all of the necessary fire management activities. Although heavily focused on preparedness and response (suppression), this Division also has a strong educational and public awareness campaign for prevention. Some attention has been given to post-fire analysis, fire effects and recovery measures. As with other countries in the region, little research has been done on post-fire restoration efforts in these forest types.

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.

B. Private Sector

The Forest Industry Organization (FIO), a government-owned enterprise that manages plantations in Thailand documented the only industrial use of fire. Forest managers for FIO annually use prescribed burning to manage under storey growth and competition in these plantations. Although there is very little documentation on this FIO's fire use for silvicultural purposes is well known.

C. Civil Society

Fire is an integral part of rural life in Thailand (Rakyutidharm 2002, Makarabhirom et al. 2002). The Royal Forestry Department estimates that 26% of the fires started in Thailand are for promoting and collecting non-timber forest products. Another 18% are used for agricultural debris burning and 15% for hunting. According to a recent study (Makarabhirom et al. 2002), Thai people living in or around forests use fire for many purposes in their daily lives, such as in:

- Rotational cultivation (undertaken by the Lua and Karen ethnic groups);
- The promotion of mushroom species such as Hhed Ppoa (*Astraeus hygrometricus*);
- Promotion of leaf growth of species like Ppak Wwaan (*Melientha suavis*);
- Cultivation and promotion of bamboo or grass shoot such as Pphai Ppaa (*Bambusa arundinaceae*) and Pphai Ppek (*Arundinaria purilla*);
- Promotion of seed germination of species such as teak (*Tectona grandis*); and
- Hunting small animals such as wild pig (*Sus scrofa*), barking deer (*Muntiacus muntjak*), lan (*Varanus bengalensis*) and wild fowl;
- Managing growth of a grass called Yyaa Mmai Gguard (*Thysanolaena maxima*) for the production of brooms. (an economically productive activity undertaken by the community groups in Nan Province); and
- Promotion of another grass species, Yyaa Kka (*Imperata cylindrica*), which is commonly used for making thatched roofs.

- In Thailand, there have 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 advance 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 place (Chamarik and Santasombut, 1994, Sukwong 1998, Ganz et al., 2001, Makarabhirom et al. 2002).

Non-government 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.

Fire Data

Thailand has very good national level data on fire frequency, number of rai burned (1 rai = 0.16 hectares) and location of fires going back for a least a decade. The latest fire statistics by region are given in Tables 18 and 19. Table 20 gives the last 15 years of fire extent as determined by GIS and remote sensing of imagery (Forest Fire Control Website 2003). In this analysis, there is no distinction between wanted and unwanted fires.

Table 18: *Number of Fires and Area burned by Region in Thailand for Dry Period between October 1, 2001 to April 11, 2002*

| Location | Number of fires | Percentage (# of fires) | Burned area (rai) | Burned area (hectares) | Percentage (area) |
|------------|-----------------|-------------------------|-------------------|------------------------|-------------------|
| Center | 1,076 | 9.5 | 58,970.5 | 9435 | 24.8 |
| North-East | 2,992 | 26.5 | 83,606.7 | 13377 | 35.1 |
| North | 6736 | 59.5 | 64,089.4 | 10254 | 26.9 |
| South | 506 | 4.5 | 31,406 | 5025 | 13.2 |
| Total | 11,310 | | 238,071.6 | 38091 | |

Source: Personal communication, Royal Forestry Department, April, 2003

Table 19: Number of Fires and Area Burned by Region in Thailand for period October 1, 2002 - April, 2003

| Location | Number of fires | Percentage (# of fires) | Burned area (rai) (hectares) | Burned area | Percentage (rai) |
|------------|-----------------|-------------------------|------------------------------|-------------|------------------|
| Center | 410 | 10.5 | 11,867.5 | 1899 | 22.8 |
| North-East | 791 | 20.2 | 16,617 | 2659 | 32.0 |
| North | 2,666 | 68.2 | 22,100.7 | 3536 | 42.5 |
| South | 42 | 1.1 | 1406 | 225 | 2.7 |
| Total | 3,909 | | 51,991.2 | 8319 | |

Table 20: Annual burnt areas from forest fire in Thailand

| Year | Area burnt by forest fire (hectares) |
|------|--------------------------------------|
| 1985 | 3,535,110 |
| 1986 | 3,797,289 |
| 1992 | 2,030,160 |
| 1993 | 1,459,617 |
| 1994 | 763,648 |
| 1995 | 643,799 |
| 1996 | 490,303 |
| 1997 | 660,208 |
| 1998 | 1,145,452 |
| 1999 | 293,480 |
| 2000 | 93,324 |
| 2001 | 76,189 |
| 2002 | 139,389 |

Source: Adapted from Akaakara (2003)

Most of the fire history in Thailand is based on its very accurate accounting and mapping of fires over the last ten years. Prior knowledge of fire extent goes back to the early 70's but there have been only a few attempts to characterize fire history. Some sediment analysis and tree ring history have been attempted in Thailand but there is little published on this topic.

Discussion

Thailand is posed 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. Several study tours and formal trainings with its ASEAN neighbors have also been undertaken. In addition, Thailand's research center in Haay 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.

Vietnam

I. Background

France occupied all of Vietnam by 1884. Independence was declared after World War II, but the French continued to rule until 1954 when they were defeated by communist forces under Ho Chi Minh, taking control of the north. US economic and military aid to South Vietnam grew through the 1960s in an attempt to bolster the government, but US armed forces were withdrawn following a cease-fire agreement in 1973. Two years later North Vietnamese forces overran the south.

The Socialist Republic of Vietnam occupies a land area of 33.7 million hectares. Vietnam is a country with rich natural resources and a well-educated, diligent population of 81.4 million (literacy rate is over 94%) (UN 2003). Since 1986 the ruling Communist Party of Vietnam has committed itself to economic reform, or “Doi Moi” (New Changes) a move from a centrally planned economy to a multi-sectoral one based on open market principles. Its growth has been remarkable. GDP growth was 6.8% in 2001, which was equivalent to most of its richer neighbors.

Vietnam is administratively divided into 58 provinces, which are subdivided into 400 districts, and further into communes, with each commune containing a few villages. Vietnam borders the Gulf of Thailand, Gulf of Tonkin, and South China Sea, alongside China, Laos, and Cambodia. Vietnam’s society comprises many ethnic tribes with the Vietnamese in the majority (85 %) and Chinese, Hmong, Thai, Khmer, Cham, and hill tribes as minorities. According to 1998 estimates, 37% of the population lives below the poverty line.

As of 2000, 30% of Vietnam’s land base was covered by forest (32,550,000 hectares). Official figures appear to understate the importance of forestry in the rural economy, indicating that forestry accounts for only 2% of the country’s GDP (Van San and Gilmour 1999). Vietnam has a wide range of climatic and topographic conditions which accommodate a diverse forest flora and a variety of forest types including broad-leaved tropical evergreen and semi-deciduous, sub-alpine tropical, conifer, bamboo, mangrove and Melaleuca (Van San & Gilmour 1999). The majority of Vietnam’s forests are found within the mountainous midland and upland regions, with the central highlands containing upwards of 42% of the nation’s remaining forests.

These upland regions are inhabited by a majority of Vietnam’s 50+ ethnic minority groups, representing some 13% of the nation’s population (UNDP; AFN 1998). Approximately 24 million people live in or around forests and depend on the forests for their livelihood. The forests provide sources of income through the harvest and sale of bamboo, firewood, medicine, fruit, fodder and game (Phien and Siem 1998). Estimates of the annual rate of deforestation range from between 200,000 hectares to

4,000,000 hectares per year (AFN 1998; Hirsch 1996; Van San and Gilmour 1999). According to calculations based on satellite imagery, about 50% of the forest cover in Vietnam was lost during the period of 1943 to 1983 (Van San and Gilmour 1999). Rapidly expanding populations and migration into forest areas are major pressures on remaining areas of forest.

Forests are fast declining due to over-exploitation and frequent wildfires (Abdullah 2002). The underlying causes of deforestation and forest degradation in Vietnam have been identified as rural poverty, insufficient arable land, limited and inappropriate institutional capacity, and land tenure (Van San and Gilmour 1999). 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.

Vietnamese forest policy has recently shifted its emphasis from exclusive state control towards increased private sector involvement, enlisting rural households for national goals (AFN 1998). New development objectives are controlled by market demands and the government has removed most price controls, reduced trade restrictions, encouraged private and foreign investment and abolished most subsidies to state enterprises (Van San & Gilmour 1999). The culmination of the FAO-sponsored Tropical Forestry Action Plan of 1989, the Forest Resources Protection and Development Act 1991, and the first National Forestry Action Plan (NFAP) 1991 introduced a new framework for forest management in Vietnam. This new policy designated private households to replace State Forest Enterprises (SFEs) in overseeing the forest (Poffenberger 1997). The 'non-state', or private sector, has been assuming an increasing role in forest management since at least the 1970s. SFEs have been encouraged to reform and diversify their mandate, and, by contracting the use of forest land to local households, the SFEs are gradually reducing their direct influence over land use. By the late 1980s, government statistics reported the importance of the non-state sector for forest production, employment, and afforestation that far-outweighed the role of the state sector. The non-state sector accounted for close to nine-tenths of total revenues and labor force in the forestry sector (AFN 1998).

II. Fire Information

Vietnam's fire management approach has traditionally placed more attention on prevention than on mitigation. Fires in Vietnam occur during a dry period of seven months from October to April of the following year. All of Vietnam's forest types (broad-leaved tropical evergreen and semi-deciduous, sub-alpine tropical, conifer, bamboo, mangrove and Melaleuca forest) are susceptible to fire during this dry period. According to a recent report, about 56% of the Vietnamese forest areas are susceptible to fire because they are open forests (Abdullah 2002). An average of 50,000 hectares of forests have been burnt annually in Vietnam, with a maximum reaching up to 100,000 hectares (Pham 1999).

In the Melaleuca forest type, several large-scale forest fires have been recorded in the last five years. Truong Quoc Tuan, chairman of the People's Committee in Kien Giang province, told news reporters in early April, 2002 that a fire in U Minh Ha Forest and U Minh Thuong National Park had burned 4,200 hectares of forest in the

8,500-hectare national park in the coastal province. Tuan also reported that 200 soldiers were sent in to join a 200-strong force of militia members and residents of Kien Giang to fight the fire in an area six km (3.7 miles) by seven km (4.3 miles). Upon request from MARD's Forest Protection Department, the Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ) in collaboration with the Global Fire Monitoring Center (GFMC), United Nations Development Program and the UN-Office for Coordinating Humanitarian Affairs conducted an assessment in U Minh Ha Forest and U Minh Thuong National Park in response to on-going large wildfires burning within the area. This assessment determined that the presence of canals in Melaleuca peat forests render these forests more susceptible to ignitions by illegal users by altering the historic/natural water regime. When these canals are constructed, peat forests experience lower than normal soil ground water levels increasing the severity of drought years like 1998 and 2002.

The causes of fire in Vietnam are similar to those of its neighboring ASEAN countries. Local people 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. This is particularly the case in Western Nam Bo where local people have received no instruction on burning techniques (Hung 2001).

Grasslands are also burnt 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. In addition, careless reforestation efforts (during the dry season and with fire prone species) has increased the sources of fuel resulting in increased large-scale fires. Another cause of fire in Vietnam is retaliatory action taken by forest squatters who have been fined or were driven out by legal action (Hung 2001).

The impact of forest fire caused by war is another key element in Vietnam. During the Indochina War, much of the forest along the legendary Ho Chi Minh Trail, on the Lao-Viet Nam border, was bombed by United States forces. It is not known how much forest was permanently damaged by fire from bombs and by defoliants used during the war. It is speculated that the impact of the war may have changed the development of forest and its fire regime.

Vietnam is one of the few South East Asian countries with a Forest Fire Danger Rating System specifically designed for its climate and fuel conditions. This system is used across the country with five grades to forecast, alarm, and raise awareness of severe fire conditions. Several long-term studies have been involved in the design of this system and it has since stood up to scientific scrutiny.

In Vietnam, some attempts have been made to estimate the economic impacts of forest fires. The fire in U Minh Ha Forest and U Minh Thuong National Park was roughly estimated to have cost the government 7-8 billion Dong (USD 500,000.00) (Sanders 2002). A government report estimates that forest fires, from 1998 to 2000, cost the government hundreds of billions of Dong (Hung 2001).

A. Government

In Vietnam, there are several government structures for fire management. First and foremost, the Ministry of Agriculture and Rural Development's (MARD) Forest Protection Department functions on a national level with 40 staff members including drivers, trainers and others at provincial level. At District level there are 203 staff members of this particular department. However, it is the decentralized structure with its protection committees, which reaches a much greater potential labor force.

Under a Central Fire Protection Committee for the country there are both provincial and district committees that function for fire management. At the provincial level, the Vice Chair of the Party Committee of the Province is the Chair of the Provincial Fire Protection Committee. The head of the Forest Protection Department for the Province is the Vice Chair of this committee. Membership on this committee also includes the Police, Ministry of Agriculture and Rural Development, Land Administration Department, and other government agencies with influence and impact on fire management issues. At the District level, there is a District Fire Protection Committee that mirrors the Provincial Committee but at the next level down. Again, the Vice Chair of the Party Committee of the District is the Chair and the Head of the Forest Protection Department for the District is the Vice Chair. From District to District there may be some variation in membership. For example the army or industry may be involved depending on the circumstances and impacts of unwanted fires.

The same structure exists at village level where there is also a Village Party Committee, which focuses on management and administration. There is no specific Fire Protection Committee at this level but the functionality remains as this organizational structure allows for collective action. At this 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 generally applied across all of Vietnam in the 58 provinces particularly where there are forests.

Vietnam has been very proactive in developing measures to combat forest fires. Its approach has focused more on prevention than on mitigation. In Decision No. 1856/1996 on the Development of Forecast Levels for Forest Fires, the government assigned the Forest Protection Department to organize the development of forest fire forecast levels for the country's nine different ecological regions. Under Decision No. 86/1998, a Central Steering Committee for the Prevention and Fights Against Forest Fires was established with the Minister of Agriculture and Rural Development as the Committee Chairman to deal specifically with forest fire prevention. This exemplifies Vietnam's commitment to address forest fires with comprehensive regulatory regimes. Despite this commitment, implementation remains difficult. Problems arising from inadequate human and financial resources and jurisdictional overlap between the Forest Law and the Law on Environmental protection needs to be resolved (Abdullah 2002).

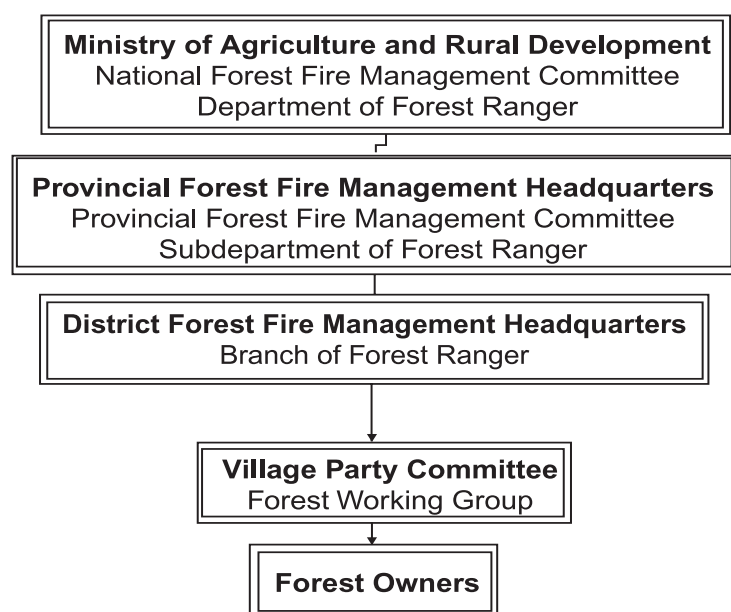
The government's coordination, through these various levels of committees, serves as a functioning structure for all aspects of fire management. Various fire management activities, such as the administering of the National Forest Fire Danger Rating System,

is implemented through this administrative structure (Figure 9). It is this structure, which gives Vietnam one of the most comprehensive regulatory regimes in the ASEAN region (Abdullah 2002).

The GTZ/GFMC/UNDP assessment of fire coordination at U Minh Ha Forest and U Minh Thuong National Parks reflected on this government structure and coordination:

“The National, Provincial and U Minh staffs (sic) of the Forest Protection Department (FPD) have a well-established organization. Additionally, close coordination between FPD and provincial steering committees was clearly evident. Their organizational ability, initiative, motivation, and capacity in mobilizing people, equipment, and supplies and managing these two large fire emergencies are commendable. The spirit of community assistance and cooperation was prevalent at all levels (Sanders 2002).”

Figure 9: Vietnam's forest fire prevention and suppression structure



Source: Adapted from Hung (2001)

In addition to the regulatory structure, there are several government initiated projects, such as Program 327 / the five million hectare program, which will heighten the role of fire management in Vietnam. The formulated five million hectare program (5MHRP), has the following objectives and expected outcomes.

- Increasing the forest cover rate up to 43% in the country by 2010
- Establish areas for raw material combining with the development of the forest product processing in order to meet the need of domestic and export markets
- Enhancing forest's contribution to socio-economic development by providing increased income and employment for forest dwelling people.

The program intends to accomplish the following tasks;

- Creation of 2 million hectares of special use and protection forests, including 1 million hectares naturally regenerated.
- Creation of 3 million hectares of production forest, including 1 million hectares of cash crops.

It is unclear at this time whether fire management was considered when designing this reforestation effort. Issues such as species selection, stand structure and composition may all play a role when considering fuel management.

B. Private Sector

Besides the indication by MARD officials that the private sector may play a role in Fire Protection Committees (at various government levels), there is little to no information available on the private sector and its involvement in fire management in Vietnam.

The role of the private sector is likely to increase in the years to come with the general political and economic changes associated with “Doi Moi”.

C. Civil Society

There are several reports, which compliment the forestland allocation program for devolving the power and responsibility to local people for forest fire management (Hung 2001, Van Chieu 2001, Ganz et. al. 2000). As a result of this land reform, civil society has a prominent role in fire management and in designing District level fire prevention plans in some localities, which include:

- prediction of forest fires (systematically through the national forest fire danger rating forecast system);
- the construction of firebreaks along roads, canals and ditches;
- the construction and use of watchtowers; the development of man-made ponds and natural lakes as water sources for fire fighting;
- the development of prevention regulations
- the design and implementation of awareness raising programs for fire prevention amongst the local community, especially rural youth and schools in mountainous areas;
- the development of best management practices and instruction for:
 - slash-and-burn techniques, and;
 - reduction of fuel loads.

Fire Data

There is currently very little data for fires in Vietnam.

Within the three year period from 1998 to 2000, Vietnam experienced 2,108 forest fires covering 22,668 hectares including plantations, natural forests, savannas, and bush (Hung 2001). During this period, Forest Protection Department, under the jurisdiction of MARD, mobilized 37,969 people to assist in fire suppression.

Also during this timeframe 107 people were arrested or fined for causing unwanted forest fires (Hung 2001). In Long Son Province, a large fire in a State Forest Enterprise that burnt 143 hectares of natural forest and 95 hectares of plantation was reported in 2000 (Moore 2001).

New research on the fire in U Minh Ha Forest and U Minh Thuong National Parks has recently been posted by the Vietnam National Center for Natural Science and Technology. This GIS/RS work uses a time series analysis to evaluate land use changes in the park (Table 21). It also documents the habitat loss within the park and the percentages in designated classification types. The total burned area of this particular fire was 29.54.4 hectares and covered 37.5% of the park. The majority of this area was in natural Melaleuca forests covering 32.1% of the area (Table 22).

Table 21: Land cover change from 1988 to March 2002 prior to the forest fire at U Minh Tong National Park

| Land use cover | Area 1988 | | Area 1995 | | Area 3/2002 | |
|-------------------------|-----------|------|-----------|------|-------------|-------|
| | ha | % | ha | % | ha | % |
| Dense melaleuca forest | 4471.4 | 56.3 | 2970.8 | 37.4 | 3524.6 | 44.37 |
| Sparse melaleuca forest | 1054.4 | 13.3 | 928.7 | 11.7 | 2125.1 | 26.75 |
| Swamp with grass | 614.4 | 7.7 | 1081.7 | 13.6 | 249.9 | 3.15 |
| Paddy field | 696.8 | 8.8 | 1871.3 | 23.6 | 978.5 | 12.32 |
| Dense scrubs | 1106.9 | 13.9 | 1091.3 | 13.7 | 1063.2 | 13.38 |
| Burned area | | | | | 2.4 | 0.03 |

Source: Adapted from Nguyen Hanh Quyen and Tran Minh Y, Vietnam National Center for Natural Science and Technology (2003)

Table 22: Area and Type of Habitat Loss from 2002 fire in U Mihn Tong National Park

| HABITAT | AREA BURNT (ha) | % |
|---------------------------------------|--------------------|------|
| Dense melaleuca forest | 2552.94 | 32.1 |
| Plantation melaleuca forest and scrub | 231.51 | 2.9 |
| Swamp with grass | 161.01 | 2.0 |
| Paddy field | 37.73 | 0.5 |

Source: Adapted from Nguyen Hanh Quyen and Tran Minh Y, Vietnam National Center for Natural Science and Technology (2003)

Discussion

Vietnam has a strong administrative structure and technical capacity for managing fire. This comes from a strong commitment to address fire as a land management issue from all levels of government and civil society. Also unique to Vietnam is an educational system, which also places merit on fire management training at the University level. All students who study silviculture and forest protection are required to take several units of fire management training. This training covers socio-economic, ecology and the ecological impacts of fire on the environment, fire behavior and prevention methods with concentration on the Vietnam Fire Danger Rating System (Moore 2001). The emphasis in training has suffered substantially from inadequate human and financial resources.

Vietnam's regulatory structure is also unique in that it addresses important socio-economic aspects. A recent report, which reviewed the legal and regulatory aspects of forest fires in these ASEAN countries recognized the unique Vietnamese approach (Abdullah 2002). Of note from this report is that Vietnam offers rewards and incentives for the public and government officers in assisting the authorities in forest fire management. This public participation is not only rare in the region but rarely recognized in fire management systems in the world.

Vietnam has also made the link between the socio-economic causes of fires and secure land tenure. Its forest land allocation program has recognized the role of indigenous people as landowners, devolving the responsibility of protecting forest resources because it is inherently in their best interest to do so.

This has led to the formulation of fire management guidelines at the local level, which effectively prevent and combat harmful forest fires while allowing for the beneficial uses of fire. This has resulted in one of the most comprehensive regulatory regimes dealing with forest fire in the ASEAN region.

Vietnam suffers from lack of accurate data and information on forest fires. These are vital for law enforcement and this impressive regulatory structure to perform as it was designed. In addition, accurate information on forest fires will serve the country well as outsiders weigh the potential of Vietnam'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. 51 p.
- ADB (Asian Development Bank) and BAPPENAS (National Development Planning Agency). (1999).** Causes, extent, impact and costs of 1997/98 fires and drought. Final Report, Annex 1 and 2. Planning for Fire Prevention and Drought Management Project. Asian Development Bank TA 2999-INO July 1998 – March 1999. Fortech, Pusat Pengembangan Agribisnis, Margueles Pöyry. Jakarta, Indonesia.
- AFN (Asia Forest Network). (1998).** Stewards of Vietnam’s upland forests. Research Network Report Number 10, January 1998. University of California, Berkeley: Center for Southeast Asia Studies.
- Ahmad Ainuddin Nuruddin (1998).** Global Fire Monitoring Center Website, IFFN No. 18 - January 1998
- Akaakara, S. (2003, In Press).** Forest Fire Control in Thailand - Law and Regulation Aspects. In *Fires, Laws and Regulations towards best practice for legal aspects of fire* Workshop Report. June 2-4, 2003. Hanoi, Vietnam. Project FireFight South East Asia
- Akaakara, S. (2001).** Forest fire control and research in Thailand. South East Asia Forest Fire Scientist Network Meeting, April 5-7,2001, Faculty of Forestry, Bogor Agriculture University, Bogor, Indonesia
- Aragon, L.V. (1997).** Distant processes: The global economy and Outer Island Development in Indonesia. In *Life and Death Matters: Human Rights and the Environment at the End of the Millennium*. B.R. Johnston (editor). London: Altamira Press.
- Asian Development Bank. (2000).** Poverty in the Lao PDR: Participatory Poverty Assessment (PPA) Summary. State Planning Committee, Vientiane, Lao PDR.
- Barber, C.V. & Schweithelm, J. (2000).** Trial by Fire. Forest fires and forestry policy in Indonesia’s era of crisis and reform. World Resources Institute (WRI), Forest Frontiers Initiative. In collaboration with WWF-Indonesia and Telapak Indonesia Foundation, Washington, D.C. USA
- Bartolazo, D. L. (1997).** Forest fire management in the Philippines: The 1995 forest fire season. *Int. Forest Fire News* No. 16, 22-25. Global Fire Monitoring Center Website - January 1997 <http://www.fire.uni-freiburg.de/iffn/country/>

- BAPPENAS (Badan Perencanaan Pembangunan Nasional). (1992).** International Workshop on Long-Term Integrated Forest Fire Management in Indonesia, Bandung, 17-18 June 1992. Bappenas, Jakarta.
- Bin Tambi, D.J. (2002).** Malaysia's experience and perspectives in fire management, suppression and disaster response. Paper No.1 presented at the World Conference on Land & Forest Fire Hazards, Kuala Lumpur, Malaysia. 10-12, June 2002.
- BizAsia website (2003)** http://www.bizasia.com/economy_/gxer2/thailands_economic_growth.htm
- Bouaket, S. (1999).** Forest Fires in Lao PDR. Ministry of Agriculture and Forestry Department of Forestry, Forest Protection and Wood Industry Division, Vientiane, Lao People's Democratic Republic. IFFN No. 20 - March 1999
- Brauer M.& J. Hisham-Hashim, (1998).** Indonesian fires: Crisis and reaction *Environmental Science and Technology* 32: 404A-407A.
- Cambodia Daily website (1999).** <http://www.camnet.com.kh/cambodia.daily/> , Phnom Penh, Cambodia
- Cambodia Environment News Update (1999)** [http://www.bigpond.com.kh/users/ngoforum/WokingGroupIssues/Environment/Updated Information on the Environment.htm](http://www.bigpond.com.kh/users/ngoforum/WokingGroupIssues/Environment/Updated%20Information%20on%20the%20Environment.htm)
- Castillo, A. (2001).** Community-based fire management with a watershed sub-project in a remote area in the Philippines. In Ganz, D., Moore, P. & Shields, B.(eds.) *Community Based Fire Management Regional Workshop*, December 6-8, 2000. Regional Community Forestry Training Center, Bangkok, Thailand. RECOFTC Report 19. 87 p.
- Chan, B.S.T. (2001).** The Private Sector and Sustainable Forest Management — Southeast Asian Perspective. Paper presented at International workshop of experts on financing sustainable forest management, Oslo, Norway, 22 – 25 January 200. OSLO Workshop Document No.: OSLO/III.4/PS
- Chrystanto, S.Y. & A. Justianto. (2003).** National Forest Policy Review in. An Overview of Forest Policies in Asia. Information and Analysis for Sustainable Forest Management: Linking National and International Efforts in South and Southeast Asia (Enters, T., Qiang, M. & R.N. Leslie , eds.). Food and Agriculture Organization of the United Nations, Bangkok.
- Claridge, G. (2000).** Phou Hin Boun National Biodiversity Conservation Area (NBCA) Management Plan. FOMACOP, Vientiane, Lao PDR.

- Department of Forestry, Ministry of Agriculture and Forestry, Lao DPR. (2000).** Draft: Framework for Strategic Vision on Forest Resources Management to the Year 2020, Vientiane, Lao PDR.
- Duckworth, J.W., Salter, R. E., & Khounboline (1999).** Wildlife in Lao PDR: 1999 Status Report. Vientiane: IUCN- The World Conservation Union/ Wildlife Conservation Society/Centre for Protected Areas and Watershed Management.
- FAO (2002).** An Overview of Forest Products Statistics in South and Southeast Asia. Information and Analysis for Sustainable Forest Management: Linking National and International Efforts in South and Southeast Asia (Qiang, M. & J.S. Braodhead, eds.). Food and Agriculture Organization of the United Nations, Bangkok. 177 p.
- Fire Brigade Enactment (1966).** Brunei Fire Services Department, Ministry of Home Affairs, Government of Brunei Darussalam
- Forest Fire Control Office Website (2003),** Royal Forestry Department, Thailand http://www.forest.go.th/ForestFire/_private/indextrue.htm
- Forest Fire Control Office personal communication (2003),** Royal Forestry Department, Thailand
- Galt, A. Sigaty, T. & M. Vinton (Eds) (2000).** The World Commission on Protected Areas, 2nd Southeast Asia Regional Forum, Pakse, Lao PDR, 6-11 December 1999. IUCN, Vientiane, Lao PDR.
- Ganz, D.J & P.F. Moore (2002).** Living with Fire. In *Communities in Flames* Proceedings of 1st International Conference on Community Involvement in Fire Management (Moore,P., Ganz, D., Tan, L.C., Enters, T, & Durst, P. eds.), FAO RAP Publication 2002/25, 133 p.
- Gilmour, D.A. & Nguyen Van San (1999).** Buffer zone management in Vietnam. Hanoi: IUCN Vietnam.
- Global Fire Monitoring Center Website (2000).** IFFN country archive Indonesia and South East Asian Fire Monitoring. <http://www.uni-freiburg.de/fireglobe/>.
- Glover, D & Jessup, T. (1998).** The Indonesian Fires and Haze of 1997: the economic toll. <http://www.idrc.org.sg/eepsea/>.
- Glover, D & Jessup, T. (1999).** The Indonesian fires and haze: The cost of catastrophe. Institute of Southeast Asian Studies, Singapore and International Development Research Center, Canada.

- Goldammer, J. G., & S. R. Peñafiel. (1990).** Fire in the pine-grassland biomes of tropical and subtropical Asia. In: Fire in the tropical biota. Ecosystem processes and global challenges (J. G. Goldammer, ed.), 45-62. Ecological Studies 84, Springer-Verlag, Berlin-Heidelberg-New York, 497 p.
- Goldammer, J. G. (1985).** Multiple-use Forest Management. The Philippines. Fire Management. FAO: DP/PHI/77/011, Working Paper No. 17, Rome, 65 p.
- Goldammer, J. G. (1987).** TCP Assistance in Forest Fire Management. The Philippines. Forest Fire Research. FAO: TCP/PHI/66053 (T), Working Paper No. 1, Rome, 38 p.
- Goldammer, J.G., & B. Seibert (1990).** The impact of droughts and forest fires on tropical lowland rain forest of East Kalimantan. In: J.G. Goldammer (editor). Fire in the tropical biota. Ecosystem processes and global challenges. Ecological Studies 84. Springer-Verlag, Berlin-Heidelberg, Germany. pp. 11-31.
- Hassan, H.A. & A.C. Manila (1997).** Forest Fire Management and its influence on forest development in ASEAN. In *Transboundary pollution and the sustainability of tropical forests*. Edited by. Hassan, H.A, Taha, D., Dahalan, M. & Mahmud, A. ASEAN Institute of Forest Management, Kuala Lumpur.
- Heil A. (1998).** Air pollution caused by large scale forest fires in Indonesia 1997. Paper presented at South East Asian Land/Forest Fires: Science and Policy Workshop, Centre for Remote Imaging, Sensing and Processing (CRISP), 30 April -2 May 1998, Singapore.
- Hinrichs, A. (2000).** Financial losses due to the 1997/8 fires in timber concession of East Kalimantan, Indonesia. GTZ-SFMP Report (unpubl.), Samarinda, Indonesia.
- Hirsch, P. (1996).** Natural resource management in the Mekong River Basin: Perspectives for Australian Development Cooperation. Final Overview Report to Ausaid. (www.usyd.edu.au/su/geography/hirsch)
- Hon P. (1998).** Economic value of the 1997 haze damages to Singapore. Economy and Environment Program for Southeast Asia (EEPSEA) and World Wildlife Fund for Nature – Indonesia. Report 10 March 1998
- 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

- Igsoc, R. O. (1999).** Appropriate mission and structural organization concerning forest fire management, the Philippines. Paper presented during the 2nd International Workshop on Forest Fire Control and Suppression Aspects, Bogor, Indonesia, 16-21, February 1999.
- Ilicos Times Online (2003).** Ilicos Times Top News December 26 - January 01, 2003 www.ilicostimes.com/dec26-jan01-03/topnews_4.htm - 8k
- Innovation science magazine (2003)** Vol. 3. Number 3. World Scientific Publishing and National, University of Singapore, Singapore.
- Jurvélius, M., & D. L. Bartolazo. (1995).** Creation of a new Forest Protection and Rehabilitation Division. *Int. Forest Fire News* No. 13, 18-19.
- Lebel, L. (1998).** Impacts of transboundary haze from vegetation fires on tourism in Southeast Asia. Discussion Paper for the Satellite Workshop on the Impacts of 1997/1998 Transboundary Haze Episode on Tourism in SE Asia. Walailak University/IC-SEA. Tha sala, Nakhon-sri-Tammarat, 25 October 1998
- 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
- London, S. (2003, in Press).** Community-based fire management in the Lao People's Democratic Republic: past, present and future In *Community-based fire management: case studies from China, The Gambia, Honduras, India, Lao People's Democratic Republic and Turkey*. Joint FAO RAP/ PFFSEA Publication.
- McLellan, R. (2003).** Profile on the Eastern Plains Conservation Landscape: Mondulkiri, Kratie, Stung Treng, and Ratanikiri Provinces, Cambodia, and Dac Lac and Gia Lai Provinces, Vietnam. WWF Cambodia Report. Phnom Penh, Cambodia. 6 p.
- Markarabhirrom, P., Ganz, D. & S. Onprom (2000).** Forest Fire & Community Involvement: A Case Study in Thailand. Paper presented at the International Workshop on "Community Based Fire Management" (Ganz, D., Moore, P., & B. Shields, eds.) RECOFTC, Bangkok, Thailand, December 6-8, 2000. RECOFTC Report 19, pp 21-33.
- Makarabhirom, P., Ganz, D. & 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 (Moore, P., Ganz, D., Tan, L.C., Enters, T, & Durst, P. eds.), FAO RAP Publication 2002/25, 133 p.
- Moore, P.F. (2001).** Unpublished trip report. Long Son Province, Cao Loc District Project Firefight South East Asia. 23rd February – 2nd March 2001

- Myanmar Data on Internet (1995).** Myanmar Home Page, Fire Services Department <http://www.myanmar.com/DATA/21-02.htm>
- Nath, P., T. Maung & T. Zin (1998).** FAO working paper 1998: FAO technical assistance in Myanmar. Yangon.
- National Statistics Center. (1997).** Lao Census 1995, country report. Vientiane: State Planning Committee, Government of Lao PDR.
- Nichol J. (1998).** Smoke haze in SE Asia: A predictable recurrence. *Atmospheric Environment* 32: 2715-2716.
- Pajarillaga, G.D. & F.P. Lansigan. (2000).** Forest fire control and management in the Philippines. Paper presented at the Regional Workshop on Forest Fire Management Collaboration in ASEAN, 29-31 March 2000, Chiang Mai, Thailand.
- Pham, N.G. (1999).** Community based forest fire management for biodiversity conservation in Vietnam. Paper presented at the Proceedings of First International Workshop on National Guidelines on the Protection of Forests against Fire, March 1999, Bogor, Indonesia.
- Phien, T., & N. T. Siem. (1998).** Sustainable cultivation on sloping land in Vietnam. Ha Noi. http://www.rrcap.unep.org/reports/soe/vietnam/issues/pressure/land_pressure.htm
- Pinto J., Grant, L.D. & T.A. Hartlage (1998).** Report on US EPA Air Monitoring of Haze from S.E. Asia Biomass Fires. EPA/600/R-98/071. USEPA, National Center for Environmental Assessment, Research Triangle Park, NC.
- Ploadpliew, A., Viriyarattanaporn, T., & Phononghai (2001).** Mae Hong Son, Community Forest Fire Control Project. Unpublished paper submitted to the International Conference "Communities in Flames", Balikpapan, East Kalimantan, Indonesia, July 25-28, 2001
- Pogeyed, M. L. (1998).** No Fire Bonus Plan Program of Mountain Province. *Int. Forest Fire News* No. 18, 52-56.
- Poffenberger, M. (1997).** Rethinking Indonesian forest policy: Beyond the timber barons. *Asian Survey* 37(5):453-469.
- Quyen, N.H. & Minh T. Y. (2003).** Vietnam National Center for Natural Science and Technology Website www.unescap.org/enrd/space/RWDM_Bangkok/Powerpoint/VIETNAM-ForestFire-Quyen.ppt
- Rakyutidharm, 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 (Moore, P., Ganz, D., Tan, L.C., Enters, T., & Durst, P. eds), FAO RAP Publication 2002/25, 133 p.
- Rao, S. (2003 In Press).** Forest fire management in Cambodia. In *Fires, Laws and Regulations towards best practice for legal aspects of fire* Workshop Report. June 2-4, 2003. Hanoi, Vietnam. Project FireFight South East Asia
- Rao, S. (2001).** Forest fire management in Cambodia and its Prevention Remedies. In *Community Based Fire Management Regional Workshop* (Ganz, D., Moore, P. & Shields, B., eds.), December 6-8, 2000. Regional Community Forestry Training Center, Bangkok, Thailand. RECOFTC Report 19. 87 pages.
- Rao, S. (2001).** Forest fire management in Cambodia and its Prevention Remedies. South East Asia Forest Fire Scientist Network Meeting, April 5-7, 2001, Faculty of Forestry, Bogor Agriculture University, Bogor, Indonesia
- Roder, W. (1995).** Relationship between ethnic groups and land use in the hilly areas of Laos. Submitted for publication in *Human Ecology*, October 1995, IRRI-Lao Project, Luang Prabang, Lao PDR.
- Rundel, P. W. (1999).** Forest Habitats and Flora in Lao PDR, Cambodia and Vietnam- draft. Conservation Priorities in Indochina- WWF Desk Study. WWF Indochina Program, Hanoi.
- Samsudin Musa and Wan M. Shukri Wan Ahmad. (1998).** Report on the status of forest fires in Kelantan and Terengganu. Forest Research Institute Malaysia (unpubl.).
- Sanders, B. (2002).** Fire Fire Incident Assessment Report, U Minh Ha Forest and U Minh Thuong National Park, Ca Mau and Kien Giang Provinces, Vietnam. April 20 – 26 2002. Global Fire Monitoring Center Website. IFFM final report 2002. 11 p.
- Savet, E. & Sokhun, T. (2003).** National Forest Policy Review in. An Overview of Forest Policies in Asia. Information and Analysis for Sustainable Forest Management: Linking National and International Efforts in South and Southeast Asia (Enters, T., Qiang, M. & R.N. Leslie , eds.). Food and Agriculture Organization of the United Nations, Bangkok.
- Savet, E. (1999).** Forest and Land Fire Prevention in Cambodia.). Global Fire Monitoring Center Website, IFFN No. 20 - March 1999, p. 2-5
- Shahwahid, H.O. & O. Jamal. (1999).** Malaysia. Chapter 3, Indonesia's fires and haze: The cost of a catastrophe (Glover, D. & T. Jessup, eds.). Institute of South East Asian Studies. Singapore.

- Shulman, D. (2002).** Fire Management Assessment, Tram Chim National Park, Dong Thap Province. Global Fire Monitoring Center, IFFN No. 26 – January 2002, p. 106.
- Simorangkir, D. & 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 p.
- 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. In Community Forest Newsletter 5 (10): 13-15. RECOFTC.
- Thai, S. K. (2000).** Malaysia country report. Paper presented at the Regional Workshop on Forest Fire Management Collaboration in ASEAN, 29-31 March 2000, Chiang Mai, Thailand.
- Travel Asia 1997. 10 October (1997).** This is the time for ASEAN unity. http://www.travel-asia.com/10_10_97/
- U. Myat Thinn (1999).** Forest Fire Prevention and Management in Myanmar. Global Fire Monitoring Center Website, IFFN No. 20 - March 1999, p. 21-28
- UNDP & FAO (1994).** The Cambodia Land Cover Atlas 1985/87 - 1992/93. The Mekong Secretariat for Project CMB/92/005.
- Van Chieu (2001).** Effectiveness of the forestland allocation program on forest fire reduction in Cao Lau Commune, Cao Loc District, Lang Son Province, Vietnam. Paper presented at the International Workshop on “Community Based Fire Management” (Ganz, D., Moore, P., & B. Shields, eds.) RECOFTC, Bangkok, Thailand, December 6-8, 2000. RECOFTC Report 19, pp 73-75.
- Wan M. Shukri Wan Ahmad (2001).** Global Fire Monitoring Center Website, IFFN No. 26, January 2001, p. 66-74
- World Bank (2001).** Indonesia: Environment and natural resource management in a time of transition. World Bank, Washington, D.C., USA