The ASEAN Fire Forum: Initial Thoughts towards Cooperation in Fire and Smoke Research and Management in the ASEAN Region

AIFM Conference on Transboundary Pollution and the Sustainability of Tropical Forests:
Towards Wise Forest Fire Management
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Abstract

The application of fire in land-use systems in the ASEAN region has reached unprecedented levels and has been leading to increasing environmental problems. Traditional shlash-and-burn systems in the shifting agriculture mode have been replaced by modern large-scale conversion of forest into permanent agricultural systems which are partially maintained by fire, and into forest plantations. Wildfires escaping from land-use fires are becoming more and more regular. The impact of land-use fires and wildfires are detrimental to biodiversity and the atmospheric quality at SE Asian regional scale. Within the ASEAN region a joint, concerted approach is needed to cope with the problem of transboundary pollution caused by vegetation burning. However, since fire is an essential tool in land use in the tropics a response strategy must be developed in which the benefits from fire use would be encouraged, at the same time the negative impacts of fire be reduced. A regional fire management action plan must take into consideration the complexity and diversity of fire uses in different vegetation types and land-use systems.

Introduction

In this introductory paper to the ASEAN Fire Forum, an overview is given on the fire environment in insular and mainland South East Asia. This paper will not go into the basic details, which have been presented elsewhere (e.g. Goldammer et al. 1996), including this conference (see Goldammer, this volume). The paper summarizes the basics of fire and fire-generated smoke problems in SE Asia and provides the background of international initiatives in which an ASEAN-wide activity in fire research and management may play an important role to meet the objectives of these international initiatives.

Fire has been present in the SE Asian biota since the Pleistocene. Long-term climate variability (glacial vs. non-glacial climate) and short-term climate oscillations caused by the El Niño - Southern Oscillation (ENSO) event have repeatedly created conditions that make even rain forest subjected to wildfires. The occurrence of wildfires is increasing with modern land-use changes. Forest degradation and repeated fires lead to the formation of fire climax grasslands (alang-alang) of low productivity and short-return interval fires. In monsoon forests of mainland South Asia, annual fires during the dry season have shaped the composition and productivity of this forest environment by selecting fire-tolerant species. Severe problems of land degradation (erosion, loss

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of nutrients) are the consequence of fires in these seasonally dry forests. Fire protection (fire exclusion) leads to a progressive development towards a more species-rich forest ecosystem. Fire climax pine forests are found in all SE Asian mountain regions. Burning of agricultural crop residuals, especially rice straw burning, add to the smoke generated by conversion fires and wildfires.

The fire events of in SE Asia in the seasons of 1982-83, 1987, 1991, and 1994 led to several national and international initiatives, especially in Indonesia. The Bandung Conference (Indonesia) of 1992 developed a "Long-Term Integrated Forest Fire Management Strategy" for Indonesia. Examples are given on the implementation of the Bandung Strategy.

Furthermore the paper describes the role of fire-generated emissions from SE Asia on global cycles. The South East Asian Fire Experiment (SEAFIRE), a planned research programme under the International Geosphere-Biosphere Programme (IGBP), intends to clarify the mechanisms of origin, transport and impacts of fire emissions on the regional and global atmosphere.

A strong pan-ASEAN Fire Management Programme is proposed. This program should take advantage and coordinate all national fire management programs in the region, through the "ASEAN Forest Fire Management Action Plan", and include various other initiatives in fire research and management.

The program will contribute to meet the objectives of various agreements and activities under the auspices of the United Nations, e.g. the United Nations Food and Agriculture Organization (FAO), the United Nations Environmental Programme (UNEP), the International Tropical Timber Organization (ITTO), the International Decade for Natural Disaster Reduction (IDNDR), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Disaster Relief Organization (UNDRO), and the United Nations Commission on Sustainable Development (CSD).

The Fire Environment in Insular and Mainland SE Asia

Fire, Climate Change and Climate Oscillations

Prehistory and history of fire in the different South East Asian vegetation types is closely linked with the effects of climate variability and human influences. Long-term climate changes, e.g. the glacial periods during the Pleistocene, created conditions for a more pronounced seasonal climate. It is generally recognized that during the last Ice Age the transfer of water from the oceans to continental ice caps lowered the global sea level by at least 85 m (CLIMAP 1976). Besides exposing land, especially on the Sunda Shelf, the drop in ocean water levels may have caused the development of an overall arid climate at that time. Although palynological evidence from the tropical lowlands is still very scarce (Flenley 1982), it must be assumed that lowland vegetation was generally that of areas with a more pronounced dry season. At that time, fuel characteristics and flammability of the prevailing vegetation must have created conditions suitable for the occurrence of wildfires. Evidence of ancient wildfires in East Kalimantan was found by Goldammer and Seibert (1990). ^{14}C-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 (BP).

Contemporary climate variability in SE Asia are linked with the El Niño-Southern Oscillation (ENSO) phenomenon. The ENSO phenomenon is regarded as one of the most striking examples of inter-annual climate variability on a global scale. It is caused by complicated atmospheric-oceanic coupling. The event is initiated by the Southern Oscillation, which is the variation of pressure difference between the Indonesian low and the South Pacific tropical high. During a low pressure gradient, the westward trade winds are weakened, resulting in the development of positive sea surface temperature anomalies along the coast of Peru and most of the tropical Pacific Ocean (low phase of the Walker Circulation). The inter-tropical convergence zone and the South Pacific convergence zone then merge in the vicinity of the dateline, causing the Indonesian low to shift its position into that area. Subsequently, during a typical ENSO event, the higher pressure over Malesia leads to a decrease in rainfall and the trapping of emissions from forest and other vegetation burning in the lower troposphere. The severity of the dry spells depends on the amplitude and persistence of the climate oscillations. The most severe drought in the recent history occured in 1982-83, followed by slightly less severe droughts in 1987, 1991 and 1994.

In the rain forest biome these prolonged droughts drastically change the fuel complex and the flammability of the vegetation. Once the precipitation falls below 100 mm per month, and periods of two or more weeks without rain occur, the forest vegetation sheds its leaves progressively with increasing drought stress. In addition, the moisture content of the surface fuels is lowered, while the downed woody material and loosely packed leaf-litter layer contribute to the build-up and spread of surface fires. Aerial fuels such as desiccated climbers and lianas become fire ladders potentially resulting in crown fires or "torching" of single trees.

Peat swamp forests found in the lowlands of Borneo represent another fuel type. With increasing precipitation deficit and a lowering of the water table in the peat swamp biome, the organic layers progressively dry out. During the 1982-1983 ENSO, various observations in East Kalimantan confirmed a desiccation of more than 1 to 2 m (Johnson 1984). While the spread of surface and ground fires in this type of organic terrain is not severe, deep burning of organic matter leads to toppling of trees and a complete removal of standing biomass. It is further assumed that smoldering organic fires may persist throughout the subsequent rainfall period, to be reactivated as an ignition source in the next dry spell (Goldammer and Seibert 1990). Such re-ignition is similar to fire behavior in organic terrain of northern boreal ecosystems.

Long-lasting fires in coal seams extending to, or near, the surface, are found in various rain forest sites in East Kalimantan and are another important source for wildfires spreeading into the surrounding forest (Goldammer and Seibert 1990; Bird 1995). It has been assumed that all of the ca. 150 coal seam fires known to be burning at present (White 1992) were ignited by the 1982-1983 wildfires. This is questioned by Goldammer and Seibert (1989), since there are numerous oral reports of burning coal seams made before in 1982-1983 drought. Bock (1881) reported that Modang people consider the burning of coal seams "since the memory of man". Goldammer and Seibert (1990) focused their research on dating ancient coal seam fires by investigating the "baking" effects of subsurface fires on sediment or soil layers on top of the coal seams. These effects of old, meanwhile exinguished, coal seam fires can still be seen today. The material, locally called "baked mudstone" is utilized at present for road construction purposes. Thermoluminescence analysis of burnt clay, collected on top of an extinguished coal seam in the vicinity of active coal fires, proved a fire event 13,200 to 15,300 years BP. It is assumed that ancient coal fires were ignited by lightning.

Fire Regimes and Smoke Sources

Fire in Tropical Rain Forests: A Tool for Land Use and Land-Use Changes

In the rain forest ecosystems of SE Asia the prevailing source of fire and smoke is linked to human land-clearing activities:

- Temporary forest conversion by traditional slash-and-burn systems
- Permanent forest conversion for establishment of agricultural land-use systems
- Conversion of natural forest (mainly exploited or otherwise degraded secondary forest) into forest plantations
- Wildfires: Uncontrolled fires escaping from land-use fires into surrounding natural forest and forest plantations

The last years with extraordinary fire activities in SE Asia were influenced by the "low phase" of the Walker Circulation. The droughts of 1982-83, 1987, 1991, and 1994 favoured land clearing activities as well as the spread of wildfires. While the fire season of 1982-83 was characterized by large-size wildfires on several million hectares, caused by escaped land-use fires, the situation was different in the following years. The smoke emitted from the Indonesian archipelago in 1987, 1991, and 1994 came mainly from land-use fires.

The data on the extent of burning in 1994 in Indonesia, collected and released by the Ministry of Forestry, are a good example for the source of smoke in that particular year. The survey indicates that a total land area of ca. 5.1 million ha had been affected by fire. The extent of uncontrolled forest fires was small as compared to land-use fires (Tab.1).

As a consequence of the Low Phase of the Walker Circulation, which dominated these years of high fire activity, the smoke was trapped in the lower troposphere. A typical regional "smog" situation developed and caused enormous health and saftey problems in Indonesia and its neighbour countries of Southeast Asia, particularly in Singapore and Malaysia.

However, additional typical fire and smoke sources in the South East Asian region must be identified before drawing conclusions for a regional approach in fire and smoke management. They are described briefly below.

Tab.1. Vegetation and land-use systems subjected to fire in Indonesia during the 1994 fire season. Source: Ministry of Forestry, Indonesia.

Vegetation / Land-Use TypeAffected by Fire	Area Burned (ha)
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

Fire in Severely Disturbed (Savannized) Vegetation

It is generally observed that disturbed rain forest is aggressively invaded by pyrophytic grasses. In SE Asia the most important post-disturbance invader is *Imperata cylindrica* (Alang-alang). Large tracts of tropical lowlands formerly occupied by rain forest are now degraded *Imperata* grasslands. It has been estimated that in Indonesia alone more than 50 million ha disturbed sites are covered by *Imperata* fields. These grasslands become highly flammable during dry spells and are maintained by short fire-return interval fires (predominantly 1-yr fire intervals) in a fire climax stage which is characterized of low biodiversity and productivity. The fires are intentionally set by rural people in order to keep down the regrowth of bush and secondary forest. Escaping agricultural burns are the other main cause of alang-alang fires.

Basically similar disturbance- and fire-generated forms of degraded vegetation are found in other vegetation types and physiognomic life forms, e.g. in degraded dry or mixed deciduous dipterocarp forests of mainland South Asia (cf. next paragraph).

Fire in Seasonally dry Forests

The occurrence of seasonal dry periods in the tropics of South Asia increases with distance from the perhumid equatorial zone. The forests gradually develop to more open, semi-deciduous and deciduous formations (e.g., dry dipterocarp forest, mixed deciduous forest, dry evergreen forest, hill evergreen forest). The main fire-related characteristics of these formations are seasonally available flammable fuels (grass-herb layer, shed leaves) which allow the spread of surface fires. Grass species, understory plants (shrub layer) and the overstory (tree layer) are adapted to regular fire influence. The fires usually develop as surface fires of moderate intensity and tend to spread over large areas of forested lands. The tree layer is generally not affected by the flames, although crowning may occur earlier in the dry season when the leaves are not yet shed. In some cases fires

may affect the same area two or three times per year, e.g., one early dry season fire consuming the grass layer and one subsequent fire burning in the shed leaf litter layer (Goldammer 1993).

No reliable information exists on the extent of recurring fires in the seasonal forests of the ASEAN region. It was estimated that in Burma between 3-6.5x10^6 ha of forests are annually affected by fire (Goldammer 1993). A report from Thailand in the late 1980s estimated an annually burned area of ca. 3.1x10^6 ha, predominantly in dipterocarp monsoon forests. The affected area has diminished considerably since then: measures of fire protection have reduced the average area burned to ca. 1.4x10^6 ha (cf. report of S. Akaakara, this volume). The analysis of historic information from British India reveals that during the last century and early this century almost all Indian deciduous forests were burned every year (Goldammer 1993).

The effects of the annual wildfires in the seasonal forests are different from those occurring in moist forest ecosystems: The surface fires in the seasonal forests consume less fuel per area unit, thus producing different quantities of emissions. The area regularly affected by wildfires in the seasonal forests, however, is very large as compared to the wildfires in the near-equator forests. The contribution by Malingreau *et al.* (this volume) on first regional assessments of fire occurrence in SE Asia provide a good picture of the seasonality and geographic distribution of fires. These "fire calendars" need to be translated into quantitative and qualitative information on fire occurrence and fire impacts.

Submontane and Montane Fire Climax Pine Forests

In mainland South Asia and Insular SE Asia the pines (*Pinus* spp.) are largely confined to the zone of lower montane rain forest. They are usually found on dry sites and prefer a slight to distinct seasonal climate. Most tropical pines are pioneers and tend to occupy disturbed sites, such as landslides, abandoned cultivation lands and burned sites. Besides the pioneer characteristics, most tropical pines show distinct adaptations to a fire environment (bark thickness, rooting depth, occasionally sprouting, high flammability of litter) (Goldammer and Peñafiel 1990). The tropical pure pine forests of South Asia, e.g., *Pinus khesyia, Pinus merkusii, Pinus roxburghii*, most often are the result of a long history of regular burning. As in the tropical deciduous forests, fires are mainly set by graziers, but also spread from escaping shifting cultivation fires and the general careless use of fire in rural lands. Fire return intervals have become shorter during the last decades, often not exceeding one to five years. These regularly occurring fires favor the fire-adapted pines which replace fire-sensitive broadleaved species. Tropical fire climax pine forests occur throughout submontane elevations in Burma, Thailand, Laos, Kampuchea, Viet Nam, the Philippines (Luzón) and Indonesia (Sumatra).

The pine forest area annually burned within SE Asia is not exactly known. The total size is smaller as compared to the seasonal deciduous forest biome. However, the pine forest are critically important for the ecological stability of the mountain landscapes. In any ASEAN fire management program these forest ecosystems therefore must receive special attention.

Crop Residual Burning: Rice Fields, Weed and Succession Control, and Waste Disposal

The burning of vegetation residues and the use of fire for weed control and other regular burning takes place all over SE Asia's lands, which have been permanently converted into agricultural and pastoral land-use systems. Most striking is the burning of rice paddies, which leads to severe seasonal haze in the region.

The total extent of agricultural residue burning is not known at present. However, some first estimates made for rice straw burning in Viet Nam show that ca. 20 Tg (20 million tons) of rice straw are exposed to fire in this country alone which contribute significantly to regional air pollution budgets (for details cf. Nguyen *et al*. 1995).

Burning of household waste finally adds to the manifold open fires in the region. In these fires vegetation residues are increasingly mixed with other waste types, e.g. plastic materials, etc.

Other Emission Sources: Biofuel and Fossil Fuel Burning

The use of biofuels (fuelwood) in households is another source of plant biomass combustion. Together with fossil fuel burning, these emissions do not contribute significantly to regional haze. However, the emissions of aerosol and the non-visible trace gases add to the overall anthropogenic emission budgets of the region. They need to be included in regional assessments and mitigation strategies at national and regional scale. The research component of future ASEAN-wide haze management plans must include these components.

Regional and National Initiatives in Fire and Smoke Management

Regional Initiative on "Transboundary Haze Pollution" in the SE Asian Region

The regional smog events of 1991 and 1994 triggered a series of regional measures towards cooperation in fire and smoke management. In 1992 and 1995 regional workshops on "Transboundary Haze Pollution" were held in Balikpapan (Indonesia) and Kuala Lumpur (Malaysia). This was followed by the establishment of a "Haze Technical Task Force" during the *Sixth Meeting of the ASEAN Senior Officials on the Environment (ASOEN)* (September 1995). The Task Force is chaired by Indonesia and comprises senior officials from Brunei Darussalam, Indonesia, Malaysia, and Singapore. The objectives of the work of the task force is to operationalize and implement the measures recommended in the ASEAN Cooperation Plan on Transboundary Pollution relating to atmospheric pollution, including particularly the problem of fire and smoke (ASEAN 1995).

The AIFM Plan of Action Regarding Forest Fire Management is a proposal, which aims to fulfill the actions required by the ASEAN Cooperation Plan. The proposal is described by the following two papers in this volume and discussed in the ASEAN Fire Forum (see working group reports).

National Initiatives I: Development of a Long-Term Integrated Forest Fire Management Strategy in Indonesia

As a consequence of the smog episode of 1991 in SE Asia which was mainly caused by fires burning on the Indonesian archipelago the Government of Indonesia called for international cooperation to support national fire management capabilities. In June 1992, an international conference on Long-Term Integrated Forest Fire Management was held in Bandung. Participants were national agencies involved in fire management and the international community represented by national and international development organizations and potential donors. The objective of the conference was to develop the framework for an internationally concerted action plan on "Long-Term Integrated Forest Fire Management" for Indonesia. In this programme all partners involved are sharing expertise and resources in fire management (Bappenas 1992).

Implementation of the "Bandung Strategy" is underway. In 1994, a bilateral Indonesian-German project "Integrated Forest Fire Management" (IFFM) became operational. The project is aimed to build up fire management capabilities in the Province of East Kalimantan (project duration: 1994-2000; for details: cf. contribution by H. Abberger, this volume). The IFFM system includes community-based fire management approaches. IFFM will serve as a model for other Indonesian provinces. IFFM closely cooperates with:

- the Japan International Cooperation Agency (JICA) which is implementing fire management projects in Sumatera (Jambi) and West Kalimantan;

- the European Union project "Forest Fire Prevention and Control Project" (FFPCP) in Sumatera (Palembang);

- the UK Overseas Development Administration (ODA) "Fire Warning Project" in Central Kalimantan;

- the Food and Agricultural Organization of the United Nations (FAO) at the central level (Ministry of Forestry; meanwhile terminated); and

- the United States Department of Agriculture (USDA) and US AID which are conducting fire management training courses (inter-project).

In 1995, a "National Coordination Team on Forest and Land and Fire Management" (c/o Environmental Impact Management Agency BAPEDAL) was established at national level. This coordination body provides a round table for all national parties involved in fire and smoke management and supports the activities of the "National Preparedness Assembly" (see contribution by A. Deddy, this volume).

National Initiatives II: The Fire Response Plan of Thailand

Most fires in Thailand occur in seasonally dry forest types as described above. Estimates made in the early 1970s indicated that more than 18 million hectares of forested land were burned annually. During the period 1985 and 1986 aerial surveys indicated that still ca. 3.7 million ha were burned annually. This number was reduced to 1.4 million ha (equivalent to 10% of the

forested area). The reduction of annually burned surface was the result of an ambiguous program which followed a Cabinet Resolution of 1981 (for more details cf. contribution by S. Akaakara, this volume). The Forest Fire Control Section in the Forest Management Division of the Royal Forest Department (RFD) was established in 1976 and upgraded to a Division of Forest Fire Control (RFD) in 1993. The efficiency of the national measures in fire prevention and control is the most advanced in SE Asia and may significantly contribute to an ASEAN-wide fire and smoke management program.

Research Initiatives

Fire Ecology

Fire research in the South East Asian region in the 1980s largely concentrated on fire effects on ecosystem properties and ecosystem stability. Much of this research has been summarized in the following publications (besides research results these publications provide a review of numerous sources of scientific papers and government reports on specific countries and forest types):

- Lowland rain forest (Goldammer and Seibert 1990)
- Lowland deciduous forest (Stott *et al.* 1990)
- Pine-grassland biomes (Goldammer and Peñafiel 1990)
- Dipterocarp forest in general (Goldammer *et al.* 1996)
- The voluminous ITTO reports on "Assessments of Fire Damage and Rehabilitation of Dipterocarp Rainforests in Indonesia" (all cited in Appendix 8 of the "ITTO Guidelines for Fire Management in Tropical Forests", reproduced in this volume; the results are summarized in the publication of Goldammer *et al.* [1996])
- A major SE Asian fire synthesis contained in a monograph on tropical fires (Goldammer 1993)

The state of research provides a tremendous knowledge of basic fire impacts. However, it also reveals a still lacking research on long-term observations of fire-affected ecosystems.

The Socio-Economic and Cultural Background of Fires

While many of the publications cited above contain information on fire causes, there are only few in-depth studies available on the socio-economic and cultural aspects of managing the fire problem. The forest fire management system in Thailand has its strong base on a fire prevention approach which is being realized by a close cooperation with the local population (cf. contribution by S. Akaakara, this volume). The same refers to the IFFM approach in Indonesia (cf. contribution by H. Abberger, this volume; see also the work of Otsuka [1991] on forest management and farmers in East Kalimantan). A basic study on the socio-economic and cultural background of forest fires in the pine forests of the Philippines was conducted in the late 1980s and reveals the usefulness of such surveys for further management planning (Noble 1990).

Despite of the initial efforts it must be stated that there is a tremendous gap of expertise and available methodologies of socio-economic and cultural approaches in integrating people into operational fire management systems.

Interdisciplinary Research: Coupling of Ecological, Atmospheric and Climate Research in the IGBP/IGAC SEAFIRE Programme

The main driver of this AIFM conference is the transboundary pollution caused by smoke from vegetation fires. Haze (smog) is the visible consequence of fire in the region with all its well known impacts on human health, traffic safety (air, ground, marine) and other effects. The paper of Tsuruta (this volume) highlights the atmospheric chemical phenomena described by different sensors during the 1994 fire season in SE Asia.

A systematic, quantitative and qualitative regional research approach, however, is still missing. This gap will be filled by the South East Asian Fire Experiment (SEAFIRE). SEAFIRE is a planned research activity under the scheme of the International Geoshere-Biosphere Programme (IGBP). The International Global Atmospheric Chemistry (IGAC) Project is a core project of IGBP. One of the activities of IGAC Focus 2 (Natural Variability and Anthropogenic Perturbations of the Tropical Atmospheric Chemistry) investigates the impact of biomass burning on the atmosphere and biosphere (Biomass Burning Experiment [BIBEX]). SEAFIRE will establish the fire research component within the Integrated SARCS/IGBP/IHDP/WCRP Study "Human Driving Forces of Environmental Change in Southeast Asia and the Implications for Sustainable Development" (references: cf. Goldammer, this volume).

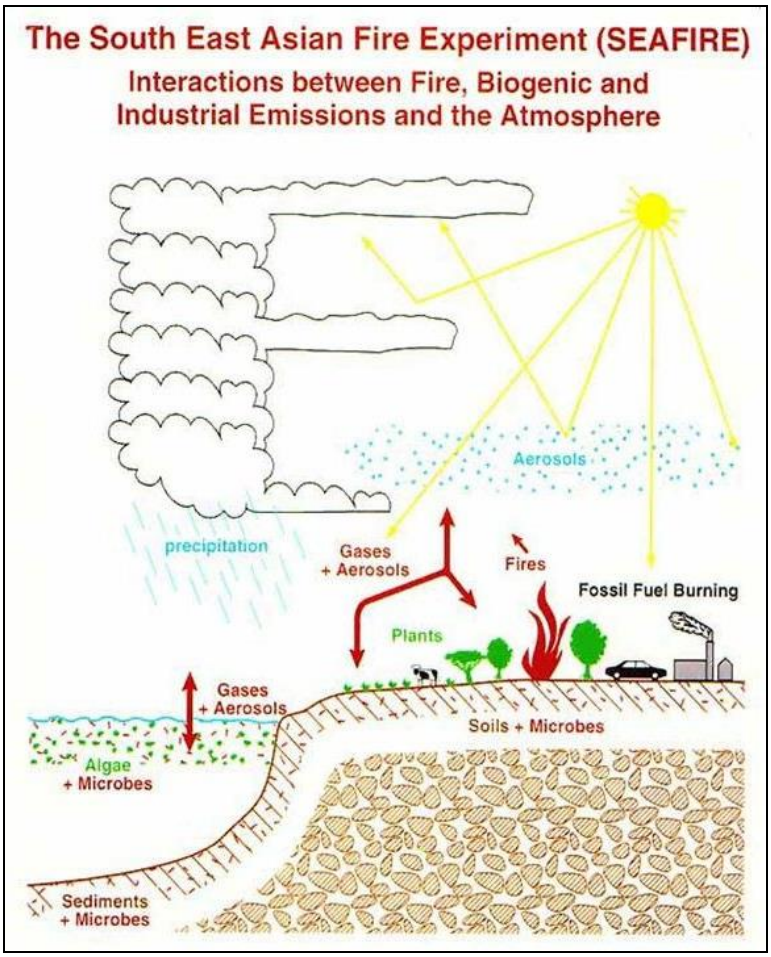
SEAFIRE will take place in the late 1990's and investigate the ecological impacts of fire in land use (fires used in forest conversion and shifting cultivation, grassland and seasonally dry [monsoon] forests) and the characteristics and regional and global transport of pyrogenic emissions. Biogenic and marine sources of trace gases and aerosols will be considered. Special emphasis will be laid on inter-annual climate variability (ENSO vs. non-ENSO) and the role of the "Warm Pool" in global distribution of fire products (cf. also Goldammer, this volume).

The SEAFIRE procedures will include or coordinate with other regional (ASEAN) activities in fire management and research, e.g. the planned AIFM Forest Fire Management Plan of Action, the national projects mentioned above (e.g., Indonesia's IFFM and FFPCP, the Thailand Fire Response Plan.), and international programmes, such as the remote sensing programme conducted in cooperation between the EU (Institute for Remote Sensing Applications), the PR China, Viet Nam, and NASA (Langley Research Center) (cf. contribution by J.P. Malingreau *et al.*, this volume).

The SEAFIRE programme had its first two planning meetings in 1995-96:

- September 1995: Initial scientific planning workshop (Samarinda, East Kalimantan, Indonesia)
- Two planning sessions at the 13th Conference on Fire and Meteorology (Lorne, Australia, 27-31 October 1996)

It is intended to start implementation of SEAFIRE in 1998 with a combined ground- and aircraft-based campaign and evaluation of remotely sensed data. Any further progress in SEAFIRE planning will be published in International Forest Fire News and through the SEAFIRE Web Site (http://tooms.arts.monash.edu.au/~seafire/).



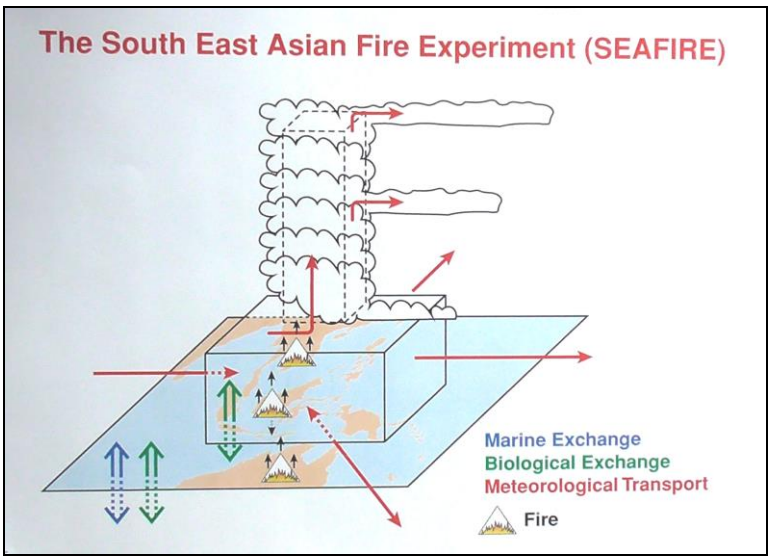


Fig. 1a,b. The South East Asian Fire Experiment (SEAFIRE) will be devoted to clarify the interactions between emissions from vegetation burning, biogenic sources and industry and the regional and global atmosphere.

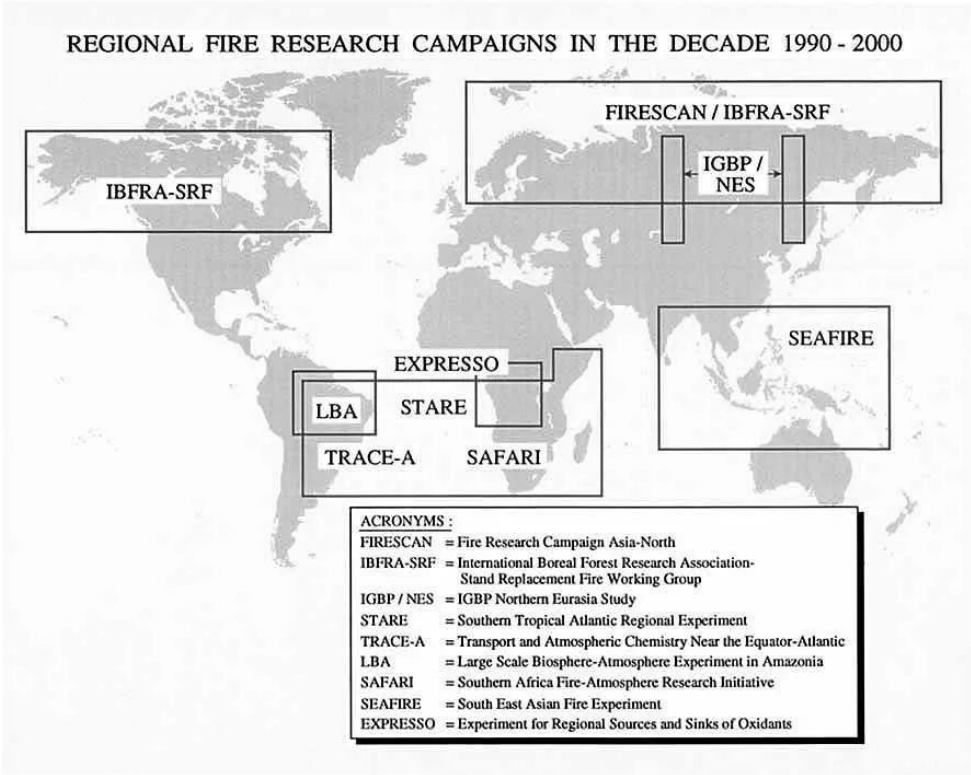


Fig. 2. World map showing the target areas of regional fire research campaigns, including the SEAFIRE region, which are in the stage of implementation or planning (from Goldammer 1994, updated).

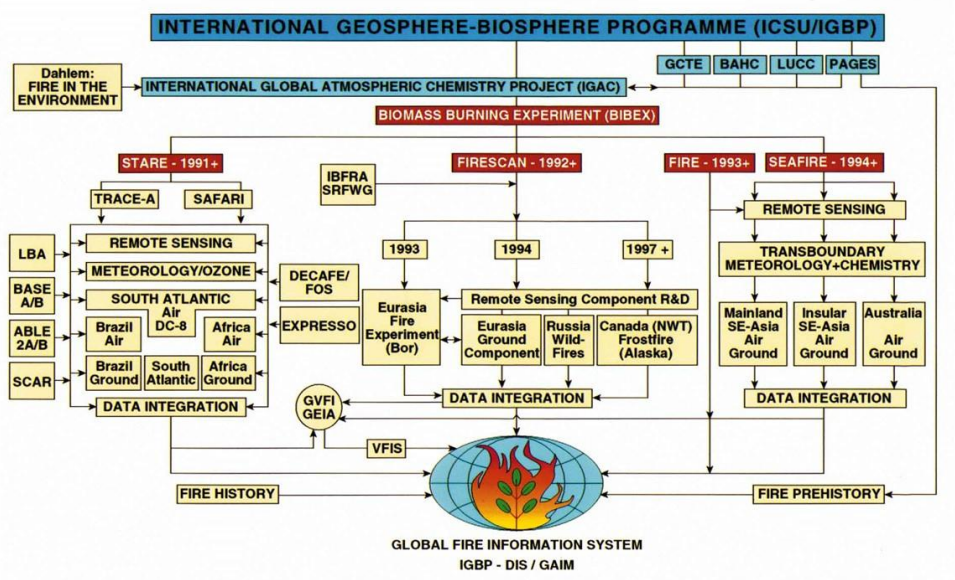


Fig. 3. Organizational diagram of international fire research activities, which will be integrated into the development of a global fire model. Acronyms are explained in the main text (from Goldammer 1994, updated).

Tab. 2. List of acronyms of regional and global fire research activities (cf. Fig. 2, 3)

List of Acronyms of Regional and Global Fire Research Activities

ABLE	Amazon Boundary Layer Experiment (→ GTE)
BIBEX	Biomass Burning Experiment (→ IGAC)
EXPRESSO	Experiment for Regional Sources and Sinks of Oxidants
FIRE	Fire in Global Resource and Environmental Monitoring (CEC-JRC)
FIRESCAN	Fire Research Campaign Asia – North (→ IGAC)
FOS/DECAFE	Fire of Savannas/Dynamique et Chimie Atmosphérique en Forêt Équatoriale
GAIM	Global Analysis, Interpretation and Modeling
GEIA	Global Emissions Inventory Activity (→ IGAC)
GTE	Global Tropospheric Experiment
IBFRA	International Boreal Forest Research Association
ICSU	International Council of Scientific Unions
IGAC	International Global Atmospheric Chemistry Project (→ IGBP)
IGBP	International Geosphere-Biosphere Programme (→ ICSU)
IGBP-DIS	IGBP Data and Information System
IGBP-NES	IGBP Northern Eurasia Study
LBA	Large Scale Biosphere-Atmosphere Experiment in Amazonia
SAFARI	Southern African Fire-Atmosphere Research Initiative (→ IGAC)
SCAR	Smoke, Clouds, Aerosols, and Radiation Experiment
SEAFIRE	South East Asian Fire Experiment (→ IGAC)
STARE	Southern Tropical Atlantic Regional Experiment (→ IGAC)
SRFWG	Stand Replacement Fire Working Group (→ IBFRA)
TRACE-A	Transport and Atmospheric Chemistry Near the Equator - Atlantic
VFIS	Vegetation Fire Information System (→ Dahlem Konferenz Model)

Other International Initiatives Relevant to an ASEAN Programme

Several other international activities should be closely linked or coordinated with an ASEAN-wide fire programme. Some initiatives have been mentioned before, e.g. the activities of ITTO (cf. ITTO contributions, this volume) and the FAO/ECE/ Team of Specialists on Forest Fire (cf. Goldammer, this volume).

A stimulation of fire management activities at ASEAN level would also meet the objectives of the International Decade for Natural Disaster Reduction (IDNDR). The Objectives of the IDNDR, which was created by the UN Resolution 44/236 of 22 December 1989 and signed by the ASEAN countries, are:

> "…to reduce through concerted international actions, especially in developing countries, loss of life, property damage and economic disruption caused by natural disasters such as earthquakes, windstorms, tsunamis, floods, landslides, volcanic eruptions, ***wildfires*** and other calamities of natural origin such as grasshopper and locust infestations".

The following four goals represent the desired destinations, which Decade efforts should lead to:

(1) improve the capacity of each country to mitigate the effects of natural disasters expeditiously and effectively, paying special attention to assisting developing countries in the assessment of disaster damage potential and in the establishment of early warning systems and disaster-resistant structures when and where needed;

(2) devise appropriate guidelines and strategies for applying existing scientific and technical knowledge, taking into account the cultural and economic diversity among nations;

(3) foster scientific and engineering endeavours aimed at closing critical gaps in knowledge in order to reduce loss of life and property;

(4) develop measures for the assessment, prediction, prevention and mitigation of natural disasters through programmes of technical assistance and technology transfer, demonstration projects, and education and training, tailored to specific disasters and locations, and to evaluate the effectiveness of those programmes.

By the year 2000, all countries, as part of their plan to achieve sustainable development, should have in place:

(1) comprehensive national assessments of risks from natural hazards, with these assessments taken into account in development plans;

(2) mitigation plans at national and/or local levels, involving long-term prevention and preparedness and community awareness, and

(3) ready access to global, regional, national and local warning systems and broad dissemination of warnings.

An interim report on the IDNDR is provided by the Yokohama Strategy, which was developed by the World Conference on Natural Disaster Reduction (IDNDR 1994, 1995).

Reliable and comparable statistical databases on the extent, economic and environmental significance of fire are a basic prerequisite for any fire programme. At present, various institutions are working on a comprehensive international set of comparable data on forest fires and other wildland fires. Internationally standardized fire statistics are essential for understanding global impacts of fire and for providing information for policy makers and for operational planning (national, regional and international).

Regional and global collection of fire statistics are conducted at present under the auspices of ECE/FAO (for the ECE region), within the European Union (i.a.w. the Resolution No.3 of the First Ministerial Conference on the Protection of Forests in Europe, Strasbourg 1990), and globally through FAO (in prep.).

The ASEAN countries need to come up with a regionally agreed system of fire data collection. Such system should be determined i.a.w. the recommendations of the UN (ECE/FAO/ILO 1996; cf. Appendix).

Towards an ASEAN Fire Management Programme

The outcome of this AIFM meeting comprises several proposals and recommendations for an ASEAN-wide fire management strategy, which are described in this volume. In general, this strategy will focus on a system of sharing responsibilities and resources, e.g.:

- Development of policies which will mitigate the negative effects of fire on the environment and the societies;
- Prediction of fire hazard and fire effects on ecosystems and atmosphere;
- Detection, monitoring and evaluating fires; and
- Sharing fire suppression technologies and resources.

The ASEAN region will potentially serve as a pilot region in which resource sharing will be based on the fact that two distinct fire problem seasons exist within the region. While within Indonesia the fire season is mainly during the months of September to November (southern hemisphere dry season), the fire season in monsoon-influenced mainland SE Asia is between January and May. Sharing resources means that hard- and software technologies and human resources (fire management personnel) will concentrate on the hemispheric fire problems, and even costly fire suppression equipment, e.g. airplanes, can be used more economically throughout the whole year.

Conclusions

The fire-generated smog problems of the 1980s and 1990s are a visible symptom of changes in the natural environment of South East Asia, which is subjected to increasing human pressure through population growth, land-use changes, and industrialization. An ASEAN-wide response strategy is urgently required to cope with the problems arising from these changes. The AIFM Conference on Transboundary Pollution and the ASEAN Fire Forum during this conference are important steps towards an ASEAN fire and smoke management programme.

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APPENDIX

Conclusions and recommendations of the Seminar on "Forest, Fire, and Global Change" Shushenskoe (Russian Federation), 4-9 August 1996

Extracts from the conference report (ECE/FAO/ILO 1996)

1. General Statement on the Role of Fire in the Global Environment

I. Both anthropogenic and natural fires are an important phenomenon in all vegetation zones of the globe. Their impacts, however, are not uniform. Fires may lead to the temporary damage of forest ecosystems, to long-term site degradation and to alteration of hydrological regimes, which may have detrimental impacts on economies, human health and safety.

II. As a consequence of global population growth and land-use changes, the cumulative effects of anthropogenic disturbances, and the over-use of vegetation resources, many forest types, which over evolutionary time periods became adapted to fire, are now becoming more vulnerable to fire.

III. On the other hand, in many vegetation types, of the temperate, boreal and tropical ecosystems, fire plays a central role in maintaining the natural dynamics, biodiversity, carrying capacity and productivity of these ecosystems. In many parts of the world, sustainable forestry and agricultural practices as well as pastoralism depend on the use of fire.

IV. Vegetation fires produce gaseous and particle emissions that have significant impacts on the composition and functioning of the global atmosphere. These emissions interact with those from fossil fuel burning and other technological sources, which are the major cause for anthropogenic climate forcing.

V. Global climate change is expected to affect fire regimes and lead to an increase of occurrence and destructiveness of wildfires, particularly in the boreal regions of continental North America and Eurasia.

VI. Fire control has been the traditional fire policy in many parts of the world. An increasing number of countries have adopted fire management policies instead, in order to maintain the function of fire in removing the accumulation of fuel loads that would otherwise lead to damaging wildfires, and in order to arrest succession at stages that are more productive to humans than are forests and brushlands that would predominate in the absence of fire.

VII. In many countries, however, inappropriate choices are made – often because the responsible authorities and managers are not provided adequately with basic fire information, training, technologies and infrastructures. Large-scale wildfire disasters which occurred in the past years, especially in the less developed countries, may have been less severe and extended if national fire management capabilities had been developed and assistance through the international community provided.

VIII. Although the global fire science community has made considerable progress to investigate global impacts of fire, using available and developing new technologies, no international

mechanisms exist for systematically collecting, evaluating and sharing global fire information. There are also no established mechanisms at the international level to provide fire disaster management, support and relief.

IX. Therefore, the participants of the FAO/ECE/ILO Seminar on "Forest, Fire and Global Change" adopted the following conclusions and recommendations:

Conclusions and recommendations of the Seminar on "Forest, Fire, and Global Change" Shushenskoe (Russian Federation), 4-9 August 1996

A. CONCLUSIONS

1. The economic and ecological impact of wildland fire at local to global levels has been demonstrated at this seminar. The possibility of major world disasters, such as the transfer of radioactive materials in wildland fire smoke, and the substantial loss of human life in recent fires, has been scientifically documented. The lack of, and need for, a global statistical fire database, by which the economic and ecological impact of fires could be spatially and temporally quantified, was identified. Such a reliable database is essential, under current global change conditions, to serve sustainable development and the urgent needs of fire management agencies, policy makers, international initiatives, and the global modelling community.

2. Similarities in wildfire problems throughout the world are evident, particularly increasing fire incidence and impact coupled with declining financial resources for fire management, underlying the urgent need to coordinate resources at the international/global level in order to deal effectively with impending major wildland fire disasters.

3. As climate change is a virtual reality, with predicted significant impacts at northern latitudes, seminar participants recognize that boreal and temperate zone fire activity will increase significantly in the future, with resulting impacts on biodiversity, forest age-class distribution, forest migration, sustainability, and the terrestrial carbon budget. It is essential that future fire regimes in these regions be accurately predicted, so informed fire management decisions can be made.

B. Recommendations

1. Quantifiable information on the spatial and temporal distribution of global vegetation fires is urgently needed relative to both global change and disaster management issues. Considering the recent various initiatives of the UN system in favour of global environmental protection and sustainable development, the ECE/FAO/ILO Seminar on Forest, Fire and Global Change strongly urges the formation of a dedicated United Nations unit specifically designed to use the most modern means available to develop a global fire inventory, producing a first-order product in the very near future, and subsequently improving this product over the next decade. This fire inventory data will provide the basic inputs into the development of a Global Vegetation Fire Information System.

The FAO should take the initiative and coordinate a forum with other UN and non-UN organizations working in this field, e.g. various scientific activities of the International Geosphere-Biosphere Programme (IGBP), to ensure the realization of this recommendation.

The information given in the Annexes I to III (Draft Proposals for the Development of a Standardized Fire Inventory System) to these recommendations describe the information requirements (classes of information, information use), the establishment of mechanisms to collect and distribute fire inventory data on a global scale.

2. The development of a satellite dedicated to quantifying the geographical extent and environmental impact of vegetation fires is strongly supported. Such an initiative is currently being evaluated by NASA, and this seminar strongly recommends that this and similar initiatives (e.g., NOMOS sensor on MIR space station) be encouraged and supported.

3. A timely process to gather and share information on ongoing wildfire situations across the globe is required. The creation of a WWW Home Page to handle this information flow is recommended. This could be coordinated with an ongoing G7 initiative, the Global Emergency Management Information Network Initiative (GEMINI), which includes a proposal to develop a Global Fire Information Network using the World Wide Web.

4. Mechanisms should be established that promote community self-reliance for mitigating wildfire damages and would also permit rapid and effective resource-sharing between countries as wildfire disasters develop. Since the United Nations Disaster Relief Organization (UNDRO) is an organization recognized and established to coordinate and respond to emergency situations, including wildfires, it is recommended to entrust this organization, in collaboration with the United Nations Educational, Scientific and Cultural Organization (UNESCO), to prepare the necessary steps. The measures taken should follow the objectives and principles of the International Decade for Natural Disaster Reduction (IDNDR).

5. The unprecedented threat of consequences of fires burning in radioactively contaminated vegetation and the lack of experience and technologies of radioactive fire management requires a special, internationally concerted research, prevention and control programme. Such programme should be implemented under the auspices of the FAO/ECE/ILO.

6. The Wildland Fire 97 International Conference in Canada should be used as a forum to further promote the recommendations of this seminar. This can be realized through co-sponsorship of this conference by the FAO, UNDRO, UNESCO, IDNDR and the ECE/FAO/ILO Team of Specialists on Forest Fire.

ANNEX I

Draft Proposals for the Development of a Standardized Fire Inventory System

I. Preamble

A Vegetation Fire Inventory System at both national and international levels serve a large number of practical needs:

1. Regional - national fire management

(a) budget – resource requirements
(b) daily to annual tracking of activity compared to normal
(c) long-term trends
(d) interagency – intergovernmental assistance
(e) changes in long term trends

2. Regional - national non-fire

(a) integrated assessments – monitoring of fire impacts on other resources
(b) policies and regulations on
    (i) air quality
    (ii) global change
    (iii) biodiversity
    (iv) other

3. International use of fire inventory

(a) updated forest inventory; availability of timber; fire integrated in resource availability salvage
(b) market strategies
(c) import-export policies – strategies
(d) food and fibre availability rangelands
(e) interagency – intergovernmental assistance agreements
(f) national security
    (i) food and fibre assessment grass and fodder
    (ii) water supply and quality
(g) research
    i global change
    ii integrated assessments monitoring
(h) international treaties agreements
    (i) UNCED
        - climate convention
        - biodiversity
    (ii) CSD, IPF
    (iii) Montreal protocol on ozone
    (iv) IDNDR, others

4. Economic data utility national, but not international compatibility of assumptions

ANNEX II

Information Requirements

A. Classes of information

alpha type	- fire start and end dates - fire location (lat, long; resolution) - fire size - cause of fire
beta type	- fuels - biome classification - fuel loading forest inventory, age class, size class
gamma type	- fire characterization (crown, surface, etc.) - fuel consumption - structural involvement (wildland urban interface)
delta type (current ECE/FAO)	- number of fires - area burned (by forest type) - number and area of fires by causes
epsilon type	- gas and aerosol emission data
eta type	- total expenditure of fire programme - total fire suppression costs - total direct losses of merchantable timber, structural losses

B. Decision Space Table

Information use	Information type					Frequency of info
	alpha	beta	gamma	delta	eta	
Regional/National (fire)						
1. Budget resource requirements	x	x			x	A
2. Daily to annual fire activity	x	x	x		x	D W M A
3. Long term trends	x	x	x		x	A
4. Interagency agreements	x				x	D W M A
5. Resource allocation	x	x	x		x	D W M
Regional/National (non fire)						
6. Assessment monitoring	x	x				A
7. Air quality policy regulations	x	x		x		A
8. Global change policy regulations	x	x	x			A
9. Habitat change	x	x	x			A
International (fire)						
10. Intergovernmental assistance	x	x	x		x	D W M A
International (non-fire)						
11. Treaties and agreements	x	x	x	x		A
12. National security	x	x	x			D W M
13. Research		x	x	x	x	A
14. Market import/export forecasting	x	x		x	x	A

D = daily; W = weekly; M = monthly; A = annual

C. Parsimonious Fire Inventory

Intergovernmental assistance at bilateral or regional level does not require a global database. These agreements are regional and may differ in requirements from one region to another. If we exclude national security, we need only annual data for a global database. The gamma data type is assembled from the alpha data so there is no need to report this separately. The beta data on fuels can be obtained from other inventories, but must be standardized. The gamma data type will also require development of international standards before it can be considered. All vegetation fires must be included in this database.

ANNEX III

Establishment of Mechanisms to Collect and Distribute Fire Inventory Data on a Global Scale

A. Current State of Fire Inventory

A Data consisting of individual fire reports are developed by many nations, but many regions of the world are not covered.

B Only ECE and EU nations have established mechanisms to share data.

C Current shared data consists of statistics aggregated from individual fire reports.

D Data from remote sensing is rapidly becoming available, but only for fires that can be defined by either heat signature or by fire scars on the landscape.

B. Issues

A A large number of uses of an international fire inventory have been identified in fire management, environmental policy and agreements, and in economic growth of nations.

B A parsimonious inventory has been identified which can be utilized by all nations (see statement on standardized fire inventory).

C There needs to be international agreement to provide fire inventory (similar to the FAO global forest inventory).

C. Implementation

A Fire inventory at the global scale should consist of individual fire data of date of fire start and end, location of fire, size of fire, and cause of fire. Fire location from individual fire reports normally report origin of fire. Remote sensed data are more likely to report centre of burned area. Should fire reports contain centre rather than origin, in addition to origin?

B Two additional forms of data will be needed in the future, biome classification and fire characterization. Standard for these additional information will need to be developed

C Rapid electronic communication is available for nearly all parts of the globe. Fire inventory data can be made available through World Wide Web. FAO is an appropriate centre to compile and distribute these data.

D Remote sensed data will need to be placed in the same format as individual fire reports and be made available on World Wide Web. Images can also be made available through WWW. Appropriate potential centres for compilation and distribution of these data are ISPRA (EU) or NASA's EOS-DIS.

F Those nations, which cannot provide data in electronic format, should agree upon a hard copy format which can be scanned and readily placed in electronic format.