THE MISSION ON FOREST FIRE PREVENTION AND MANAGEMENT TO INDONESIA AND MALAYSIA (SARAWAK)

by
Dr. C. CHANDRASEKHARAN

EXECUTIVE SUMMARY

In response to Decision 8 (XXIV) of the Twenty Fourth Session of ITTC in May 1998, an ITTO Mission visited Indonesia and Sarawak (Malaysia), 8-20 September 1998, to study the problems and issues relating to forest fires in the region and to propose action. The Mission reviewed the causes and impact of the 1997-98 forest fires in Indonesia and Sarawak in the backdrop of global fire events during the last two decades. In the past, forest fires, mainly natural, were events of an aeon. With population explosion and unsustainable land development activities, frequency and intensity of forest fires, almost entirely man-made, have increased in the recent years; the fire cycle has been reduced, in some cases to as low as 3-4 years.

Wildfires have been present on earth since the development of terrestrial vegetation, playing a significant role in maintaining biogeochemical cycles and disturbance dynamics in some ecosystems. Fire and ecosystems have interacted throughout time influencing such ecosystem functions as: recycling nutrients, regulating plant succession and wildlife habitat, maintaining biological diversity, reducing biomass and controlling insect populations and diseases.

Taking a cue from nature, early humans used fire as a tool to alter their surroundings and later to prepare land for cultivation. Use of managed fire became a common practice in land conversion activities. However once out of control, fire can lead to long-term site degradation and other detrimental impacts. Fire, therefore, is used as a weapon by persons and communities to register protest and dissatisfaction.

The recent major fires in Indonesia and elsewhere coincided with El Niño events; and therefore, El Niño has been blamed for the damage and devastation caused by these fires. El Niño is a weather phenomenon, which takes birth periodically in the Pacific Ocean, causing extreme drought conditions and upsetting weather pattern globally. This aggravates the forest fire danger situation, by creating conditions conducive for the spread of wildfire. “The year the world caught fire”, as WWF described the El Niño year of 1997-98, was the hottest on record.

El Niño is presumed to have existed for two million years or more, and occurred in a cycle of about 7-10 years; but natural fires coinciding with it or otherwise occurred once in a long period of 100 years of more. In the recent past the frequency and intensity of El Niño and wildfires have increased. Whether the increased frequency of El Nino is due to global warming is a moot point. El Nino by itself is not a sufficient cause for forest fire; and major fires have taken place in Indonesia not simply due to El Niño, but due to a much more complex interaction of human-induced conditions, which, among others, include availability of dry fuel load (caused by wasteful logging, land clearing), providing the material to feed the conflagration and an ignition source.

The forest fire scene in Indonesia is characterised by conditions emanating from negligence and linked both to subsistence and commercial activities. They are, among others:

- large scale logging, leaving a high percentage of residues in the forest, which in drought years become highly combustible;
- land clearing practices of HTIs, plantation companies and small holders using open, broad cast fires to dispose off the clearfelled materials cheaply;
- careless use of fire by graziers, NWFP collectors, campers and others;
- intentional fires for staking land claims, or for other reasons.

The situation is exacerbated by other contributory factors. They include, *interalia,* the following:

- weaknesses in policies, legislation, and their implementation/enforcement;
- reluctance/resistance, to adopt zero-burn techniques of land preparation on the part of land owners, or low-impact logging on the part of concessionaires;
- inadequacies in IFFM exemplified by lapses in monitoring, fire-danger warning, fire protection/prevention measures, pre-suppression planning and preparedness, and fire-fighting capability;
- poverty, social conflicts and lack of incentives for the local community to participate in forest fire protection;
- institutional inability to learn lessons from past experience.

Fundamental changes in these framework conditions are required for long-term control and reduction of forest fires.

Forest fires occur only infrequently in undisturbed natural forests. Fire damage to Indonesia's rain forests increase in proportion to the level of prior human interference. Density of fire was significantly higher within forest concessions and industrial tree plantations. Inspite of the dry conditions created by El Niño, a damaging fire event may not materialise if fuel load is properly controlled, fire protection measures are strictly implemented and the immediate causes of ignition are kept in check; and even if complete prevention of fire may not be possible, fire incidence can be reduced considerably.

During the two spells of wildfires between September 1997 and May 1998, an estimated 6 to 7 million ha of land was burned. Official figures of forests burned is about 800,000 ha, covering primary forests, secondary forests, peat swamp forests and forest plantations. The fire in 1997 affected four provinces of Sumatra, and portions of West and Central Kalimantan. The 1998 fire was mainly in East Kalimantan. These catastrophic fires and the associated haze resulted in profound impact on economic, ecological, physical and social environment in the ASEAN region. Millions of tonnes of biomass, including timber and NWFPs were consumed by the fires. Physical infrastructure was destroyed. It affected industrial production; resulted in fishing decline; caused loss of biodiversity; disrupted commerce; registered sharp fall in tourism revenue.

During the worst haze, atmospheric pollution index reached above 850 in some parts of Indonesia and Malaysia, while a reading of 300-500 is considered most hazardous. Health of some 70 million people in six countries were affected. The total estimated value of economic and social damages is between US$ 5-6 billion. While these figures help to provide the magnitude of the calamity, many of the deleterious effects of fire on Indonesia's tropical rain forests cannot readily be cast in economic terms.

The 1997-98 fire event, from its very beginning, lead to several initiatives at national, regional and international levels. Many countries and international organisations provided emergency assistance in cash and kind, including equipment, materials, medicines, service of fire-fighters, and so on. The Indonesian government reactivated and strengthened the Forest and Land Fire Control Centres at national and provincial levels and Executive Units and Fire Brigades at sub-divisional and local levels. The National Co-ordination Committee on Forest and Land Fire Control, with BAPEDAL serving as its secretariat, was given the responsibility to: co-ordinate monitoring of hot spots appearing on NOAA weather satellite images, carry out surveillance; provide early warning about fire danger transmit information and guidance regarding action to be taken at the local level and so on. Since the fire event was declared a disaster the BAKORNAS PB undertook the overall responsibility of co-ordinating the activities of various agencies including activities such as water bombing and cloud seeding. In spite of it, the fire suppression efforts suffered from organisational and communication weaknesses and it was the onset of rains that finally extinguished the fire.

At the regional level several initiatives were taken to address the problem of transboundary haze pollution - such as establishment of Haze Technical Task Force, regular meetings of the ASEAN Environment Ministers and ASEAN Senior Officers on Environment, formulation of ASEAN Regional Haze Action Plan and its implementation; and co-ordination of ASEAN regional level actions with support from ADB.

At the time of 1997 fires, there were four important forest fire projects ongoing (funded by GTZ, EU, JICA and [ITO) and another (UK) with a major fire related component. There are now over 35 projects (including the ongoing, new, and pipeline projects), supported by bilateral donors, UN agencies, international NGOs and others. In addition there are a number of proposals under consideration for implementation, nationally and regionally. There are also some new proposals for forest sector reforms (e.g. of World Bank) which may strengthen the capability of the sector to address the issues relating to forest fire.

Most of the current projects are of short-term scope, investigating the underlying causes, or addressing specific aspects, of actions required - e.g. capacity building, biodiversity conservation A trend in new projects is the high emphasis given to sophisticated remote sensing technology for monitoring and fire prediction, compared to practical pre-suppression and suppression activities, particularly to strengthen the capability of field offices and concession units. There are also no projects which seriously address the issue of post-fire forest rehabilitation.

A comparison of the situation in Indonesia with that in Sarawak is revealing. Even though there are several similarities between the two, such as vegetational types, existence of shifting cultivation, timber operation by concessionaires, and presence of El Niño, Sarawak was not affected by major fire events, except for the one in 1 998, which was much smaller in terms of extent and intensity. Sarawak also does not have any assistance projects on forest fire.

The Mission noted several weaknesses in Indonesia such as lack of infrastructure, inadequate trained personnel, insufficiency of equipment, and weaknesses in enforcement of rules and regulations. Sarawak also has some of these weaknesses but certain of its strengths are capable of neutralising them. The particular strengths of Sarawak are: strict observance of working plan prescriptions in tune with sustainability criteria, low impact logging and low intensity of extraction, acceptance of land preparation with zero-burn, enforcement of legal provisions regarding fire permits and restrictions on open fires, involvement of well trained Fire and Rescue Department in fire suppression, role of Forest Department in ensuring fire protection and post-suppression rehabilitation. These, along with emphasis on decentralised level of field activities, most probably made some significant difference.

The Mission underlines that integrated forest fire management is an essential component of SFM and a basic requirement to achieve ITTO Objective 2000. Integrated fire management is essential to control the damaging role of fire without unduly curtailing its beneficial aspects and to reduce the intensity of fires in cases of fire events. Scientific and planned actions for fire protection, monitoring, prediction and prevention, fire-danger warning and preparedness for fire suppression, supported by appropriate policies and strategies are essential. Forest rehabilitation, a post fire activity, is a vital component of SFM.

IFFM can be treated in three specific phases: (i) pre-fire planning and fire prevention involving fire breaks, fuel load control, weather monitoring, fire risk assessment and early warning, equipment development, enforcement and surveillance, training in fire-fighting, research and extension, and infrastructure development; (ii) fire suppression, covering fire detection; quick communication; organisation of fire crews; and (iii) post fire rehabilitation and management, covering fire inventory and classification and rehabilitation planning. In all these aspects it is necessary to strengthen institutional framework, research and public education. It is also crucial that the technology adopted is appropriate and local participation is guaranteed through proper incentives.

The need for establishing a sustainable and effectively functional system of forest fire management is urgent. Towards that end, the Mission has proposed actions to fill in gaps or to strengthen the existing capability under the following important areas: capacity building; pilot demonstration (model forest for IFFM, fire suppression training, participatory methodologies);

community participation (through incentives, income earning activities, involvement in production enterprises); rehabilitation of burned areas (through sanitary operations, salvage fellings and replanting); rationalisation of shifting cultivation (incorporating agroforestry, skill development, crafts); optimising the size of forest concessions (to ensure scientific management); formulation of national forest fire plan; establishment of pan-ASEAN fire centres; and publication of ASEAN forest fire bulletin for information exchange on forest fire related matters. The ITTO-JICA-BAPPENAS International Cross Sectoral Forum on Forest Fire Management in South East Asia to be held in Jakarta Indonesia during 7-8 December 1998 will provide an opportunity for further discussing these proposals.

In order to ensure production of timber from sustainably managed forests, ITTO is concerned with scientific and integrated FFM; ITTO has been involved in forest fire related activities in Indonesia (4 projects), as well as on a global scale through the ITTO Guidelines on Fire Management in Tropical Forests (1996).

In defining a niche for ITTO in the context of IFFM, two appropriate considerations will be: (i) areas of past involvement and (ii) relevance to sustainable production of timber. Accordingly, some of the ideas for consideration are these: assistance for preparing national forest fire plan; rehabilitation planning for fire affected forest areas; pilot demonstration and practical training in IFFM; community participation in IFFM; manuals for IFFM activities; support for selected components of capacity building; integrated forest fire management for eastern Indonesia (Maluku, Irian Jaya); expanding the scope of Model Forest Management project in Sarawak to include IFFM; support to and collaboration with national, regional and global initiatives on technology development; and building strategic partnerships with relevant agencies.

The land and forest fires that ravaged large areas of Sumatra and Kalimantan in 1997-98 have added new urgency to the issue of forest fire prevention and management in Indonesia. With the uncertainty about the next visit of El Niño, there is no time for complacency. An effective and efficient system of IFFM should be established to prevent, control and combat the devastating impacts of this phenomenon on forests.

INTRODUCTION

Seriously concerned about the disastrous and frequent forest fires in South-East Asia and other tropical regions, reaffirming the obligations and commitment of all ITTO members to the objectives of ITTA 1994 and to 'Objective 2000', and recognising the need for urgent and coordinated efforts on the issue of forest fire, the twenty-fourth session of the ITTC, held in Librevi[le, Gabon in its decision 8 (XXIV) of 28 May 1998, *interalia* decided to send expert missions to member countries suffering from forest fires, with priority given to those countries which have ongoing ITTO activities on forest fire management, to examine the extent and causes of fire during 1997-1998, to review the various national and international initiatives being undertaken on forest fires -in the countries, and to propose future options for ITTO

involvement within the framework of ITTA, 1 994. Accordingly, an 'ITTO mission on forest fire prevention and management was sent to Indonesia, and Sarawak, Malaysia, 8-20 September 1998.

The composition of the mission and the duration of participation of the members were as follows:

Cherukat Chandrasekharan (India)	8-9-1998 to 20-9-1998
Isamu Yamada (Japan)	8-9-1998 to 20-9-1998
Surendra Shrestha (UNEP Representative)	8-9-1998 to 12-9-1998
Gunarwan Suratmo (Indonesia)	12-9-1998 to 14-9-1998
Ludwig Schindler (GTZ)	13-9-1998
Michael Brady (Canada)	15-9-1998
Johann Georg Goldammer (Germany)	16-9-1998 to 20-9-1998

The mission's terms of reference is given in Appendix I. Both in Indonesia and Sarawak, Malaysia, the mission held wide ranging discussions with government officials, donor agencies, NGOs and others. Appendix 2 provides the mission's itinerary and list of persons met during the mission is given in Appendix 3. Particularly, the mission was benefited by exchange of information, and joint briefing sessions/meetings in Jakarta and Bogor, with the JICA forestry team which was also visiting Indonesia on a similar initiative.

1.1 Forest Fires And Ecosystem Health

1.1.1 General

Wildfires have been present on the earth since the development of terrestrial vegetation and the evolution of the atmosphere. Lightning, spank generated by swaying bamboos and volcanoes have been nature's way of igniting forest and keeping the plant environment dynamic; and a perfect relationship existed between fire and ecosystem (Soares, 1991). Such natural wildfires occurred at very long intervals. Occurrence of fires, however, had an influence on the vegetational types and their composition. For example, tropical rain forests are not fire resistant, as fire was not a common factor influencing their ecological evolution and development.

Fire was the first major tool used by man to alter his surroundings. In the earliest stages of cultural development, it was the only effective tool for clearing land and keeping it open for farming and animal grazing. Now, fire is an important recurrent phenomenon in all the regions of the globe; and fine is one of the significant causes of deforestation throughout the world.

In some ecosystems fire plays a significant role in biogeochemical cycles and disturbance dynamics. In others fine may lead to the destruction of forests or to long-term site degradation. As a consequence of demographic and land-use changes and the cumulative effects of anthropogenic disturbances, many forest types adapted to fire are becoming more vulnerable to high-intensity wildfires, often (ironically) due to the absence of periodic low-intensity fires. In other forest types, however~ as well as in many non-forest ecosystems (e.g. grasslands), fire plays an important role in maintaining their dynamic equilibrium productivity and carrying capacity (Goldammer, 1 997b). Most deciduous forests and savannahs are fire climax forests which are fire-tolerant and often fire-dependent. The fire climax forests are not necessarily in an ecologically stable condition. Long-term impact of frequent fines, or of effective fire protection, can set an ecological retrogression or progression, in motion.

Prescribed burning has been used as a management tool by foresters, for manipulating species, composition and characteristics of forests and also for preparing sites for forest plantations. If properly manipulated, fines in suitable situations can help to check weed growth in forest plantations, induce better regeneration and growth of plants (e.g. teak), maintain a seral status of vegetation which contain high percentage of commercial species (e.g. moist deciduous forests), reduce soil acidity, increase bacterial activity and reduce protozoan population (GOI/FAO, 1 990b).

Tropical rain forests have been regarded as ecosystems in which natural fires were excluded, or fines take place in a long cycle, due to fuel characteristics and prevailing moist conditions. Human impact on tropical forest lands is rapidly increasing, causing overall degradation and conversion of

rain forest vegetation to pyrophytic life forms with increased inflammability, fire intensity and fine frequency. Today, among the various threats affecting forest resources, fire appears to be the most serious. The growth of population and economic development have increased the injurious impacts of forest fires, and fine cycle around the world has quickened -in some cases from oven 100 years to only 3 to 4 years. An overwhelming majority of the world's forest fines is human-initiated, with lightning induced natural fires accounting only for a very small percentage of the total. Intensity of the fine would vary depending on fuel load, fuel type, thermal exposure, humidity and so on.

Air, temperature (heat) and fuel are considered the three corners of a fire triangle. It is the type and condition of fuel that determine the rapidity and intensity of any fire. Moisture content in fuels could minimise the chances of blaze. Moisture must evaporate to permit the temperature to rise to ignition point. Constant circulation of wind dries up the fuel, enhancing chances of an outbreak, and also helps the blaze to spread. Monitoring and manipulating these components are important to reducing the impact on fire and to ensure *ecosystem health.* Fires and ecosystems have interacted throughout time, establishing fine as an influence in such ecosystem functions as: recycling of nutrients; regulating plant succession and wildlife habitat; maintaining biological diversity; reducing biomass and controlling insect populations and diseases.

Forests are the most productive among the natural ecosystems. A healthy forest is one that is resilient to changes. The term ecosystem health can be defined as the structural and functional stability of an ecosystem and its ability to bounce back after stress (Gupta and Yunus 1998). *Forest fire management* (FFM) is therefore an important aspect of *sustainable forest management* (SFM) to ensure health of forest eco-system.

Integrated forest fire management (IFFM) is a concept which has been developed in tropical countries recently, e.g. in Indonesia (GTZ-supported project in East Kalimantan, ITTO-supported project: national guidelines on forest protection against fire) and Namibia (Jurvelius, 1998), and is also underway in Mongolia (Wingard and Naidansuren, 1998). It is a twofold approach, first, recognizing the traditional use of fire and the role of natural fire, the concept of IFFM does not build on fire exclusion (prevention, suppression) only. The beneficial role of fire is considered an integral element of the overall approach of sustainable vegetation resources management and protection; second, in order to address the main source of land-use fires as well as of unwanted wildfires, local people and communities have to be integrated into the overall system of fire management.

1.1.2 Forest Fire Type Classification

While a land fine (e.g. in farmlands) may lead to a forest fire, a distinction is often made between the two in view of the differences in their causes, impacts, control measures and so on. For this purpose, forest fires may be defined as any fire in forest land which is not being used as a tool in forest protection or managem ent in accordance with an authorized plan (SAF, 1964).

Forest fire type classification is important in designing and implementing appropriate control measures. Forest fires are variously classified, based on:

Source of ignition: natural and man-made fires. Man made fires may result from carelessness and accidental reasons, or may be incendiary in nature (often using fire as a weapon instead as a tool);

Size of area affected: large, (e.g. over 50,000 ha) medium and small fires (irrespective of the nature of damage);

Intensity of burn and damage: very heavy, heavy, medium and light fires (depending on fuel load and other factors (e.g. duration));

Nature of burn: underground fire (e.g. coal seams); ground fine (that consumes the organic materials beneath the surface litter; surface fire (that burns surface litter and other loose debris of forest floor), creeping fire (that spreads over-ground); and crown fine (consuming the upper branches and foliage).

Depending on the circumstances, weather conditions, fuel load, undergrowth and so on, one form of fire may change into another or into a combination of different types.

1.1.3 Causative Agents

There are predisposing factors or inherent conditions, as well as immediate causes which might result in wild forest fires and influence its frequency and intensity. The predisposing factors are of different kinds: economic (poverty and dependence of rural communities on forests for livelihood); demographic (increased population pressure on forests for their goods and services); meteorological (weather conditions including high temperature and lower atmospheric humidity particularly when occurring in logged-over areas with considerable amount of dry matter); related to crop condition (amount of canopy opening causing desiccation and water stress, nature and amount of ground vegetation and fuel load); nature and condition of ecosystem (vegetational types; fire resistance level of component species and locational topography); socio-cultural (cultural significance of fire to the forest dwelling and rural communities); and institutional (lax environmental laws, inadequate enforcement capability, indifference of public administration to environmental matters, lack of information dissemination on weather conditions and a system of fine danger warning, misuse of funds earmarked for fire protection and management and policy weaknesses).

Contribution of natural fines to the overall tropical wildland fire scene today is negligible. Most tropical fines as set on spread accidentally or intentionally by humans, and are related to several causative agents, some of them linked to subsistence livelihood or commercial activities (Goldammer 1997a). These, among others, include:

deforestation activities (conversion of forest to other landuses, e.g. agricultural lands,

pastures, estate crops, mining, exploitation of other natural resources);

rural land clearance and land preparation for agricultural crops;

traditional, slash-and-burn agriculture;

grazing land management (fines set by graziers, mainly in savannahs and open forests with distinct grass strata);

use of non-wood forest products (use of fire to facilitate harvest or improve yield of plants, fruits, and other forest products, such as honey, resin and antlers, predominantly in deciduous and semi-deciduous forests);

wildland/residential interface fines (fires from settlements, e.g. from cooking, torches, camp fires etc.);

other traditional fine uses (in the wake of religious, ethnic and folk traditions; tribal warfare);

socio-economic and political conflicts over questions of land property and land-use rights, arson gaining ground in many cases;

speculative burning to stake land claims;

accidental fires due to falling of dry leaves and twigs on high tension electricity lines;

fires introduced by design (e.g. prescribed fines) going out of control and becoming wildfires).

1.1.4 Multidimensional Array of Impacts

Forest fires have serious impacts, often resulting in loss of life, livestock and capital; the damages caused by fire are often difficult to quantify, especially when non-tangible losses are involved. Impact of forest fires have several dimensions - ecological, economic, social and others, which could be on-site and off-site. The extent of impacts would depend on the frequency and intensity of fires, fuel load, type of forest involved and local climatic factors.

Ecological impact of forest fine is reflected in the degradation of the quality of vegetation, expansion of savannah and sterile grasslands, erosion of biodiversity, damage to the health of forest ecosystem, loss of wildlife habitat and overall ecological retrogression. Fires affect the quality and productivity of soil by destroying humus, increasing soil temperature, decimating the microbial inhabitation, reducing the moisture retention capacity of the soil, causing erosion of surface soil and nutrient loss, increasing run off, lowering sub soil water table and causing desertification. Forest fires contribute to global climatic change and warning; burning of forest also destroys an important sink for atmosphere carbon dioxide. Biomass burning is recognised as a significant global source of emissions contributing as much as 10% of the gross carbon dioxide and 38% of tropospheric ozone (Goldammer and Seibert, 1990; Landsberg, 1997).

The immediate effects of burning is the production and release of gases and particulates into the

atmosphere. The instantaneous combustion products of burning vegetation include carbon dioxide, carbon monoxide, methane, non-methane hydrocarbons, nitric oxide, methyl chloride, and various other gases which are released and returned to the atmosphere in a matter of hours. The greenhouse gases viz, carbon dioxide and methane influence global climate. Combustion particulates affect the global radiation budget and climate. Methane, non-methane hydrocarbons and nitric oxide are all chemically active gases that affect the oxidising capacity of the atmosphere and lead to the photochemical production of ozone in the troposphere. Recently it was discovered that biomass burning is also an important global source of atmospheric bromine in the form of methyl bromine. Bromine leads to the chemical destruction of ozone in the stratosphere and is about 40 times more efficient in the process than is chlorine on a molecule-to-molecule basis. Burning also enhances the biogenic emissions of nitric oxide, and nitrous oxide from soil. Biomass burning affects the reflectivity and emissivity of the earth's surface as well as hydrological cycle by changing rates of land evaporation and water run off. (Crutzen and Goldammer, 1993, Goldammer, 1993, Anon, 1997a and 1998).

Apart from causing transboundary air pollution, smoke emissions from wildfires affect human health, particularly causing respiratory ailments, and in some cases loss of human life. It also causes visibility problems which may result in accidents and economic loss.

Forest fires cause serious direct economic losses through damage and decline in the quality of valuable growing stock, reduced availability of forest raw material, and the need for new investment in forest rehabilitation and fire protection measures. Indirectly it affects agricultural productivity and tourism, It affects the indigenous population and their livelihood means.

Forest fires also degrade some of the surviving forests by exerting potential impact on crop composition, regeneration, productivity, protective powers, soil quality, wildlife and aesthetics.

1.1.5 Fire-Forest Relationship

Understanding the relationship between fire and forest health requires a clear distinction between prescribed fire and wildfire. Forest managers must have knowledge of how fire behaves under specific atmospheric conditions. Fire almost always has some negative effects, even on species that are fire adapted. Whenever fire is prescribed, managers must weigh negative influences against positive ones.

The need for forest fire protection and management has been emphasised in the UNCED Agenda 21 and Forest Principles. The Antalya Declaration of the XIth World Forestry Congress, 13-22 October 1997, has singled out forest fire for special attention of the countries. Noting with alarm, the continued rate of forest loss and degradation in many regions of the world, the XIth World Forestry Congress called upon countries "to develop, implement and review policies, plans, and management practices aimed at minimising the destructive nature and extent of wildfires on forest lands." (WFC, 1997)

1.2 Forest Fire Management

The message of any management system is that the existing situation can be improved by better management. Improved and modern management practices can be adopted to deal with forest fires. Recent research has produced knowledge of fire behaviour, fire ecology, fire suppression, and other fire sciences which are being incorporated into ecosystem management. The importance of fire management is increasing as forests, woodlands, and grasslands have greater demands placed upon them for both commodities and amenities. FFM can take several forms from no active management to fire exclusion. i.e. total suppression. Fire exclusion can be appropriate for plantations or plant communities of thin-barked trees; no active FFM can be appropriate for wilderness and national park areas where fire can be allowed to play out its role as a natural disturbance agent; or fire management can take an integrated form incorporating fire-management planning at all levels based on a thorough understanding of impacts of fire on specific forest types and conditions. The integrated fire management option embraces all possible treatments. We need to manage ecosystems to enhance the benefits of fire and concomitantly to reduce its detrimental effects. (Landsberg 1997, Goldammer, 1 997a).

The overwhelming evidence that fire can play a positive role in certain ecosystems, and that forest resources must be managed under the multiple-use and sustained-yield management concept, have now led to the inclusion of fire in land management planning. This in turn has led to the concept of integrated fire management, a more enlightened approach to fire in the environment that derives from a greater awareness of the ecological role of fire. Barney (1975) defined fire management as "the integrating of fire-related biological, ecological, physical and technological information into land management to meet desired objectives." The interrelated activities include fuel management, fire prevention and control, fire suppression, beneficial use of fire and the associated planning, training, education and research.

Since fire can either be the cause or the result of changes on the landscape, IFFM should be conceived on a landscape scale, incorporating forests and their immediate surrounds.

Approaches towards IFFM will vary for different forests/landscapes, dictated by their characteristics. An essential tool for IFFM is a fire management plan forming part of, or integrated with, the forest management plan, aiming at sustainability and efficiency. Preparation of IFEM plans should be based on relevant information, statistical and non-statistical, including inventory of past forest fires, weather details, topography, fuel type and so on, and supported by updated land-use and forest cover maps. A system of classification, and a clear understanding of forest fines and fire sources are important to establish alternative approaches and measures for fire prevention as well as for forest rehabilitation. In an integrated approach to FFM, it is necessary to think comprehensively and on a long-term basis, taking into consideration the situation regarding technology and skills.

IFFM was and continues to be, largely a reactive process in most developing countries, with little data handling capacity (Landsberg, 1997). The situation needs to be improved. In any scheme of IFFM it is also necessary to involve local community and the civil society.

1.2.1 Pre-Fire Planning and Fire Prevention

The purpose of forest fire planning is to develop elements of a fine protection programme and to achieve an adequate level of readiness to attack a wildfire, when it happens, efficiently and effectively. It covers aspects such as hazard reduction, early fire warning and capacity development for quick response to fire incidents. It involves engineering, education and (law) enforcement. A distinction is often made between fine prevention, referring to avoiding fire starts by education, awareness-building, law enforcement, etc., and pre-fire planning (commonly known as pre-suppression) referring to all activities of setting up infrastructure, equipment, training, command system, fire detection, etc., to contain and fight fires when they occur.

Specific measures are to be designed based on underlying causes and other situational aspects (e.g. why, where, when and how of forest fires), and this is important for obtaining adequate budget provisions. Recent fire statistics for the ECE region ([CE/FAQ, 1997) indicate that, of the human-caused fires listed for 1992-1994, some 68% was classified as due to negligence and rest 32% as arson. Forest fines should be prevented as much as possible since fire-fighting is more difficult and costly.

For implementing forest protection measures there are important infrastructural needs - fire access roads and fire corridors, water storage ponds, communication facilities and so on. Equally important are the fire-related laws, rules and regulations (e.g. forbidding certain activities during summer in forests prone to fire damage) and their enforcement, serving as deterrent for those who commit environmental crimes, and providing incentives to those who co-operate in preventing forest fires. Also eco-labelling requirements and certification of forest products can be linked to the track record of producers in carrying out forest fire protection measures.

Hazard reduction is an important aspect of fire protection. While it is difficult to prevent fires completely, it is possible to reduce fire incidence and damage. Establishment and maintenance of fire breaks, which are natural or constructed barriers to stop or check fires; clearing the paths, tracks and campsites of any inflammable materials; planting belts of fire resistant species around parks, protected areas and forest plantations, and along road margins; spraying of fire retardant chemicals in vulnerable locations; and prescribed burning to reduce combustible materials before the onset of fire season are some of the relevant activities in this regard.

Prescribed burning often used as a silvicultural tool, is the controlled and knowledgeable application of fire to wild land fuels in specific areas, to attain planned resource management objectives. To accomplish a prescribed burn safely, managers must prepare a plan and instructions detailing how the burn will be executed. A prescribed burn will be safer and more successful if the perimeter of the area is extended to natural boundaries such as lakes, rivers, and marshes. Narrow roads or single-blade bulldozed fire lines may not be wide enough to prevent the fire from crossing. Along with prescribed burning in the forests, zero burning methods of site preparation for commercial crops in private lands adjoining forests are often promoted.

Forest fire prevention should be undertaken as a joint effort of all concerned - as a matter of civil defence involving government institutions, private agencies, and people. Participation of rural people, and their goodwill, is particularly important. It is necessary to provide appropriate incentives for their sustained co-operation.

1.2.2 Forest Fire Warning and Surveillance

An important strategy to prevent or to reduce the magnitude of forest fires, is a system of early fire danger warning, based on an assessment and evaluation of the contributory factors such as temperature, humidity, wind speed and direction, fuel load and activities in the neighbourhood. Based on the fire danger index appropriate action can be taken to provide additional preventive measures, or be in a state of high preparedness, including continuous surveillance such that any fire event can be contained with minimum of damage.

Many countries such as Australia, Canada, Germany, and USA, have already developed and established forest fire risk assessment arid fire danger rating systems, to identify/classify areas by fire risk level and to provide instructions on how to respond to different fire risk situations. Sophisticated technologies like infra-red screening and aerial surveying are currently in vogue in many advanced countries, for locating areas of fire danger and incipient l fires.

Early warning of fire and atmospheric pollution hazard may involve locally generated indicators, such as local fire-weather forecasts and assessment of vegetation dryness or advanced technologies which rely on remotely sensed data, evaluation of synoptic weather information and international communication systems. (Goldammer, 1997b). Models of forest fire generally

concentrates on determination of the influence of meteorological conditions on the possibility of arising and spreading of forest fires, supported by studies on properties of forest combustible matters, and the influence of combustion, and investigations of the geometry of forest fire spreading.

With the development of sophisticated remote sensing, weather forecasting and satellite technologies, the capacity for fire risk monitoring and fire modelling has enhanced considerably. NQAA-AVHRR, Landsat, ERS, SPOT, IRS and other satellites are now being commonly used for monitoring 'hot spots' (fire-likelihood places), and satellite data are integrated into fire danger estimates and used to develop fire hazard maps (duly linked to GIS). The day-to-day measurement of fire danger has become a fire management tool in several advanced countries; some of these technologies are also being adopted by some tropical countries. Also, there are private companies capable of providing some of the fire-related services involving higher level of technology.

Fire risk modeling in expected future climate change scenarios indicate that within the next three to four decades, the destructiveness of human-caused and natural wildfires will increase. Due to the multi-directional and-dimensional effects of fire on the different vegetation zones and ecosystems and the manifold cultural, social and economic factors involved, fire management strategies cannot be generalized.

It is necessary to understand the limitations of some of the new systems and to introduce supporting measures for validation of information and for surveillance and early detection of forest fires. While aerial surveillance with multi-spectral scanners, fire detection by satellite sensors, satellite imageries to locate smoke plumes represent the higher side of the technology, at a practical field level it is necessary to have a system of fire (lookout) towers, surveillance teams with

two-way communication equipment, fire patrol teams, and local informants for immediate detection of fire. Local villagers are often the key informants and they need to be provided adequate incentives.

Another aspect to be highlighted is that the results of automatic processing of satellite imageries as well as of surveillance measures are to be transmitted immediately to the local fire-fighting units for ground verification and fire suppression, as warranted. This calls for an effective and efficient communication system, linking all levels in the fire management system. In many situations there are cost constraints in establishing technologically advanced systems.

Along with information generation, it is essential to ensure that there is adequate capability and preparedness to quickly respond to the needs for fire—fighting-in items of adequate personnel, tools techniques, skills, infrastructure and mobility.

The advent oh advanced technology has led to the development of computerised fire management systems that offer the chance to overcome some of the weaknesses in fire management planning. Along with appropriate models to provide an integrated fire rating scheme, it will be possible to develop an advanced fire suppression strategy by integrating the ground positioning system, GIS and high resolution remote sensing.

1.2.3 Fire Suppression

In the chain of IFFM, effective fire-fighting and suppression reflects the efficiency of other linked aspects of fire protection, early detection, generation of response capability etc. Fire-fighting and suppression involve efforts to extinguish forest fires and it is to be carried out with speed and efficiency. Steps and stages involved include: planning the attack based on the nature of the fire; organisation of crew for specific tasks; quick briefing of the crew about access roads, water sources, escape routes, and particularly about their allocated tasks; getting the fire-fighters to the site; mount a co-ordinated attack using brush (beating), water, soil, and retardant chemicals; and isolating the fire by cutting breaks or trenches to prevent it from spreading. Back-firing and counter-firing may be required (when fire cannot be put out by heating, due to intensive heal) by starting a blaze in the opposite direction, duly considering wind speed and other factors. Mopping-up or post-fire suppression (including felling of smouldering trees) is important to ensure that the fire is fully extinguished. A GIS database consisting of elevation, hydrology, geology, vegetation, transport networks, settlements, and so on, will be useful in planning fire suppression activities and rnobilising resources.

Quick planning of organised fire-fighting and co-ordination of the allocated roles and activities of the crew is particularly vital to avoid haphazardness. In respect of remote and inaccessible areas, it may be necessary to airlift the crew or resort to aerial fire control. Wherever feasible, ground efforts will need support through water-bombing. In the cases of large fire events, f ire-fighters will need to be supported by vol untary fire brigades, forest workers, armed forces and others. Smoke control, through efforts to isolate the fire, and to reduce the volume and effects of smoke, is an integral part of fire management.

1.2.4 Quality of Equipment And Training

Development, procurement, storage and maintenance of equipment (e.g. fire-fighting, communication, surveillance and transportation equipment) are important aspects of IFFM. The variety involved is enormous, ranging from helicopters, light aircrafts, tractors, water tanks, fire retardant tanks to pump units, hoses, back packs, smoke masks , hand tools and first-aid kits. In all cases, it is important that the equipment is kept in a state of good repair.

Capacity building programmes ranging from training for managers in theoretical and practical aspects of IFFM (covering forest fire factors, fire prediction and planning, surveillance, fire protection, fire suppression, rescue operations, arid rehabilitation measures) to periodical practical drill in fire suppression for fire-fighters is essential to keep up preparedness to face fire events. Appropriate training is also required for local volunteers and others who will he required to participate in fire-fighting

1.2.5 Post Fire Management And Rehabilitation

Salvage and sanitary operations to save usable timber, and to dispose—off the combustible materials to avoid future fire is an essential post-fire activity. The dead materials would also be otherwise injurious since they serve as sanctuary for pests and disease. Another important but often neglected, post-fire activity is to-assess the damages arid to make a report on it, including important observations. Post-fire silvicultural operations would cover short- and long-term rehabilitation measures involving complete protection from damaging influences, cutting back of seedlings and saplings capable of sprouting, and phased replanting programme depending on the condition of the burned area. When the area and damage involved is large (consequently requiring heavy investment), it will be necessary to address the situation based on a detailed rehabilitation plan.

1.2.6 Research And Technology Development

With increase in fire events (damaging hitherto safe areas like rain forests and wetlands), and intensity of their impacts, it has become necessary to meet the challenge on a scientific basis. This calls for increased efforts of research relating to all aspects of IFFM ranging from predisposing factors, fire models, and fire economics to equipment and methods for fighting fire in different forest types and terrain and rehabilitation silviculture. Considerable amount of forest fire research has been going on in temperate countries. It has been estimated that over 1 00,000 publications - books, scientific papers, and meeting reports on fire-related subjects exist. It will be possible to adopt or adapt some of the knowledge to tropical country conditions.

1.2.7 Co-ordination as a Key Component

Co-ordination in IFFM is required at four important levels (i) between FFM and management of other national disaster situations, involving inter-sectoral co-ordination; (ii) of FFM and SFM involving the related institutions and policies; (iii) among different forest fire related actions (e.g.

fire protection, fire suppression, rehabilitation), particularly where these functions fall under the responsibility of different organisations; and (iv) field level practical co-ordination of elements within an area of action such as fire prediction and fire suppression.

Wildfires are a hazard which can be predicted, controlled and in many cases prevented. How efficiently this is achieved depends on how effectively the activities are co-ordinated. Lack of co-ordination causes delays; when dealing with forest fire, delay in action makes things exponentially more difficult.

1.3 Global Fire Events

Annual rate of deforestation in developing countries during the 1 980s was 16.3 million ha, and the corresponding figure for the developing countries of the Asia-Pacific region was 4.3 million ha. During the period 1990 -1995, there has not been much change in the rate of deforestation, and it stood at 13.7 million ha for all developing countries, and 4.2 million ha for those of the Asia-Pacific region (FAO, 1997). While several causes are attributed to the alarming rate of deforestation, it has been indicated that in majority of cases fire has played a decisive role (*Mol et al*, 1997)

Every year, millions of ha of world's forests are being consumed by a large number of fires, big and small, resulting in billions of dollars in suppression costs and causing tremendous damage in lost timber, real estate and recreational values, property losses and even loss of life. Wildfire is influencing many aspects of our life: the flow of commodities on which we depend; the health and safety of the communities in which we live; and the health and maintenance of our wildland ecosystems.

Many forests are seldom affected by fire, others regenerate easily after burning. Some forests involved are subject to high fire frequencies and heavy destructive impact. It is extremely difficulty to estimate the number and extent of forests fires and related losses taking place annually in the world. Comprehensive reports on losses are not available, and forest fire statistics is extremely deficient. According to the archived information available at the recently established Global Fire Monitoring Centre **(http://www/uni-freiburg.de/fireglobe),** it can be roughly estimated that between 10 and 20 million ha of forests are *affected* annually by wildfires in the boreal and temperate forest zone, *circa* 0.5 million ha forest and shrubland in the Mediterranean region, several hundred million ha of grass, tree and brush savannahs in the tropics, subtropics and sub-boreal steppes, and occasionally up to several million ha of equatorial primary and degraded forest. In addition traditional slash-and-burn cultivation and planned conversion of forest to plantations and non-forested landuse systems involve burning on probably more than 20 million ha per year.

1.3.1 Recent History of Forest Fires

In the recent past, since the 1 960s, there has been several fire events which attracted world attention. The Parana fire in Brazil in 1963 burned 2 million ha, destroyed more than 5,000 houses and claimed 110 lives. With this started the new history or wildfires in Brazil, and a permanent worry, mainly with regard to the damage that fire can cause to forest plantations. The effect of fire on vegetation became an issue in 1988 due to devastation in some parts of the Amazon forests. According to WWF, large scale logging and forest fires have contributed to wipe out some 12 to 1 5% of the Amazon rain forest. In early 1998, the savannahs in the state of Roraima left parched by the worst drought in history resulted in big blazes, which burned some 3.2 to 3.5 million ha of which about 200,000 ha were good forests and the rest were already deforested areas or secondary forests. (Anon, 1 997a).

The Kalimantan fire in Indonesia in 1982 burned about 3.5 million ha and caused monetary losses of about US$ 6 billion. Fires swept through the forests of Kalimantan and Sumatra (also elsewhere) in Indonesia several times during the last two decades, engulfing millions of hectares in severe blaze and causing losses valued at several billion US dollars.

The Ash Wednesday fire in Australia in 1983 caused 77 fatalities, killed 300,000 heads of sheep and cattle and burned more then 2,500 homes. The Great Black Dragon Fire of Northern China in 1987 burned around 1 .3 million ha, destroyed more then 10,000 houses and resulted in a death toll of about 200. The Yellowstone fire in the United States in 1988, almost completely burned out one of the worlds most famous parks. In 1982-83, the West African country Cote d' Ivoire was swept by wildfires over a total area of about 12 million ha. The burning of some

40,000 ha of coffee plantations 60,000 ha of cocoa plantations, and some 10,000 ha of other cultivated plantations had detrimental impacts of the local economy. More than 100 people died during this devastating fire period. (Goldammer, 1998b).

Unusual weather conditions (and global weather change) during the last three years have led to fire outbreaks in several parts of the world, one of the latest being in Florida, USA, in 1998 covering an area of some 100,000 ha. Some of the conflagrations during 1996-1998 have been particularly damaging. During this period, fires swept across the fragile rain forests of South America; millions of hectares of forest lands were destroyed in fires in the Australian outback; and two waves of forest fires gripped Indonesia in the form of a national disaster. Fires devastated the virgin cloud forests in Chimalapas in Mexico; the economic and environmental damages caused by the fires is not yet fully assessed. Figures released by Mexican authorities in May 1998 indicated that reduction of industrial production in Mexico City, which was imposed in order to mitigate the additional smog caused by forest fires, would involve daily losses of US$ 8 million (Goldammer, 1998b).

Fires burned the forests and pastures of Mongolia, consecutively in all the years during 1 996-1998. The 1996 fire affected an area of 10.2 million ha, including 2.4 million ha of forests, in which 22 million cum of growing stock was lost. The 1997 fire ran over 12.4 million ha, of which forests accounted for 2.7 million ha. This fire killed some 600,000 heads of livestock and damage to Mongolian economy was estimated at US$ 1 .9 billion (Chandrasekharan, 1998). Details are not yet available regarding the 1998 fire.

1.3.2 Weather Variability

Meteorologists, based on available thermometric record, assess that four of the hottest years in history were banded together in the 1990s - i.e. in 1990, 1995, 1997 and 1998. The first five months of 1998 were the planet's hottest on record according to the scientists of the US National Oceanographic and Atmospheric Administration. The El Nina phenomenon is considered as the main reason behind the mercury ascend. Also, El Niño is frequently blamed for the major forest fires since these fires have somewhat significant correlation with the occurrence of the El Nina phenomenon. About 93% of all droughts in Indonesia have occurred during an El Niño event (Goldammer eta!., 1996). El Nina affects the global weather pattern, resulting in extreme dry condition, which in turn predisposes the forests for tire incidence due to their parched condition. Thus, while El Niño is not a source of fire, it aggravates the fire danger situation, where negligence and management lapses can lead to severe conflagration; and, dry condition created by El Niño have resulted in fires getting out of control in several cases. Some tend to point out that El Niño has all along been in existence, without frequently causing major world-wide forest fire calamities. They suggest that the recent mood swings of El Nina are due to climatic changes and global warming, further noting that in the 20th century greenhouse gases, mainly carbon dioxide, have been the most dominant factor in the global weather changes. Some ecologists assert that ecologically fire is not a part of the virgin rain forest ecosystem; fire is nothing more than a secondary factor in the destruction of dense and moist rain forests, which will not burn unless trees are felled and slash allowed to dry.

Another factor to be flagged in this regard is the connection noted (in the absence of deliberate management policy intervention), between population growth and deforestation, including those caused by forest fire. The 1995 world population stood at 5.7 billion, and is expected to grow to about 9.4 billion by 2050, with all the attendant impacts on natural resources. How to obtain a respite from deforestation and forest fire is a major management challenge.

1.4 El Niño And Global Weather Pattern

The weather is a complex system and a number of factors influence it, chief among them being the rotation of the planet which helps give direction to the winds. This disturbance in the atmosphere takes the form of a giant heat exchange system. These movements help to balance the overall temperature of the earth. Otherwise the tropics would become unbearably hot and the middle latitudes increasingly cold.

The sea gains and gives up heat more slowly than the land. The ocean currents are dependent on the winds themselves and influence the winds helping to carry heat to the colder parts of the earth. The winds also carry the rain on which human activities like agriculture depend.

El Nina takes birth in the Pacific, periodically, to upset weather patterns, globally. The El Nina

effect leads to the strengthening of a warm ocean current called the equatorial counter-current in the mid-Pacific causing the entire weather mechanism to be disrupted. Rainfall is delayed, crops are adversely affected and storms occur where they should not (Anon, 1 997a).

1.4.1 Walker Circulation

In the 1 920s, Sir Gilbert Walker made the seminal connection between barometer readings of air pressure at sea level at stations on the eastern and western sides of the Pacific Ocean. He observed that when pressure rises in the east, it usually falls in the west, and *vice versa.* This effect, which explains the El Nina phenomenon, is referred to as the Walker Circulation. Walker and his team analysed weather records till they found some patterns of rainfall in Latin America which could be associated with changes in the temperature of ocean waters.

In the warm Indonesian archipelago, extensive burning of vegetation (from shifting cultivation, forest conversion, and other agricultural burnings) takes place. Although the impacts of these fires on atmospheric chemistry have not yet been explored, it is assumed that two major patterns of emission takes place based on the Walker Circulation. During the "high phase" (normal years) of the Walker Circulation, low pressure is centred over the Indonesian hot spots. Air masses with products from biomass burning (aerosols, trace gases) are carried to the high troposphere and exported globally. During the 'low phase", the warm waters from the west are transported to the eastern Pacific, and high pressure builds up over the Indonesian archipelago. A typical situation develops during which emissions from forest burning are trapped in the lower troposphere. The last few years, with extraordinary fire activities in Indonesia, were characterised by the low phase of the Walker Circulation (Goldammer, 1 998b).

1.4.2 Impact of El Niño

El Nina is an oceanographic phenomenon when a strong and extensive warming occurs in the upper ocean in the tropical eastern Pacific. This is linked with a change in atmospheric pressure known as the Southern Oscillation, and the overall phenomenon is often called ENSO. The typical global impact of ENSO is the anomalous pattern of rainfall and temperature. The surface ocean in the central and eastern equatorial Pacific is normally colder than that in the western equatorial Pacific. In some years, however, the ocean is especially warm. This warming typically occurs around Christmas and lasts several months. It is caused by complicated atmospheric-oceanic coupling which is not yet entirely understood. During these warm intervals, fish are less plentiful. Fishermen along the coasts of Ecuador and Peru originally termed the phenomenon "El Nina "(Spanish for "the Christ child"). The term El Nina now refers to the extensive warming of the central and eastern equatorial Pacific that leads to a major shift in weather patterns across the Pacific. Such episodes have occurred during the last 50 years at irregular intervals of two to seven years.

In the eastern equatorial Pacific, the overlying air is heated by the warmer waters below, increasing the buoyancy of the lower atmosphere and fuelling convective clouds and heavy rains. But the air over the cooler western equatorial Pacific becomes too dense to rise to produce clouds and rain - in other words, dry conditions result in Indonesia, the Philippines and Australia, while more flood-like conditions are caused in Peru and Ecuador. Over the past 50 years, 12 major El

Nina s have been recorded: The worst of these began in March 1997 and faded away in June 1998. Before this, the El Nina of 1982-1983 had been the most severe.

It is now presumed that El Nina has existed for at least 2 million years. Scientists today believe that the Atacama desert in Peru is the result of atmospheric activity associated with El Nina. The rain forests of Borneo island (Indonesia/Malaysia) are supposed to owe their existence to this phenomenon. But according to scientists, the frequency and intensity of El Nino is on the increase. In the 19th century, El Nino appeared on an average every seven-and-a-half years; now it comes in less than five years on average. Factors responsible for this increased frequency are not clear. There is a view that this is perhaps one of the manifestations of global warming.

In 1982-83 El Nina caused world wide destruction, particularly severe flooding and extensive damages in Latin America and droughts in parts of Asia. In Australia forest fires destroyed thousands of houses and took countless lives in the El Nina season of 1982. The total damages of 1982-83 El Nina phenomenon was estimated to be between US$ 8 and 13 billion, and about 2,000 lives were lost. In 1991-92 the effects of El Nina led to severe drought in Southern Africa, forest fires in Indonesia and bush fires in Australia. During 1997-98, El Nina spread its tentacles from the Pacific to vast areas in Australia, Africa and Asia. It caused severe draughts in Australia and Papua New Guinea. It led to famine in southern Africa. Hurricanes in Mexico and Southern USA are said to have been caused by this phenomenon. It caused violent tornadoes in the US. It fuelled forest fires in Indonesia and the Amazon. Scientists believe that the 1997-98 El Nina was the most severe in this century.

Much speculation and many misconceptions have been built around the issues of fire and the El Niño phenomenon. During the COP3 in 1997, WMO released an update that addresses the questions and concerns of an audience that ranges from the general public to the policy makers. The document, however, does not confirm that El Niño is associated with the increase of greenhouse gas concentrati on in the atmosphere.

In contrast to El Niño, La Nina (the girl child) refers to unusually cool ocean temperatures across the central and eastern equatorial Pacific. This generally causes sharp reversals of weather patterns around the globe. This occurs roughly half as often as does El Niño , and six major La Ninas have been recorded in the past 50 years. In La Nina years, monsoons are enhanced over Australia and south-east Asia, but the central equatorial Pacific becomes drier than usual, a reverse of El Niño effects. It has been noted that La Nina does not necessarily follow hard on the heels of El Niño . However, it has done so three times in the past 1 5 years. In general, slightly higher than normal rainfall has been recorded during La Nina; but in certain years the amount of rainfall can be much higher than in La Nina years.

This time, the impact of La Nina is expected to be most clearly seen in October-November 1998, and will have more influence on rainfall during the northeast monsoon, if the intensity of La Nina is moderate or strong. 1998 is predicted to witness an unusually strong La Nina. Several governments, such as Malaysia, the Philippines and Indonesia, have taken measures to strengthen preparedness for 1998-99 La Nina, including upgrading of drainage systems, limiting development activities in high risk areas and improving flood control systems.

The recent devastation caused by El Nino has added a new urgency to a long running scientific mission: the quest to be able to forecast weather precisely, and to understand the cause and effects of the unnatural climate swings.

2. AN ANTHOLOGY OF FOREST FIRES IN INDONESIA AND SARAWAK

2.1 The Indonesian Scene

Indonesia's population increased from 165 million in 1985 to 198 million in 1995, the increase in density being 91 per sq.km to 109 per sq.km. Till the beginning on the second half of the century, landuse activity in Indonesia's outer islands was primarily subsistence agriculture, traditional shifting cultivation being the dominant practice.

Starting in the late 1 960s, Indonesia's forests were opened up for large scale timber extraction. Extensive forest areas were cleared for expanded transmigration activities, commercial and estate crops, and for other economic activities like mining and industrial development.

Mechanised logging started in the natural forests in the late 1960s under a system of timber concessions. Currently there are 657 concessions covering 69.2 million ha. Total roundlog production increased from 5.3 million cum in 1968 to about 34.5 million cum in 1995. Total roundwood production increased from 145 million cum in 1981 to over 185 million cum in 1995. Logging activities were being carried out mainly in the mixed hill forests (which includes the tropical rain forests and covers about 65% of the country's natural forests), and the peat swamp forests (which covers about 12% of the natural forests).

Landuse changes taking place in Indonesia's outer island led to extensive deforestation. Slash and burn agriculture (shifting cultivation) exists side by side with settled agriculture. In all cases fire is an important tool in land clearance and preparation.

Slash and burn agriculture in Indonesia covers about 11 million ha, being practised by some 1 .2 million households. Some 300,000 to 500,000 ha of forests are cleared annually for shifting cultivation. Apart from the bonafide shifting cultivators, the practice is being carried out by transitory forest farmers (land speculators and landless) and proxy farmers, clearing land for others (GOI/FAO 1 990b). As a result of planned and unplanned landuse changes, Indonesia's average annual rate of deforestation reached a level of 1 .2 million ha during the 1 980s and continued at an average annual rate of 1 .1 million ha during 1990-95. The deforestation coupled with annual/periodical fires has led to expansion of area under *alang a/ang,* the fire climax grassland of *Imperata cy/indrica.* Approximately 1 5 million ha of Indonesia's land surface has by now been invaded by *a/ang alang.*

Accounting for nearly 60% of the land area, forests continue to dominate the landscape of Indonesia. Their capability to support sustainable development would depend on how well they are managed.

2.1.1 History of Forest Fires

There is evidence of forest fire occurrences in Indonesia since pre-historic times. They were discrete instances forming part of the natural ecological process. There are a number of studies tracing the history of forest fires in Indonesia, providing detailed account of the fire environment and analysing the influence of climate variability and anthropogenic factors on fire regimes (Goldammer et a!., 1998; UNDAC/OCHA, 1998; Schweithelm, 1988; WWF, 1 998).

With the acceleration of economic activities in the Indonesian outer islands, forest fires have become commonplace. Fires occur every year. During pronounced El Niño years when conditions are usually dry, fires and smoke problems tend to be much more serious in terms of its magnitude and nature. Serious fires occurred in 1982-83, 1987, 1991-92, 1994-95 and 199 7-98.

There has been growing interest in the forest fires of Indonesia and their global impact, and there are a large number of reports available on the recent forest fires in Indonesia. They differ considerably on details; however, they reflect the magnitude and serious nature of the events.

2.1.2 Forest Fires of 1982-83

The fire season of 1 982-83 was characterised by escaped land fires facilitated by ENSO, which caused large scale wildfires. Fire ran out or control from several land clearings and slash and burn sites as well as from logging areas, *a!ang alang* and camping sites. It has been estimated that the overall land area of Kalimantan affected by fire exceed 5 million ha. In East Kalimantan alone, about 3.5 million ha were affected by drought and fire. Of this, some 0.8 million ha was primary rain forest, 1 .4 million ha logged-over forest, 0.75 million ha secondary forest and 0.55 million ha peat swamp forest. It resulted in the loss of timber values of about US$ 8.3 billion, and a total of timber and non-timber values and rehabilitation costs of about US$ 9.1 billion (Goldammer eta!., 1996). Undisturbed primary forests were less affected by fire, compared to the moderately disturbed and heavily disturbed forests. Logged-over forests are very sensitive to drought, and easily combustible.

2.1.3 Forest Fires Between 1983 and 1997

Land and forest fires which occurred during the extended dry periods in 1 987 (49,300 ha), 1991 (119,000 ha) and 1994 (162,000 ha) were distributed over some 25 provinces, including in Sulawesi and Maluku. These fires were larger than during years with normal rainfall, but not nearly as large as the fires of 1982-83 or 1997-98. The smoke emitted from the Indonesian archipelago during these years, though, was not primarily caused by forest fires, but by application of fire for converting forests into estate tree crops and forest plantations, and by slash and burn agriculture (Goldammer, 1998b). Also, the burning coal seams represents a permanent fire source from which wildfires spread whenever severe drought conditions occur and fuel conditions are suitable for carrying a fire.

2.1.4 The 1997-98 Forest Fire Season

Indonesia (and Malaysia) experienced one of the worst recorded drought spells in the recent history caused by ENSO during 1997-98. It occurred in two spells. The dry condition which started around September 1997 abated somewhat by November 1997; but with El Niño persisting and drought condition already returning in early 1998, in a pattern reminiscent of the El Nino drought and fire episode of 1982-83, the second spell lasted from January to April! May 1998, till the onset of rain. Several reports and papers including the WWF discussion papers "When the World Caught Fire" (WWF, 1997) and "The Fire This Time" (Schweithelm, 1998) contain overview of the Indonesian wildfires in 1997 and 1998.

Official figures of MOFEC/PHPA (1998) shows that the 1997 forest fire, occurring in 25 provinces, burned an area of 263,992 ha. A far higher estimate of the forest fire in 1997, commonly seen stated, is 2 million ha. Preliminary remote sensing assessment of the area burned in 1 997 indicates that approximately an area of 3.6 million ha was affected (2.2 million ha in Sumatra and 1.4 million ha in Kalimantan). Another EU-sponsored analysis using data from EU, JICA and GTZ sources suggests that 2.7 million ha of area was burned in South Sumatra alone, including 700,000 ha of forest area (Schweithelm, 1 998). A large portion of the area burned was not forest, but grass, agricultural residues and scrub. Forests burned were mainly logged over and secondary areas.

According to official information, in 1998, while fires burned 508,732 ha of forest area, in East Kalimantan, nine other provinces reported forest fires over an area of 5,464 ha. Some 86% of the fire was in timber concessions, mostly burning logged-over areas. One of the worst hit was ITCI in Balikpapan, 2.3% of primary forest and 6.6% of plantations forest (HTI) under license to the company also got burned. Other areas affected by fire in 1998 in East Kalimantan included protected areas - e.g. Kutai National Park and Bukit Suharto. Fire damage was considerably less in well preserved evergreen forests. Against these official figures, estimates of other sources put the area burned (including land and forest fires) to be about 3 million ha. (The results of the combined NOAA/ERS radar evaluation done recently give a figure of about 5 million ha).

Thus, while the official figure of total forest land affected by fire is about 800,000 ha, some estimates would suggest the extent of fire affected area to be about 7 million ha. CRISP is currently investigating the total area affected by land-se fires and wildfires in Sumatra and Kalimantan during the 1 997-98 fire season on the basis of high resolution SPOT satellite data. Preliminary data suggests the total fire affected area exceeded 4 to 5 million ha. The disparity of various estimates appears to be partly due to definitional problems. In the absence of adequate landuse information and maps, one finds it difficult to reconcile the differences and to breakdown the fire damage by landuse and vegetational classes.

Forest fires in Indonesia had spread to hill forests and peat lands, to production and protection forests, natural reserves and wildlife sanctuaries, recreation forests, national parks and research forests. Production forests accounted for 75% of the fire; secondary forests and HTI formed bulk, nearly 80%, of the production forest burned.

2.1.5 Analysis of Causes

An analysis of the causes of forest fires is useful to design remedies - preventive and combating measures. The causes can be grouped into two categories - predisposing (creating conditions favourable for fires) and immediate (leading to ignition). Both th ese can be natural or man made; and they reinforce each other.

El Nino phenomenon is a natural predisposing factor, whereas man-made factors are: wasteful logging, forest clearance for agricultural crops, estate crops and forest plantations leading to build up of combustible materials; inadequate fire protection measures; lax laws and policies or their inadequate enforcement.

Carelessness in the use of fire for land preparation or for other purposes such as collection of honey and horns, and trapping of animals (e.g. collection of live turtles), and deliberately setting fires for staking land claims or for registering protest against government policies are often the immediate cause for spreading of fire in conditions where there is plenty of dry matter to feed the fire. (Immediate cause for fire could also be a natural occurrence, but such cases are extremely rare).

A major fire event occurs only when these different causes work in unison. In spite of the dry conditions created by ENSO, a damaging fire event may not materialise if fuel load is properly controlled, fire protection measures are strictly implemented and immediate causes are kept in check.

One of the major causes of Indonesia's 1 997-98 wildfires, identified by investigators, is the land clearing practices of the oil palm plantations companies and small holders using fire to prepare land for cropping at low personal cost of no cost. Over 60,000 ha of forest land *per year* has been converted into oil palm between 1995 and 1997. Most of the oil palm plantations were opened up through systematic burning of vegetation, primarily logged-over forest. In addition to the existing 2.4 million ha the Indonesian government intends to allocate another 3.1 million ha for future conversion into oil palm plantation.

In Indonesia, there is reluctance/resistance on the part of landowners and companies to adopt more expensive 'zero burn' land preparation system. This is also true of forest plantations. Fire protection measures such as fireline clearance are also not being done in HTIs as was observed by the mission during field visit. And, Indonesia has about 6.5 million ha under forest plantations of different categories.

Reports further indicate that fires were also caused due to carelessness and irresponsibili ty of campers, spontaneous migrants, illegal loggers and graziers. The drought conditions propelled by El Niño did aggravate the blazes. The area of land and forest burned in Indonesia from year to year is somewhat related to land development policies (or lack of it) and length of dry season.

El Nino and practice of slash and burn agriculture are often singled out as the main culprits for the recurrence and spread of wildfires. But these are not new to Indonesia. It is the new land development activities (rate of which has increased immensely in the recent past), which ignite and prompt the wildfire. As observed by many, virtually all fires in Indonesia are man made and often

intentional (Goldammer 1997a, Schweithelm 1998). They are, therefore, preventable through improving/implementing landuse policies, landuse management systems and land tenure regulations. Only a fundamental change in these framework conditions will, in the long run, lead to substantial reduction of land and forest fires.

2.1.6 Impact of the 1997-1998 Wildfires

The loss inflicted by the fires on Indonesia's forest resources, and the damage to bio-diversity and the health of forest ecosystems have been simply tremendous. An added dimension of this fire, compared to those in the past was the severe transboundary pollution it caused.

The Haze Pollution

>From September to November 1 997, smoke from the Indonesian wildfires enveloped the region covering Brunei, Indonesia, Malaysia, Philippines, Singapore and Thailand by a dense haze, the size of western Europe, affecting some seventy million people, directly or indirectly. Instead of stray individual fires, 80% of the haze was produced by seven clusters of tires in and around peat forests in Sumatra and Kalimantan. The thickest haze came from an extensive fire in a one million ha area of peat being drained by the government for a massive rice planting project.

The haze consists of smoke, condensation and particulate matter created by burning of organic matter. The haze is normally termed smog, as it contains an airborne mixture of pollutants that are toxic to humans and animals. The smog problem suffered by Indonesia and its neighbours, due to the 1 997 wildfires, were a result of a combination of factors - the volume of smoke, humidity, and the lack of strong winds and rain due to the regional climatic inve rsion.

The 1998 fire event in Indonesia did not seriously affect mainland Asia as in 1997. The haze covered the source area of East Kalimantan and spread over East and West Kalimantan and south eastern Sarawak.

What had alarmed the environmentalists most about the 1997 fire was the spread of fires in peat forests which are waterlogged forests growing on a layer of dead leaves and plant material of upto 20 metres deep. These are a biologically diverse resource and a recognised component of the world's biological heritage. The annual meeting of the Standing Committee of the Convention on Wetland (Ramsar Convention) in October 1997 expressed grave concern at the burning of peat swamp forests and called for urgent action to prevent such events.

Fires in peatlands are unique in that they create much more smoke per hectare than other types of forests fires, and they are very difficult to extinguish. Apart from their contribution to global warming and long-term climate disruption, peat fires emit noxious fumes which trigger health problems. Haze from peat fires are considered most dangerous. While the spread of surface and ground fires in this type of organic terrain may not be severe, deep burning of organic matter leads to the toppling of trees and a complete removal of standing biomass. Further, the smouldering organic fires may persist and be reactivated as an ignition source in the next dry spell (Goldammer and Seibert, 1 989).

During the smog periods, atmospheric pollution index had reached high levels in the region. In September-October 1997, API reached upto 851 in Sarawak. An API reading of about 1000 was recorded in the interior of East Kalimantan in mid-April 1998. An API count of upto 200 is considered unhealthy; between 200 arid 300 is very unhealthy and between 300 to 500 is considered hazardous.

Multiple Impacts

Catastrophic forest fires in Indonesia and associated haze problem resulted in profound impacts on the economic, ecological, physical and social environments of the ASEAN sub-region. The economic impacts included the loss of timber and non-timber forest crops, losses and damages to infrastructural assets, agricultural crop losses and falling yields, fall in tourism revenue, unplanned cost of fire suppression efforts and so on. Ecological impacts of wildfire of 1997-1998 included loss of biodiversity, damages to protected areas, setting-in of ecological retrogression, damage to wildlife habitat, wildlife mortality, micro-climatic changes, contribution to global warming and increased fire proneness of forests. The 1998 fire gutted most of East Kalimantan's Kutai National Park and Bukit Suharto Nature Reserve. Most (some 85%) of Wanareset (research forest) was burned.

Rivers, lakes, and ocean waters and near-shore marine environment are also adversely affected by forest fire. Increased soil erosion, loss of soil nutrients and fall in productivity, reduction in water yield and quality, plant mortality and losses of forest growing stock, spread of *a/ang* a/ang and deforestation are obvious impacts of forest fire on physical environment.

The impacts from uncontrolled wildfires are severe at all levels. Locally, the health and safety of the people who suffer from the effects of smoke and haze is most serious, and in some cases loss of life has resulted. At the regional and national levels, commerce is disrupted, particularly transportation. Both air traffic and sea traffic were affected. Smog reduced visibility and smog-related air and ship accidents, in September 1 997, claimed 263 lives. Airports were closed, for several days; educational institutions and industrial establishments were temporarily shutdown. The fire burned villages, caused loss of property, and injuries and harm to people. Many lost their means of livelihood. All those who lived in smog-affected areas suffered discomfort. By blocking out sunlight for days together, smog also affected agricultural crops.

The haze episodes in south-east Asia in 1997-98 constituted a substantial health risk to the public. The smog contains, among other chemicals sulphur dioxide, nitrogen oxide, carbon monoxide, and polycyclic aromatic hydrocarbons. The main constituent of the smog that adversely affects health is the particulate matter (WHO, 1998). During the haze, health of some 40 million people were directly affected. Some sources estimate the total number affected directly and indirectly, to be about 70 million. More than 40,000 people have sought medical help and hospitalisation in Indonesia and Malaysia for smog-related respiratory ailments (Anon, 1997). It is still unclear what long-term effect smog will have on the exposed children and infirm. Physicians point out that smog can cause a range of ailments such as heart and lung diseases and damages to the nervous system, blood and kidneys.

2.1.7 Valuation Of Damages

According to the interim results of a study conducted by the WWF/EEPSEA the economic damages caused by fire in Indonesia during 1997 was valued at US$ 3.1 billion. Additional costs arising due to fire and smoke haze in Indonesia and in the neighbouring countries was estimated at US$ 1 .4 billion. Of the haze related damages in 1997, the greatest burden fell on Indonesians themselves, exceeding US$ 1 .0 billion; more than 90% of Indonesia's losses were attributable to short-term health costs. Costs to Malaysia exceeded US$ 300 million mainly from industrial production losses and lost revenues from a big drop in tourism. Singapore lost over US$ 60 million, mainly from a drop in tourist visits. Indonesia also lost nearly US$ 90 million from foregone tourist revenues, airline cancellations, and airport shut-downs, while Malaysia and Singapore together suffered almost US$ 12 million in health costs. Thus, the total damages of about US$ 4.5 billion assessed for 1997 include short-term health damages; losses of industrial production, tourism, air, ground and maritime transportation; fishing decline; cloud seeding and fire-fighting costs; losses of agricultural products, timber, and direct and indirect forest benefits and capturable biodiversity (EEPSAI'A'WF 1 998b). Many losses, such as the deaths of a large number of Indonesia's wild orangutans are impossible to monetise.

Full details of damages suffered in 1998 are not available. Official figure of timber loss in 1998 is about US$ 1 .0 billion. Continuing efforts are being made by different organisations to further refine the value of 1997 fire damages, and to calculate those of 1998.

2.1.8 Fire Management and Suppression Efforts

Fire suppression efforts in Indonesia during the 1997-98 fire season and their effectiveness is to be reviewed in the background of the state and status of fire-management related activities. Test of good fire management is the capability to contain a fire quickly if started, reflecting the sustained support from all its departments - i.e. fire protection, fuel load control, prediction and early warning, fire detection, fire suppression and smoke control. Forest rehabilitation, a post-fire activity, is a vital component of IFFM.

In the foregoing pages, the background, nature and impact of the 1997-98 forest and land fires in Indonesia have been discussed. Inspite of the experience of the country in facing several major fires during the last 20 years ,and the existence of improved technologies for monitoring fire danger and for suppressing fires when they occur, in the 1997-98 season fires raged out of control in several provinces of Indonesia and caused extensive havoc. The available reports on the fire event indicate that there were weaknesses in all aspects relating to fire management; and the need for developing and establishing a sustainable functional system is clearly evident. Some of the fire related activities (e.g. training, demonstration) were initiated during or after the 1997 fire event - mainly through donor supported projects.

Policy and Legislation

There are no separate policy or legislation relating to forest and land fires. Those having relevance to IFFM are Basic Forestry Act No. 5/1967; Conservation of Natural Resources and Their

Ecosystem Act No. 5/1 990; Act No. 5/1994 on Acknowledgement of the UN Convention on Bio-diversity; and Environmental Conservation Act No. 23/1 997. A note provided to the ITTO Mission by MOFEC (GOI/MOFEC/PHPA, 1998) listed 23 technical and procedural guidelines relating to various aspects of IFFM: fire prevention and mitigation; controlled burning; Centre of National Fire Control; landuses and forest fire suppression; use of forest fire suppression equipment; forest fire mitigation supplies; forest fire signposts; safety in forest fire suppression; forest fire suppression command system; land clearing without burning; alertness and safety; and so on.

Reports indicate that these guidelines were not adequately complied by the parties concerned (the public, concessionaires, land owners), inspite of the warning about fire risk. There is no adequate machinery to enforce the guidelines/instructions relating to zero-burning land preparation, maintenance of fire breaks, conduct of prescribed burning and establishment of water storage dams.

Fire Prevention

Establishment and maintenance of fire breaks and other fire prevention and pre-suppression measures, including the related infrastructure involve considerable investment. This is often not done by individual owners and companies to save cost. During the 1997-98 fire season there were no effective fire break system in most cases. Even though fire prevention messages were announced through media, these were of limited value, in the absence of adequate enforcement machinery. It is necessary to focus on this aspect, as a priority issue.

Fire Monitoring

During 1997-98, KLH, MOFEC and several other organisations monitored 'hot spots' appearing on NOAA weather satellite images, tracked where fires are burning each day and provided early warning about fire danger to the fire suppression teams through a chain of command structure at the national, provincial and district levels. There are now six NOAA-AVHRR systems in operation in Indonesia. They are located, one each, in Bogor, Palembang (South Sumatra), Samarinda (East Kalimantan), Palankaraya (Central Kalimantan) and two in Jakarta. There is also a smoke tracking Himavari located in Bogor.

Caution is required in using 'hot spot' data from satellite images to detect and evaluate fire conditions. They often do not show under heavy haze or cloud cover. Also, the total number of 'hot spots' counted on images taken during the day decreases on similar images taken at night, probably due to diurnal changes in humidity. 'Hot spots' may represent heat sources other than from land and forest fires, including burning coal seams, gas flares, and activities in settlement areas. The information provided has not always been effective due to the coarse scale (resolution) of the images and communication delays between provincial and district levels and between district level and fire suppression teams. The experience of 1997-98 fires has shown that much improvement is needed to strengthen the early warning capability and preparedness through a combination of enforcement and awareness programmes at the local level.

Fire Detection

Fire detection is carried out in Indonesia through surveillance by ground patrols and local community members, use of fire tower facilities, air patrolling by aircrafts and helicopters, and by enlisting co-operation of commercial airlines. A system of fully equipped fire observation towers is normally an effective means to detect and pin-point the location of fire. But there are only very few functioning fire observation towers in Indonesia. Some of them in the forest concessions are not in a state of good repair. Communication at the local level has been weak and there has been avoidable delay (Anon, 1997). All government forestry offices in the country were connected with Phillips' radio system in one frequency in the early 1990s. Lots of them are not functioning due to technical and procedural problems. There is need to strengthen/ renovate the system, to communicate urgent fire-related information.

Fire Suppression

Fire-fighting involve human resource (fire brigades), equipment, and other supplies. Availability of trained fire-fighting teams of adequate size and capability to quickly respond to fire alerts is vital.

Reports indicate that during the 1 997-98 fires, several measures were employed in the forestry sector: direct suppression by local fire crew (forest rangers) in co-operation with army and police personnel; mobilisation of fire crew from neighbouring provinces; organising local people and concession staff to fight fires; water bombing (also using chemical retardants) from aircrafts; and cloud seeding to induce rain. International emergency assistance, in addition to long-term development assistance, were received in the form of services of trained fire-fighters (e.g. from Malaysia), aircrafts and water bombing facilities (e.g. from USA), along with fire-fighting supplies, hand tools and other equipment (e.g. from Germany). The intervention through sophisticated technology (water bombing, cloud seeding) were only of a limited scale and their level of success is uncertain. Indonesia is reported to have some 14,000 persons trained in fire-fighting of whom only 1,400 are regular staff of MOFEC (forest rangers); 8,500 persons are with forest concessions, 3,500 with state owned enterprises and 600 are members of the public. Some 8,000 fire-fighters have been battling the blaze in Indonesia for months in 1997 and 1998. Additionally MOFEC has been operating its command posts for 24 hours a day at the central level in Jakarta and Bogor, and in each province. Through these posts, information and directions on fire situation and control were exchanged.

MOFEC has an exclusive sub-directorate on forest fire along with a National Forest Fire Control Centre (PUSDALKARHUTNAS) and provincial forest and land fire control centers (PUSDALKARHUTLA), executive units at the sub-district level (SATLAK), and fire brigades.

At the multi-sectoral level, a National Co-ordinating Committee (team) of Forest and Land Fire Control (TKNPKL) was established in 1997 jointly by the State Minister of Environment and Minister of Forestry and Estate Crops, with the Environmental Impact Management Agency (BAPEDAL) serving as its Secretariat.

The expenditure incurred in the forestry sector for fire suppression and related rescue and other activities during the 1997-98 fire season has been estimated to be about 7 to 8 trillion Indonesian Rupiah.

2.1.9 Disaster Dimension

Occurring in agricultural land, forests and rural areas, and spreading from one to the other, burning furiously and causing heavy haze, the fire event of 1997-98 acquired a disaster dimension,

requiring high alert. Co-ordination of fire suppression and control activities were accordingly taken up by the National Co-ordination Agency for Disaster Control (BAKORNAS PB) under the Co-ordinating Minister of Public Welfare, supported by MOFEC, KLH and the armed forces.

The role of BAKORNAS PB at the central level of co-ordination was to provide directions and guidelines, provision of financial support, organising water bombing and cloud seeding operations, and to co-ordinate emergency assistance. At provincial level the mobilisation of human resources, equipment and funds was co-ordinated by PUSDALKARHUTLA and the Coordinating Unit for Management of Disaster (SATKORLAK PB)

However, involving a large number of agencies/institutions, at the central, provincial, district and local levels proved to be a difficult task.

Official forestry sources (MOFEC, 1998) claim that every possible efforts have been made to limit losses by fire, applying Dasa *Upaya,* the ten strategies: dissemination of information and extension; human resource development; appropriate equipment and supplies; early fire warning; zero burning for land clearing and preparation; welfare of community; readiness/alertness; fire suppression organisation/co-ordination; law enforcement; and international assistance. But, as seen from experience, the efforts were not adequate. The fires continued till it was fully suppressed by the onset of rain or in some cases blocked by natural barriers like rivers and water bodies. During visit to the field, in East Kalimantan, the Mission observed that even now, the forest concessions are not having adequate fire protection measures, equipment and trained personnel. In the post-fire scene, another important lapse noted is the lack of action to carry out sanitary operations and to rehabilitate the fire-ravaged areas. These indicate the need for developing an effective and foolproof system of fire management, and to operationalise it.

2.1.10 Constraints in IFFM

There are several constraints affecting the efficiency and effectiveness of fire management in Indonesia, which often serve as an indirect cause for fire occurrence (Makarim et al, 1997). Constraints are of different nature.

Physical. Fire management is often constrained by physical condition of the locality - terrain, slope, accessibility, inadequate availability of water. Forests in steep terrain and peatlands present difficulties for movement.

Climatic/Physiographical. Conditions such as low humidity, lack of clouds, and difficulties for access to and exit from, natural water bodies can affect fire suppression operations, particularly water bombing and cloud seeding. Performance of water bombing and cloud seeding operations in Indonesia during the 1997-98 fire was unsatisfactory.

Cultural. Indigenous and rural communities with certain cultural/religious leanings tend to worship fire, and it is difficult to prevent their use of fire in landuse activities such as slash and burn agriculture. Villagers are also often reluctant to fight fire without attractive incentives.

Social. Conflict of interest among different classes of people and communities may lead to fights, and use of fire as a weapon to inflict harm on the enemy. Such situations are common among indigenous communities of Indonesia and between the indigenous communities and the transmigrants. Also, in some situations rural people move into the forest to eke out a livelihood by illegally clearing and cultivating forest land.

Economic. Benefit and cost considerations often prompt people and entrepreneurs involved in land management to act with a private profit maximising attitude and be lax on fire protection activities. Also, fire is often set deliberately for individual economic gains through activities such as grazing, collection of honey and non-wood forest products, and hunting and gathering.

Technical. Lack of knowledge about technical weakness/inadequacies may lead to inefficiency in fire suppression measures. Monitoring of fires in Indonesia is being done using NOAA-AVHRR, with a ground resolution of 1 km. The satellite can detect fire points, normally called hot spots. The satellite however, was developed for weather and oceanic purposes both of which have temperatures below 4Q0 C. The sensor measures the average temperature of 1 sq.km. This does not mean that a fire has to be this size, since a small hot fire can influence the average temperature of the 1 sq.km pixel considerably. Unfortunately, detecting hot spots is not flawless. Bare soil, corrugated iron, and low vegetation (grass) can also have a very high temperature in the sun and is often wrongly assigned as a fire hot spot. This misclassification can account for more than 50%. Furthermore, hot spots cannot be detected in areas with thick haze or smoke cover, as the sensor cannot penetrate haze, smoke or cloud. Area calculation is very difficult or impossible with only hot spot information.

Infrastructural. Lack of infrastructural facilities such as access roads, fire corridors and breaks, observation towers, water reservoirs, communication facilities, satellite stations, mapping facilities and so on affects the efficiency of fire management. For example, the total reported length of cleared fire line in Indonesia is only about 1 50 kilo metres, which appears grossly inadequate. Adequate infrastructure are found only in some of the donor-funded projects.

Institutional. Many of the constraints relating to FFM are institutional in nature.

(a) Policy changes and conflicts relating to landuse, tenure security and industrial development add considerably to the fire danger. The economic policy of Indonesia which allows large scale expansion of commercial crops prompt land speculation, and leads to ecological disaster. It has been observed that the pace of plantation development has been such that MOFEC is little more than a bystander (Anon, 1 997b). Likewise, Indonesia's policy on timber pricing subsidises the concessionaire. A study indicated that in 1990 Indonesia's timber subsidies cost the Government US$ 2.5 billion in lost revenues (Constantine, 1990); and this further leads to wasteful utilisation of resources. For reasons related to tenure security, many forest dwelling communities do not yet acknowledge current forest boundaries; and this conflict is not conducive for SFM.

(b) Absence of properly designed and suitably linked action plan relating to land-use, SFM and FFM.

(c) Lack of updated land-use maps, fire maps, fire information management and dissemination.

(d) Inadequacies of laws, rules and regulations relating to fire management, inefficiencies in enforcement and lack of compliance.

(e) Lack of institutional ability to learn lessons from past mistakes and to follow-up on the recommendations. For example, there has been several recommendations to curtail the volume of timber production to ensure SFM, including protection of forest from fire and other damaging agents; but, these have not been pursued. A national fire management plan was prepared by MoF in mid-1980s, in co-operation with FAO. According to the plan forest area was to be divided into fire-fighting control units of 40,000-50,000 ha in Java, and 100,000-1 50,000 ha outside Java, such that fires (even if they occur) can be prevented from spreading, and confined to the control unit (GOI/FAO, 1990).

(f) Lack of measures and means to improve fire management skills. Personnel trained in fire science are comparatively few. Recently, efforts have been made to strengthen training facilities. As at the end of August 1998 there were 16,175 persons trained in fire protection and suppression, up from about 14,000 in 1997.

(g) Inadequate research/technology development and knowledge about the different aspects and situations of fire, for example: in coal seams and peat swamps.

(h) Absence of an incentive system to involve people and to promote fire protection.

(i) Insufficiency of funds to adequately address the issue of forest and land fires. The situation has been the same for the last several years. A seminar on Forest Fire and Satellite Data Utilisation held in Jakarta in September 1 987 revealed that the M0F has been unable to deal comprehensively with forest fire situation, due to shortage of funds. Investigations have indicated that the country's multi-million dollar reforestation fund, collected on timber produced, had not been used to fight fires or to set up anti-fire defences.

(j) Lack of pro-active quick action approach. The Indonesian government has been somewhat late in reacting to fire warnings; data on hot spots was available during January/May 1997, and yet there was no timely proactive initiative. Even after press releases were made of impending ENSO, land preparation burnings continued as usual in August 1997.

(k) Delay or inaction in rehabilitating the badly burned areas. Apart from harbouring pests anddisases, the dead and charred materials remaining in the area can cause fires in the future by providing combustible fuel load. The reason for the present inaction appears to be the heavy investment required to clear and prepare the site, and to

replant it.

(l) All fire management and fire suppression activities have generally suffered from poor co-ordination, either among sectors, between central and provincial levels or among the donors. Inter-sectoral co-ordination at the central level is not yet effective due to inadequate institutions, inc luding unclear assignment of tasks, authorities and responsibilities among the three institutions (TKNPKHL, BAKORNAS PB, and PUSDALKARHUTNAS),especially in the mobilisation of personnel, equipment and financial resources, as well as the reporting from the field. The above problem also occurs at the provincial and district levels. The donor assistance do not come through a single gate and a clear mechanism. Some are received directly by the MOFEC, some through the BAKORNAS PB, and others directly to the provinces. Exchange of information is not well organised, which complicates monitoring of the assistance.

To Summarise: The main concentration of forest and land fires in 1997 was in Sumatra (eastern Riau, eastern Jambi, northern Lampung, southern Sumatra) and Kalimantan (southern West Kalimantan and southern Central Kalimantan). Concentration of 1998 fire was in East Kalimantan. The fires affected primary forests, logged over forests, secondary forests and swamps and peat swamp forests. Wherever peat swamps have been affected, the damage has been near total, because in most cases the structure of organic underground broke down (Goldammer, 1997).

There have been a number of post-fire studies and surveys and they provide a useful snapshot of the effects of for est fires. They are most revealing in showing how little we know about Indonesia's rain forest ecosystem. As El Nine related droughts and fires might regularly occur in Indonesia any development of silvicultural systems for the management of rain forest ecosystem in the future will not be meaningful without an assessment of their impact on FFM.

Major fires have taken place in Indonesia not simply due to El Nino, but due to a much more complex interaction of human-induced conditions. Land tenure insecurities, changes in landuse policies and the interaction between small and large holders are considered important variables. The full biological impact of the fires may not be known for years to come. While the estimate of loss noted earlier may help to provide the magnitude of the calamity, many of the deleterious effects of fire on Indonesia's tropical rain forests cannot readily be cast in economic terms.

Fires occur only infrequently in undisturbed natural forests. Studies indicate that fire damage to Indonesia's rain forest increases in proportion to the level of prior human interference. Density of fires was significantly higher within designated forest concessions and industrial tree plantations, than outside. A WWF study in the Tanjung Puting National Park in early December 1997 indicated that species diversity has declined precipitously; while there were 60 tree species per ha in 1989, after the fire of 1 997 the burned transects contained fewer than 1 5 species.

Complete prevention of fire seems almost impossible; only the fire incidence can be reduced considerably through appropriate measures such as low impact logging, logging residue disposal, sanitary operations, and integrated fire management covering all parts of the country within the frame work of SFM.

2.2 A Note On Sarawak Situation

Sarawak, Malaysia located in the northern side of Borneo, adjoins the Kalimantan province of Indonesia. They share several similarities, particularly in respect of climate and vegetation. For the ITTO mission, visit to Sarawak was revealing as to how forest fire can be controlled or reduced with due vigilance and institutional innovations.

Land area of Sarawak is about 12.3 million ha, of which some 66% are under forests. Estate crops are a major form of landuse in Sarawak and they currently cover an area of about half million ha. Rubber, oil palm, sage and pepper are the major commercial crops. An additional area of about one million ha will be developed into oil palm estates by the year 2020. Native customary land owners will be encouraged to join the programme.

Land clearance for cultivation is mostly done mechanically and land preparation for planting follow 'zero burn' methods. Logs are stacked along contours, to prevent soil erosion. Sometimes a partial/light burning is carried out to reduce the debris.

2.2.1 Forests And Forestry

Area in Sarawak under forest cover is 8.08 million ha, of which some 1 .26 million ha are under swampy vegetation. Of the total area of forest cover, some 6 million ha are earmarked as permanent forest estate. This permanent forest estate comprises three classes of legally constituted forests - forest reserves, protected forests and communal forests. The permanent forest has been demarcated on the ground by a cleared boundary line about 2 meters wide. By vegetational types, the distribution of the permanent forest estate, is as follows:

Hill (mixed) *Dipterocarp* forest	77.6%
Peat swamp forest	2 1.1%
Mangroves	1.3%

Some 60% of the total forest land in Sarawak is categorised as productive forest. Annual log production varies between 12 and 1 5 million cum. 50 to 60% of the logs produced are processed locally, rest of the logs are exported.

In the past, log production was largely based on the peat swamp forest. Extraction from hill forests have been recently stepped up. Log production in Sarawak is carried out through concessions/licenses. Sarawak is committed to low impact logging and recently has embarked on helicopter logging, to reduce environmental damages.

Reforestation activities have been small. Area of forest plantations so far raised in Sarawak is only about 1 2,000 ha, with Acacia *mangium* and several indigenous species.

2.2.2 Shifting Cultivation

Shifting cultivation in Sarawak is practised by Ibans and other indigenous groups. No precise statistical information is available. It is estimated that some 50 to 60 thousand households (about 300,000 persons) are engaged in shifting cultivation. Some 60,000 ha of forests, mostly hill (mixed) *Dipterocarp* forests, are freshly cleared annually for shifting cultivation, in addition to some 40,000 ha of secondary forests. Value of timber annually burned in clearings has been estimated to be about US$ 50 million, apart from the environmental damages involved. In many cases, shifting cultivators do prescribed burning to avoid wildfire. Some 45% of shifting cultivation land is left by the farmers for land protection.

Total estimated area covered under the system of shifting cultivation in Malaysia is about 3.3 million ha. Only about 50% of this is legal.

It is mostly the old people who are involved in shifting cultivation. While the shifting cultivation practice will continue, the area involved is declining with economic growth and with young people going into industry. There has also been an ongoing transition for expanded *in situ* developments.

Under the government policy, the illegal shifting cultivation is being converted into oil palm plantation, and people involved are resettled through: land custody and development agency (LCDA); Sarawak Land Development Board (SLDB); and Sarawak Land Consolidation and Rehabilitation Agency (SALC). They are also provided some form of title over the land.

2.2.3 Forest Management

Sarawak has maintained a good track record in managing the forest resources scientifically and sustainably. All forests are managed based on working plan prescriptions. Control measures and supervision are carried out efficiently. Working plans are prepared for a period of 10 years and are revised and updated every three years.

2.2.4 Experiences of Forest Fire Management

Sarawak has been free from any major fires in its territory, except for the small and managed fires, even when wildfires were burning in the neighbouring Kalimantan provinces of Indonesia. Sarawak was, however, affected severely by the effect of smoke generated by the Indonesian forest and land fires of 1997 and 1998.

The first major fire in Sarawak in the recent past, was recorded in 1998. (The last time a similar fire occurred was in the peat swamps, in the early 1980s). Fire started in the peat swamps and the secondary forest in the outskirts of Miri, near the Sarawak - Brunei border, in February 1998. Forest fire also took place in a hill forest concession area in south-eastern Sarawak, close to the border with Indonesia. Brunei also suffered small fire incidents during the same time and fire-fighting operations were co-ordinated.

The forest fires in Sarawak were put out completely by middle of May 1998. Onset of rain helped. No plantation crops (forest or agriculture) were affected by the fire; and the occurrence of fire was

restricted to the dry parts of Sarawak. While information on the actual area affected by fires was not available (or disclosed), the impression gained is that the fire burned an area of about 2 to 3 thousand ha.

As part of routine forest management, and as prescribed in the working plans, Sarawak maintains a system of fire breaks, and an adequate amount of fire-fighting equipment. Fire protection measures are stringent for plantations, and a mixture of fire resistant species are normally planted along the periphery.

2.2.5 Institutional Responsibility

Responsibility for FFM in Sarawak is distributed among three agencies, whose efforts are closely co-ordinated, i.e. the Sarawak Forest Department (forest fire protection measures, rehabilitation of fire burned areas); the Sarawak Natural Resources and Environment Board (NREB) (implementation of regulations under the Natural Resources and Environment Ordinance), and the Fire and Rescue Department of Malaysia (fire suppression). The distribution of responsibility (to take the lead role) is based on the technical specialisation of respective agencies.

Sarawak Forest Department

The department undertakes and/or ensures implementation of fire protection measures such as construction of fire breaks, clearing of firelines, prescribed burning, supporting fire suppression activities and arranging for post-fire clean-up operations and rehabilitation.

Forest officers are delegated with powers under the Forest Act to ensure protection of forest property. The Department has staff trained in forest fire protection and control, use of fire retardants and other aspects of IFFM.

The Sarawak Natural Resources and Environment Board

NREB was established on 1 February 1994, pursuant to section 3(1) of the Natural Resources and Environment (Amendment) Ordinance, 1993. The administration of the Board is organised into (i) a policy body and (ii) a management body. The policy body consists of 11 *ex-officio* members drawn mainly from the state government and one representative from the federal government, i.e. the Director General of the Department of Environment, Malaysia. The chairman of the Board is the Minister for Resource Planning, Sarawak.

The management body is responsible to execute the functions or exercise the powers of the Board under the Natural Resources and Environment Ordinance. The main task relates to environmental protection and management in Sarawak. The management body is headed by the Controller of Environmental Quality. The NREB has three regional offices.

The functions and powers of the NREB, as provided under section 5 of the Ordinance, are broadly summarised as follows:

To formulate or develop policies and guidelines to ensure that the exploitation, conservation and management of natural resources in the State will not cause any adverse impact on the environment;

To determine the mode and manner whereby natural resources can be exploited or used without damaging, polluting or causing adverse impact on the environment;

To direct any environmental authority and any other person or body, involved in, or undertaking, the development, exploitation, utilisation or management of natural resources, on the steps or measures to be undertaken by them to maintain environmental quality control; and

To make orders for the protection and enhancement of the environment. Environmental protection and management in Sarawak is governed by the Natural Resources and Environment Ordinance which stipulates the manner and mode of protection, enhancement and management of the environment in the State. The goal is to achieve sustainable development. Hence, a balance between environmental protection and economic development must be maintained, i.e. environmental efficiency.

The Ordinance provides NREB with authority to seize property, to impose deterrent fine, and to compound cases. The Board has sufficiently trained staff to be capable of ensuring environmental quality and efficiency. The Board maintains good co-operation with Fire Brigades, Forest Department, Police and the Army.

Fire Permits

The Natural Resources and Environment Ordinance (amended upto March 1, 1 998) specifies that open burning of refuse or other combustible materials, and use of any land to deposit refuse without permission, is an offence. The relevant provision reads: "Any person who, without the written permission of the Controller, cuts, destroys and burns vegetation in any area which is not a Native Customary Land, shall be guilty of an offence. Penalty, a fine of thirty thousand Ringgit and imprisonment for three years".

The fire permit granted will specify the period and extent covered, nature of permit and the conditions to be complied - e.g. the phasing of burn and the area to be burned each week, period within which burning is to be completed, reduction of flame, precautions to be taken and so on. The Fire and Rescue Department is informed of all the fire permits granted. The Board itself has no trained fire-fighters. During 1997, few hundred fire permits were given, concerning an area of 2,429 ha.

NREB monitors open burning on a daily basis to prevent their spread. It also monitors the level of atmospheric pollution. There are three API machines installed in border areas of Sarawak. in due course, the Board is expected to establish a fire danger warning system.

Fire and Rescue Department

Fire and Rescue Department has the lead responsibility for, and is actively involved in,

suppressing all types of fires. FRD is a federal agency with its state unit (State Directorate of FRD) for Sarawak located in Kuching. There are fire stations distributed in main centres.

The personnel of FRD are trained in the Fire Academy in Trengganu or one of its four branches, for a period ranging from four months to one year. Subjects taught in the courses include structural fires, rescue operations, use and maintenance of fire-fighting equipment, emergency management and so on. There are also facilities for refresher and upgrading training. The firemen are, however, not trained specifically in fighting forest fires.

2.2.6 Suppression of 1998 Fire

The hill forest fire near the Indonesian border was in a remote area (about 1 8 hours by forest road), with steep terrain and no water source close by. Timber operation has been carried out in the area earlier, by a concessionaire. Fire-fighting conditions were tough. 46 fire-fighters were sent to the area, reinforced with aerial support and water bombing (using 450 gallon buckets) by Air Force. Fire cranes (large helicopters used to put out fire and transport people), and logging helicopters were put into emergency service. Police and Army provided additional help. Meteorological Department constantly provided wind pattern and "hot spots" information. Eventhough cloud seeding was carried out, it was not a success. Inaccessibility was the main problem causing delay in extinguishing the fire.

In respect of the fire in peat swamp forest in Miri, inadequacy of fire-fighting equipment suitable for the water-logged area was a handicap. Peat of Mini (as in the case of peatland near Pontianak, Indonesia) is particularly difficult due to the presence of methane gas. The problem was somehow solved. Mini had only 92 fire-fighters; an additional 600 came from other pants. It took over two months of constant effort to put out the fire from the peat layers by flooding the area. Wide trenches had to be dug using excavators, to isolate the fine and to attack them in confined areas.

In all these operations the private sector and local people provided full support and co-operation. Volunteer Fire Associations in villages cooked food for the fire-fighters and provided other services. During the fire season of 1 998, hot spot information was available from different stations, through *intranet.* Commercial flight pilots gave information on fire sighting. All activities relating to the 1998 forest fire in Sarawak was co-ordinated by a Disaster Management Committee of which the Chairman was the Resident of Miri.

2.2.7 Nature of Constraints

Several of the constraints faced by Sarawak during the fire event was similar to those in Indonesia: inadequacy of tire data; remoteness of fire locations, inadequate facilities to transport the crew, lack of adequate and upgraded training on specific aspects of forest fire appropriate to site characteristics (e.g. to tackle peat fire, underground fire), disruptions caused by transboundary pollution, lack of a programme to use burned out material and to rehabilitate to the land, lack of knowledge/experience in rehabilitating peatland and others cleared of vegetation.

2.3 Indonesia and Malaysia- Similarities and Differences.

Even though there were several similarities in the situation existing in Sarawak and Kalimantan provinces of Indonesia, with specific regard to fire proneness, such as the presence of El Niño phenomenon, timber operations by concessionaires, existence of shifting cultivation and traditional farming and so on, the fire event of 1998 in Sarawak was proportionally much smaller in terms of its extent and intensity.

Forests of Sarawak are managed on the basis of regular updated forest management plans (or working plans); and forest management in Sarawak is more in tune with sustainability criteria. For example, selection felling in Sarawak takes out only 40 to 45 cum of timber pen ha, compared to some 90 cum per ha elsewhere, thereby causing less damage to the forest and accumulating less fuel load. Forests of Sarawak are much denser with a biomass volume of over 260 t/ha against around 200 t/ha in Indonesia (FAO, 1995). Regular stump inspections are carried out in Sarawak during logging to ensure uniform density of extraction (instead of heavy extraction on road sides).

The indications are that, in Sarawak, fire protection is an integral part of forest management; and issues of forest management are addressed more seriously. There seems to be genuine participation of local people, as the issues affecting their livelihood are better (and objectivity) addressed. There appears to be better co-operation among parties/agencies involved; and their activities are better co-ordinated. Increased acceptance of 'zero burn' land preparation, the system of fine permits and daily monitoring of open fires were important factors which helped

3. NEW INITIATIVES AND INTERNATIONAL ASSISTANCE

The unprecedented frequency and intensity of forest fines in Indonesia during this decade led to several new initiatives, and reviving/revamping of old ones, at all levels - national, regional and international, to address the fire problem. A comprehensive account of past, present and proposed fire projects in Indonesia during 1 982-98, with details such as objectives, component activities, target groups, geographical coverage, time horizon, counterpart agency, budget level, and, where relevant, achievements and impacts, can be found in a recent publication of CIFORICRAF-UNESCO-EU (Dennis, 1998) and on the South East Asia web site of the Global Fire Monitoring Centre (http://www.unt-freiburg.de/fireglobe).

The fire and haze related initiatives include national strategies for co-ordinated action, collaborative regional efforts of ASEAN, and involvement and support of international community. To help establish and ensure effective co-ordination of these mutually reinforcing initiatives, ADB is providing technical assistance at the regional level to ASEAN Secretariat (RETA) and Advisory Technical Assistance (ADTA) at the national level to Indonesia.

While reviewing these initiatives, it will be useful to keep in mind that the period, the 1990s, coincided with the world's preoccupation with sustainable development and SFM. Indonesia, on its

part, has reported that following UNCED decisions, Agenda 21 and Forest Principles, the country has developed a framework for strengthening national efforts for implementing PP proposals, which include protection of forests from fires (MOFEC 1 998).

3.1 National Initiatives

Following the forest fires during the 1994 dry period, the National Co-ordinating Team for Land and Forest Fire Control (TKNPKHL) was formed in 1995. The Team is headed by the State Minister for Environment and the Director General of Forest Protection and Nature Conservation (PHPA). Members of the TKNPKHL include senior officials from the Ministries of Home Affairs, Mining and Energy, Agriculture, Transmigration, Social Affairs, LAPAN, BAPPENAS, and the Agency for Technology Assessment and Application. The Deputy Head of the team and the Secretariat are located in BAPEDAL. >From national and multi-sectoral points of view TKNPKHL is responsible for co-ordinating all the related agencies/institutions, in preventing and suppressing forest and land fires. BAKORNAS PB play an important role in forest and land fire suppression, when they acquire disaster proportions.

Main functions of TKNPKHL include: formulate national policy related to the prevention and management of land and forest fire; establish operational co-ordination nationally and locally to control land and forest fires; provide guidance and direction on the protection of areas not exposed to pollution and degradation; formulate systems to strengthen: human resources, awareness, monitoring, reporting and information and development of incentives; provide policy inputs to fire control centres in the provinces headed by the Governor who will prepare the technical operational programs; develop techniques to control fire using various management approaches; and operate a fire detection and early warning system (Makarim, 1 998). With regard to its responsibility for fire detection and early warning TKNPKHL, has conceptually developed a fire surveillance scheme consisting of monitoring, identifying and prioritising hot spot areas, fire hazard mapping, communicating with command posts, aerial surveillance, ground surveillance and fire prevention/suppression action in co-operation with relevant agencies at national, provincial, district and local levels. BAPEDAL in its capacity as secretariat of the TKNPKHL, established an emergency command post (POSKO) to co-ordinate efforts to control land and forest fires The main activities of the P05KG are to act as the central body to collect, analyse and disseminate information about land and forest fires throughout Indonesia

According to official reports, information about forest and land fires in Indonesia flows through several agencies. The dominant centres controlling information flow are the command posts (POSKO) operating at the Ministry of Forestry (PHPA) and at the Central BAPEDAL. POSKO at PHPA receives radio reports from all provinces in Indonesia. The BAPEDAL POSKO receives several types of information daily including processed and unprocessed satellite images from NOAA satellites (via LAPAN and the Singapore Meteorological Service), weather reports (via the National Meteorological and Geophysical Agency), smoke and haze reports (Department of Communications, Singapore and Malaysia Meteorological Services), and telephonic and fax reports on conditions from regions. The POSKO also receives detailed boundary maps of concessions for commercial forestry and industrial timber plantations, tree crop and other agricultural plantations, conservation areas, mining and oil and gas concessions, and

transmigration projects. Daily POSKO operations include, among others: receiving and enhancing satellite images to show hot spot locations; using GIS to overlay hot sport on landuse maps to ascertain responsible parties; contacting provincial and district government offices and sectoral departments to report hot spot locations for investigation and control. Several command posts were established by other government agency members of TKNPKHL, and provided the BAPEDAL POSKO with continuous information. These posts are located at the Meteorology and Geophysical Agency, LAPAN, the Forestry Department and BAKORNAS-PB.

When G0l declared the fires a disaster on 1 5 September 1 997, BAKORNAS PB was mobilised to serve as the focal-point for operational instructions to all government and military units. BAKORNAS is headed by the Co-ordinating Minister for Social Welfare. Numerous organisations became involved including the armed forces, police, local governments, youth organisations and environmental interest organisations. During this critical period the TKNPKHL concentrated on collecting, analysing and disseminating information about the fires.

Along with the establishment of TKNPKHL, great emphasis was placed on strengthening and activating existing fire control units/facilities at various levels - i.e. from PUSDALKARHUTNAS through the PUSDALKARHUTLA and SATLAK to the Fire Brigades (SATGAS). Fire-fighting forces are also activated in forest and industrial timber concessions.

All these arrangements do not preclude the responsibility of each individual land-user or concessionaire for contributing to the national fire protection activities.

Within the forestry sector, CGIF played a major role to impress the decision makers on the crucial importance of IFFM. CGIF is meant to strengthen the communication and co-operation among all parties involved in planning, implementation, and evaluation of forestry development activities, thereby to contribute to increased effectiveness, efficiency and sustainability of forestry development in Indonesia. CGIF has 4 working groups. Under one of the groups, i.e. conservation, there is a subgroup on forest fire.

Another fire-related national development is the development of National Haze Action Plan. Since haze is the consequence of forest fire, NHAP will form an integral part of FFM.

Since the national initiatives to meet the fire disaster were made as part of an emergency plan, they need further review regarding their suitability for promoting forest rehabilitation, consolidation, and long term development.

3.2 Regional Initiatives

Between 1992 and 1997 the ASEAN community launched several national and international initiatives aimed at controlling the fire and haze episodes. These include the Bandung Conference of 1992, and a number of regional workshops and meetings on the transboundary pollution problem held in Indonesia and Malaysia between 1992 and 1995. Within ASEAN, a working group on trans-boundary pollution was formed in September 1 995. In the absence of specific operational plans, it proved to be ineffective.

Following the 1997 fire and haze disaster, the affected AMCs decided to take more focused and concerted action in preventing and mitigating the impact of large-scale fires and haze. Following

an ASOEN meeting in August 1997, the Haze Technical Task Force was established to formulate Regional and National Haze Action Plans. The plans are expected to meet the following objectives: (I) to prevent land and forest fires through better management policies and enforcement; (ii) to establish operational mechanisms to monitor land and forest fires; and (iii) to strengthen regional land and forest fire-fighting capability and other mitigating measures. The RHAP formulated by HTTF was endorsed by the ASEAN Ministerial meeting on haze held in Singapore, on 22-23 December 1997. The national haze action plans including those for Indonesia and Malaysia in draft form have since been completed. The plans divide the three components of monitoring, prevention and mitigation into some 20 activity groups and over 50 actions. Detailed implementation plans for the various NHAPs are in different stages of completion.

In a parallel development, a bilateral memorandum of understanding was signed by Indonesia and Malaysia on 11 December, 1997, which allowed the two countries to co-operate in addressing the transboundary haze problem and in undertaking joint responses to other disasters.

The signing of the RHAP by the nine ASEAN Environment Ministers signalled a new stance toward multilateral co-operation in confronting haze disasters in the region. The RHAP has an operational focus, the intent of which is to identify specific actions to be taken by particular parties at the regional, sub-regional, and national levels.

The ASEAN Environment Ministers' concern that the RHAP be fully operationalised is also apparent from their realisation that the region's fire and haze problem is far too large for any one agency to address effectively. They, therefore, requested assistance from ADB in catalysing actions to combat the fire and haze problems, as well as for funding support necessary for undertaking these actions. ADB responded by approving Regional Technical Assistance (RETA) for strengthening the capacity of ASEAN to prevent and mitigate trans-boundary atmospheric pollution. At the request of the Government of Indonesia, ADB subsequently approved a complementary Advisory Technical Assistance to Indonesia (ADTA) for planning for fire prevention and drought management.

The ASEAN Environment Ministers and senior officials, HTTF and sub-regional working groups meet at regular intervals to address the fire-related issues on a priority basis. These regular meetings have helped in underscoring the urgency of the matter, mobilising external resources, as well as ensuring timely action regarding monitoring, prevention and mitigation of land and forest fires.

Specific countries have been designated to spearhead the activities that fall under each of the three RHAP components. Malaysia is to take the lead in prevention, Singapore in monitoring, and Indonesia in mitigation of fire and haze events. This not withstanding, all of the AMCs will undertake actions at the national level that relate to all three of the RHAP components. In addition, individual actions supporting prevention, monitoring, and mitigation will also occur at the sub-regional and regional levels.

The HTTF realised that it is necessary to focus fire management efforts in specific areas. In April 1998, a work program was initiated to develop Sub-Regional Fire-fighting Arrangements (SRFAs) for Sumatra and Borneo Islands. The SRFAs are sub-activities within RHAR The Sumatra SRFA working group met on July 1 5-16, 1998 in Singapore and decided to implement a fire surveillance pilot project in Riau. The pilot study was conducted from 27 July to 8 August 1998. The main activities performed were early detection of fires using aircraft, near real-time remote and ground

based information, photo documentation of forest sites, communication of fire information to ground fire stations, rapid ground checking and fire suppression. The pilot project was funded by the Government of Indonesia, Singapore, UNEP and CIDA.

The fifth ASEAN Ministerial Meeting on Haze was held on 30 July 1998, and the tenth meeting of ASOEN on 3 September 1998. These meetings reviewed the progress of implementation of RHAP and actions to be pursued. RETA has been able to catalyse possible long-term support from several donors and assistance agencies.

An interesting aspect of the regional co-operation is the technical/scientific contributions that can be provided by individual institutions. Example of such institutions in the region involved in issues relating to forest fire and haze, among others, are: AIFM, ADPC, ASMC, and EEPSEA.

3.3 International Assistance

3.3.1 Series of Fire Projects

The 1982-83 fires brought the issue of FFM to world attention. Between 1982 and 1992 short to medium term international assistance to Indonesia in addressing the problem was provided and included fact finding, needs assessment and consultation missions; emergency assistance; technical aid and equipment; training courses and seminars; and management support by several agencies and countries such as UNDP, UNDRO, FAO, JICA, ITTO, GTZ, USA, EC, Australia, Canada and Finland. During this period 6 medium term projects, two seminars, 3 training courses and 10 missions were undertaken.

3.3.2 The Bandung Strategy

As a consequence of the smog episode of 1991 in south-east Asia, which was mainly caused by fires burning on the Indonesian archipelago, G0I called for international co-operation to support national fire management capabilities. In June 1992 an international conference on “long-term integrated forest fire management” was held in Bandung in which national agencies, involved in fire management, international development organisations and potential donors participated. The objective of the conference was to develop the framework for a concerted action plan for long-term IFFM in Indonesia. Bandung strategy became a reality in 1994, when the bilateral Indonesian-German project on integrated forest tire management” became operational, followed by other EU and JICA supported projects.

lnspite of the efforts to build capacity for fire management, the El Niño prompted fire of 1997, which spilled over into 1998, took a high disaster dimension, as the International Decade of National Disaster Reduction entered its last quarter. This prompted several emergency actions.

In response to the escalating fire and drought emergency, a United Nations Disaster Assessment and Co-ordination Team was dispatched to Indonesia at the end of September 1997, to provide assistance in needs assessment, resource mobilisation and co-ordination of international support

(Dennis, 1998). (An OCHA-UNEP mission was again dispatched to Indonesia towards the end of March 1998 to assess the impact of tires in East Kalimantan, with the worsening of drought and fire situation). The UNDAC Team co-operated with the national authorities, local donor country representatives, UN agencies, and international non-governmental organisations. They established a Fire-fighting Technical Co-ordination Group and conducted field assessment missions. Emergency assistance in cash and kind (material supplies, equipment, expertise, services of fire-fighters, use of water bombing aircrafts, helicopters, communication facilities, masks and other types of humanitarian aid) were received from different sources: Australia, Canada, China, Denmark, Finland, France, Germany, Japan, Republic of Korea, Malaysia, New Zealand, Norway, Russia, Singapore, Sweden, Switzerland, Thailand, UK and USA, as well as from UN and other agencies including UNDP, UNEP, UNICEF, UNESCO, WHO, GEE, World Bank, ADB, OPEC, EU, and ASEAN. Assistance came in through different gates - i.e. different national agencies, which added to the problem of co-ordination.

Realising the emergency of the 1997-98 forest fire, the Secretary General of the United Nations appointed the Executive Director of UNEP to monitor and co-ordinate the global assistance and expertise provided by the international community through the UN System. A meeting was organised in Geneva to mobilise resources from the donor agencies. Fire-fighting experts, other UN agencies, international organisations and the donor community were invited to participate in the meeting. Through its facilities at GRID-Sioux Falls, USA, UNEP provided daily satellite images via Internet showing hot spots and some spatial data layers such as, population, elevation, drainage, and land cover to help in fire suppression planning. UNEP supported a web site showing the biodiversity loss and species in danger due to forest fire in Indonesia.

3.3.3 On-going Pre-1997 Projects

As noted earlier, projects related to land and forest fires are undertaken by different government and non-governmental agencies, educational institutions and others. Projects relating to forest fires are normally of longer duration and are undertaken by the MOFEC. Of a total of 34 donor assisted ongoing and planned projects falling under the purview of MOFEC, as of 10 September 1998, 7 projects are directly or indirectly related to PPM. Of these, four are long-term projects started after the Bandung meeting, 3 projects having forest fire as their main concern. The 4 projects are: (i) GTZ's Integrated Forest Fire Management Project (IFFMP) in East Kalimantan (1994-2002); (ii) JICA's Forest Fire Prevention and Management Project (FFPMP) in Bogor, iambi and West Kalimantan (1996-2001); (iii) EU-Forest Fire Prevention and Control Project (FFPCP) in Southern Sumatra (1995-1998); and (iv) the Indonesia-UK Tropical Forest Management Programme (ITFMP). TEMP was started in 1992 and comprised a number of components related to fires, as part of its overall improved forest management objective. All four projects have locally installed NOAA-AVHRR satellite image receiving systems in order to detect and monitor fire hot spot activity. In addition to strengthening the institutional capacity of MOFEC to deal with fires, FFPCP, IFFMP and FFPMP have also adopted a rural or community-based approach to tire prevention and control.

Some Achievements of the Projects

IFFMP of GTZ and KfW. Based on the experience in a pilot area during phase I of the project, 12 tire centres (attack basis) will be established and substantially equipped in all the forest divisions and national parks of East Kalimantan and linked to the provincial fire centres. Personnel has been trained at all levels. A fire danger rating and early warning system has been set up and demonstrated. Fire suppression equipment and tools have been supplied to the Provincial Forest Service and training provided to local people and army personnel. At the village level, socio-economic studies were carried out to elaborate a concept of community-based fire management and to organise volunteer fire response crews. The integration of IFFMP into the structures of government forestry departments (central and provincial) provides it with direct access to those concerned with fire and smoke related decisions. Planned future activities will include: preparing fire management guidelines for timber concessions, curricula for fire training, and a fire management strategy paper; setting up a fire-GIS; refining early warning and fire detection system; and undertaking improved training and capacity building programs.

FFPMP of JICA. The overall goal of the project is to prevent forest devastation and environmental disturbances caused by wildfires and smoke. The project aims to strengthen the capability of the MOFEC at central level, in Jakarta and Bogor, to deal quickly with forest fires and also to improve prevention and initial suppression ax the local level. The project components include early warning and detection, system of forest fire base maps, extension and training in the use of pumps, hoses, hand tools, participatory forest fire prevention involving innovative institutional structures, use of fire breaks/trenches and fire resistant tree species, along with other improved land management methods. For farmers involved in the programme, the project provides seeds, seedlings, and.fencing materials; and labour is provided by people on a self-help basis.

FFPCP of EU. Objectives are: (i) to obtain an understanding of the occurrence of fire and the present means of control in the province of South Sumatra; (ii) to develop an operational NOAA fire monitoring and early warning system in Palembang (South Sumatra); and (iii) to establish forest fire prevention and control systems in three different pilot areas representing three important forest types. Other aspects covered by the project include social forestry, research on fire management and fire risk, and GIS for forest fire.

ITFMP of UK. Emphasis of the programme is on sustainable forest management. The programme, which in its current form is to continue upto the end of 1998, consists of five projects: senior management advisory team; provincial forest management; forestry research; training; and community-based conservation management. The last project has components relating to forest fire.

Others. Two other projects within the purview of MOFEC having a component of fire are: forest sector support programme and integrated forestry radio communication project with support from EU; and strengthening the management capabilities of MOFEC supported by GTZ.

3.3.4 New Fire Related Assistance Activities

After the 1997 fire event, numerous short and long-term fire projects were proposed and started. They vary in scope, focus, horizon, size of budget and so on. Some are national in their coverage, others are regional. They are listed below and briefly described.

EU Fire Response Group, established in October 1997,10 provide information on areas affected by fire. EUFREG was mobilised from existing EU projects to attempt a rapid estimation of the area affected by fire.

ITTO-CFC National Guidelines on Forest Protection Against Fire. This project is currently being implemented in collaboration with PHPA and Bogor Agricultural University. The national guidelines are expected to be finalised in early 1999. Apart from the national guidelines, the project envisages 10 other outputs: skill development; training of trainers; equipment supply; communication development; co-ordination; financing and budgeting aspects; and public awareness.

ADB assistance programme. This programme consists of two separate hut interrelated technical assistance projects. The first of these is ADB support to a national initiative via an advisory technical assistance (ADTA) to Indonesia for addressing, under the co-ordination of BAPPENAS and implemented by BAPEDAL, the problems resulting from forest fire. The objectives of ADTA are to: assess the damage and economic cost to Indonesia resulting from the 1997-98 fire and haze disaster, and to formulate ~n investment plan for Indonesia to prepare the country for recurrent droughts and fire and haze episodes. The second project consists of support to ASEAN via a regional technical assistance (RETA), for strengthening ASEAN's capacity in preventing and mitigating transboundary atmospheric pollution resulting from the forest fires, and improving co-operation among fire and smoke affected ASEAN countries. RETA's main objective is to strengthen ASEAN's capacity in operationalising and implementing the RHA~ and to catalyse identification of specific action to be taken by AMC for putting into place an institutional framework for addressing the region's fire and haze problem on a long-term, sustainable basis. Since RETA operations will last only one year, its purpose is to assist ASEAN in setting up an organisational structure for preventing, monitoring, and mitigating fires and haze.

Australian assistance to combat fires and haze in south-east Asia. This project, running for two years, covers Indonesia and Malaysia. There are 3 components covering fire prevention, mitigation and funding of WMO formulated Programme to Address Regional Transboundary Smoke (PARTS).

US Assistance under South-East Asia Environmental Initiative is a regional assistance programme package consisting of US contribution through different agencies for 10 projects under three groups namely forest management; fire prevention and fighting; and climate prediction and environmental monitoring. The 10 projects are:

- Causes and impacts of the fire in south-east Asia - technical assistance to CIFOR/ICRAF
- Reduced impact harvesting to extend the technology to other ASEAN countries, including training.
- Sub-regional fire disaster response co-ordination.

- Coal and peat fire suppression. Two components: (i) building capacity to extinguish coal seam fires in Indonesia, and (ii) assessing peat fires in eastern Malaysia. Assistance provided through Indonesian Ministry of Mines and Energy and Malaysian Fire and Rescue Department.

- Smoke/haze monitoring: assistance to enhance the region's physical monitoring capacity.

- Climate impact forecasting: establish climate models which will generate and distribute regional climate forecasts up to one year in advance.

- Atmospheric model ling capacity: to help develop and enhance region's atmosphere model ling capability in ASEAN Regional Meteorological Centre, based in Singapore.

- Disaster reduction applications of climate forecasting: USAID's Office of Foreign Disaster Assistance will work with ADPC in Bangkok.

- Health assessment: provide support to the Malaysian Centre for Disease Control (CDC) to devise health directions to minimise the impact of haze on affected populations.

The US government has approved about US$ 6 million towards this initiative, and already made an allocation of over US$ 4 million. Other donors' collaboration with this initiative is expected.

GTZ: Promotion of Sustainable Forest Management in East Kalimantan. This project has been operational since 1993 and assists forest enterprises (private and state-owned) to manage their forests sustainably. A new project component, based on an ITTO proposal, was added in 1997 and deals with the rehabilitation of fire-affected forests.

WWF - Indonesia: Analysis of the causes and impacts of forest fires and haze and Integrated Conservation Development Plan (ICDP). The latter incorporates buffer zone protection plan and impact of fires on conservation areas.

UNDP: Action Plan for Prevention and Management of Forest and Land Fires. UNDP is concentrating its efforts on strengthening the immediate ability of the Government of Indonesia to assess and monitor the environmental disaster.

Others: There are a number of specific initiatives, some of them self-funded and others fully or partly financed by donors out of the resources of approved projects. These, *interalia,* include: CIDNASEAN fire danger rating system for Indonesia; WHO project on air quality monitoring and mitigation of health implications of forest fire and haze; burned area estimation using SPOT quicklook mosaics and mapping the extent of Indonesian fires by CRISP; Monitoring Tropical Vegetation (MTV) unit of the joint research of the European Commission's two projects that address tropical deforestation and fires: (I) Fire in Global Resources and Environmental Monitoring, and (ii) Tropical Ecosystem and Environmental Observation by Satellites.

3.3.5 Meetings

A count of all the national, regional and global meetings (including conferences, workshops, and seminars) organised by different agencies, on various aspects of the 1997-1998 forest and land fires in Indonesia is not available. The following are illustrative of the range: Asian Regional Meeting on El Niño Related Crisis, 26 February 1998, Bangkok, hosted by ADPC and co-sponsored by USAID/OFDA/NOAA Asia-Pacific Regional Workshop on Transboundary Atmospheric Pollution, 27-28 May 1998, Singapore, organised by Germany Singapore Environmental Technology Agency (GESTA); 81-Regional Workshop on Health Impacts of Haze Related Air Pollution, Kuala Lumpur 1-4 June 1998, organised by WHO.

3.3.6 Global Research Initiatives

A recent initiative has been the establishment of the Global Fire Monitoring Centre (GFMC) in June 1998 in accordance with the objectives of IDNDR and the recommendations of the ITTO Guidelines on Fire Management in Tropical Forests, and the recommendations of various scientific and policy conferences in the field of fire. The GFMC is established at the Fire Ecology and Biomass Burning Research Group of the Max Planck Institute of Chemistry, Germany. GFMC has established regional activities linked to MTV.

3.3.7 Pending and Pipeline Projects, Project Ideas

Apart from the ongoing projects listed elsewhere, there are projects approved in principle but awaiting funding commitment from potential donors, those which are kept pending for future consideration, and proposals and project ideas under discussion. A brief account of them is given below.

CIFOR-ICRAF-UNESCO: The Underlying Causes and Impacts of Fires in South-East Asia. This is a 3 year in-depth study on the underlying causes of land and forest fires. CIFOR-ICRAF-UNESCO propose a three-tiered approach: (i) a general overview of the fire situation for the whole archipelago; (ii) a more detailed assessment at the level of Sumatra and Kalimantan (to assess how their fire characteristics are representative of Indonesia as a whole); and (iii) a detailed assessment of causes and effects at the site specific level (several detailed study sites in Kalimantan and Sumatra). The research is designed in a modular way; each module stands independently, but complements and supports the others. (CIFOR-ICRAF-UNESCO, 1998). The combined expertise and field knowledge of these three institutions is unique in supporting the study. While some funding commitments have already been received, more are expected soon.

World Bank: National Environmental Development Institution Building. World Bank support is expected for new legislation for national environmental development institutions, and for research and training relating to forest fire management. Proposals for a research and training centre for land and forest fire management at the University of Palankaraya in Central Kalimantan is under consideration. Also, in support of the reform process in the forestry sector in Indonesia, it is known that a large World Bank loan is being contemplated, for necessary structural adjustments.

UNEP proposal on Early Warning System and Forest Fire Hazard Mapping in Indonesia. The proposed project outputs include satellite data to demonstrate technical possibilities, creation of 015 database, forest fire hazard maps, operationalisation of early warning system, forest fire models, and improved capacity. The project will address the need for a proper spatial database at 1:50,000 scale with thematic layers (e.g. elevation, hydrology, geology, vegetation, soil, landuse).

ASEAN Fire Forum and the AIFM Plan of Action for FFM. In December 1996, AIFM convened the "Conference on Transboundary Pollution and its Impacts on the Sustainability of Tropical Forests" in Kuala Lumpur. At that conference the ASEAN Fire Forum was formed which came up with a proposal for an ASEAN-wide program in fire management and research (Goldammer, 1998a). The proposal as such did not materialise even though some of the components were incorporated in other projects. However, the 1997-98 fire and its aftermath is likely to lead towards an ASEAN Fire Management Programme with multi-donor participation.

Joint ASEAN Program in Fire and Smoke Management. This proposal is for the development of an ASEAN-wide fire and smoke management strategy and operational system, by sharing responsibilities and resources, focusing on: prediction of fire hazard and fire effects on ecosystems and atmosphere; detection, monitoring and evaluating fires; and sharing fire suppression technologies and resources.

GEF priorities and forest fires. How far the forest and land fires and related activities will qualify to be considered for GEF funding is unclear. It is hoped that fire management in protected areas and buffer zones will, in future, attract funding through GEF.

Technology assessment and applications. Application of modern technology in the different aspects of fire management such as weather monitoring, wide-area surveillance and speedy communication is being discussed as a potential project of vital importance to the region and some of the major donors appear to be interested.

ACIAR proposals for a Review Workshop on Fire Management Systems for Sustainable Agricultural and Forestry Development in Eastern Indonesia. Eastern Indonesia has a semi-arid climate with large areas of savannah vegetation, and consequently is fire prone. The region faces major problems of land and forest degradation. Fire is a fundamental component of traditional and current land management. Although the extent, severity, and impacts of fire appear to be increasing, these changes are poorly documented. There is little understanding of the processes affecting fire behaviour in eastern Indonesia and steps necessary for improved fire management. Field visits will take place in the later part of 1998 and the workshop in the first half of 1999.

IUCN and WWF: Project 'Fire-fight' to establish a collaborative global network for forest fire prevention and control. Project objectives envisaged are: to raise public awareness of the detrimental impacts of fires; to improve forest fire management world-wide; and to eliminate the adverse environmental, social and economic impacts of forest fires.(IUCNM'WF, 1998).

Develop Fireglobe into a Radius Type Global Network. The Global Fire Monitoring Centre (Fireglobe) with its core ac tivity. South-East Asian Fire Monitoring Centre, is a facility which provides natural resource decision makers with up -to-date information on forest fires and other wildland fires **(http://www.uni-freiburg.de/fireglobe).** The facility is being managed by the Fire Ecology Research Group (located in Germany). A proposal with the IDNDR Global Initiative is to bring together countries located in eco-regions with distinctly similar and distinctly different fire problems. The fireglobe concept is to promote a learning process in which the international partners would benefit from each other in developing integrated fire management strategies.

3.3.8 Science and Technology Support

Science and technology relating to forest fire cover various aspects - the natural causes/factors and their behaviour; immediate/local causes, crop condition and management of combustible materials; prescribed uses of fire; ecological functions of fire; systems of isolating forest crops from sources of ignition; measures to reduce the intensity of burn; influence of terrain conditions, wind direction and speed on fire; post fire clearing/salvaging; reclamation and rehabilitation. If there is no effective and efficient system in place to prevent, control and combat fires at *site,* any amount of technological inputs elsewhere will not be of much use. There is need for an appropriate balance of focus on various aspects.

While most of the skills needed at the field level are to be developed locally, certain sophistcated technology can be acquired through technology transfer. Use of geosynchronous satellites and space borne sensors for early warning of fires and atmospheric pollution; investigation of candidate systems for fire weather and fire danger forecasting; assessing influence of inter-annual climate variability; interpretation of fire scar characteristics, are some of the areas where most tropical countries will need to build national capability. ASMC and LAPAN are examples of institutions which can appropriately be strengthened.

The Indonesian Institute for Climate, Environment and Society (INRICES) founded in 1997, following the International Conference on "Science and Technology for the Assessment of Global Environmental Change and its Impacts on the Indonesian Maritime Continent" held in Jakarta, 10-12 November 1997, will be closely involved in the upcoming programme of South East Asian Fire Experiment (SEAFIRE).

SEAFIRE is a research activity in the planning and preparation phase and will be conducted under the scheme of the International Geosphere-Biosphere Programme (IGBP). The International Global Atmospheric Chemistry (IGAC) project is a core project of IGBP. One of the actvities of IGAC (Natural Variability and Anthropogenic Perturbations of the Tropical Atmospheric Chemistry) investigates the impact of biomass burning on the atmosphere and biosphere biomass burning experiment or BIBEX (http://www.nipch~mainzmpcJde/~bibex) SEAFIRE will establish the fire research component within the Integrated Study on Land-use Change in SE Asia, with linkage to other activities of IGBP.

SAFIRE will explore the ecological impacts of fire in landuse (fires used in forest conversion and shifting cultivation, grassland and seasonally dry forests) and the characteristics, the regional and global transport mechanisms and the atmospheric chemical impacts of pyrogenic emissions.

Biogenic and marine sources of trace gases and aerosols will be considered, as well as technogenic sources (fossil-fuel burning, secondary chemical products). Special emphasis will be laid on inter-annual climate variability (ENSO vs. non-ENSO) and the role of the "warm pool" n global distribution of fire products.(Goldammer 1998). SFAFIRE will also co-ordinate with other regional (ASEAN) activities in fire management and research.

The Programme to address ASEAN Regional Transboundary Smoke (PARTS) was established by WMO in response to the needs and request for assistance of the ASEAN Committee on Science and Technology, Sub-Committee on Meteorology and Geophysics (ASCMG), in 1995. WMO designed PARTS to improve the regional capabilities in satellite usage, modelling long-range transport of smoke, haze, and other pollutants, and to design and implement a monitoring strategy for the region.

Science and Technology relating to forest fire at the forest end is weak. There are no ongoing long-term research to address the fire-related problem areas. As already noted, a research and training centre for land and forest fire management is under consideration to be established at the University of Plangkaraya in Central Kahimantan. Two sub-regional fire-fighting arrangements in Kalimantan and Sumatra/Riau provinces will facilitate regional efforts to combat fires. The priority of these arrangements will be to ensure that fires are effectively prevented. The situation calls for urgent action to address the weaknesses in management and technology.

3.3.9 Relief Efforts of NGOs

WWF, WRI, WAHLI, SKEPHI and TELAPAK were some of the international and national NGOs who provided support in addressing the problem of forest fire and haze. Indonesian NGOs raised public donations for relief projects, supplied masks and medicines and provided other forms of humanitarian assistance. Forest Watch Network, a global network of NGOs with WRI on the lead, helped to raise public awareness and concern about the Indonesian fire disaster. The Forest Watch Network has a central node, regional nodes and subnodes. TELAPAK, located in Bogor is Indonesia's nodal organisation. 'Blaze Busters' based in Singapore, funded by Asia Foundation and others, is a unique voluntary effort serving as a link between 'donors' and recipients'.

3.3.10 Access to Information

Information on south-east Asian fire and related meteorological data can be found on various web sites. The Global Fire Monitoring Centre (GFMC) with its focus on south-east Asia provides a daily update on fire and early warning information for the region (http]/www.mpch-mainz. mpg .de/-bibex).

There is a bi-annual International Forest Fire News (IFFN) published on behalf of the joint FAO/ ECE/ILO Committee on Forest Technology, Management and Training and its secretariat, the Timber Section, UN-ECE Trade Division in Geneva. The issue comes out in January and July. The news letter was started in 1994. It has a south-east Asian section which in the recent issues has been very prominent. All issues of IFFN are now available on the GFMC web site. The current issue is available in full length. The contents of previous issues (starting with the 1992 issues) are available in 48 country files.

3.4 Trends In Fire Projects

After studying in detail the objectives and activities of 35 projects, training courses and missions, Dennis (1998) observes that fire projects are precipitated by extreme fire events. An exacerbation of the problem also increases the likelihood of attention. Interest in fire is only short lived after a spurt of activities following a major event.

The earlier fire projects addressed issues of fire prevention and control. After the 1994 fire, which created transboundary pollution, the projects became interested both in the issue of causation, and fire prevention and control. Of the 35 projects, missions and training courses, six are mainly directed at understanding the problem, 19 at doing something practical about the problem and 10 address both issues. In respect of several recent projects, there are overlaps! similarities in terms of objectives, activities, inputs and outputs even though their geographical locations differ. A lesson to be learned from the degree of overlap between projects is that cooperation, openness, and dissemination of results among projects and the relevant government departments is of paramount importance. A trend seen in the new generation fire projects is the high emphasis given to sophisticated spaceborne remote sensing technology of monitoring and prediction, compared to practical pre-suppression and suppression activities. Because of the difference in technological competencies and conditions in these two levels, a barrier to the transfer of technology, even in the transfer of information, is created. The projects analysed were implemented by different national agencies, further creating problems of co-ordination and counterpart support. (Dennis, 1998)

Another indicative trend is that lessons are not being learned from experience, about the need for preparedness. In Indonesia the bulk of the fire projects of 1997 deal with assessment of damages and development of capacities to undertake necessary activities to prevent, monitor and control fires. However, no direct provision was made for facing the re-emergence of such devastating fires, so soon, in 1998. There was, therefore, no adequate source of funding to fight the 1998 fires in East Kalimantan other than that provided by the government of Indonesia. The effort was not significant nor sufficient, in view of the scale and distribution of the fires through the province. Sarawak on the other hand has no exclusive or major forest fire projects and the currently ongoing projects emphasise on sustainable, 'model' forest management; and Sarawak's forests have been comparatively safe from fire. (It is, however, to be noted that such a fire weather and behaviour as experienced in 1 998 in East Kalimantan with thousands of fire starts all over the province, would have overtaxed any fire organisation. Fire management schemes cannot be planned properly for a such an exceptional situation).

4. TOWARDS A COMPREHENSIVE FOREST FIRE MANAGEMENT PLAN AND ACTION

The experience with forest fire in Indonesia, during the period starting from 1 982-83, and more particularly the 1997-98 episode, shows that there is urgent need to plan and implement a comprehensive, integrated, refined and rationalised IFFM. Comprehensive IFFM incorporates all its interrelated aspects: pre-fire and post-fire situation; local and national level activities, including regional co-operation; satellite technology in weather monitoring to practical down-to-earth measures of fire protection and suppression. There has been, over the years, and particularly during the last one to two years, a large number of studies, reviews, consultations and proposals covering the subject with different scope, focus and bias, and indicating what should be done.

An assessment of what has so far been done, underlines the fact that much more still needs to be done, and strengthening is required all across the fire board, integrated with an overall system of SFM. The ITTO consultation mission of 1992, proposed several broad fields of activity for integrated FFM, namely: pre-fire planning and prevention; wildfire suppression and management; smoke control; equipment development and procurement; training; post-fire management and rehabilitation; and research. The CGIF strategic approach for an effective forest fire prevention and management system enumerates components such as: fire information management and early warning system; fire management capacity and organisation; policy and legal framework for forest fire prevention and control; enforcement and surveillance monitoring and reporting; institutional set-up and strengthening; co-operation plans; and public awareness and education. The Indonesian Forestry Action Programme (GOI/MOFEC,1997) mentions about improved fire management using traditional and sophisticated methods, forest fire protection system, radio communication networks, rehabilitation of burned areas, survey and reclamation of grasslands, establishment of forest meteorology stations and training and demonstration.

The magnitude of the task involved is huge. Priorities are to be appropriately set to avoid distorted action. A National Forest Fire Plan becomes vital in that regard. A comprehensive fire plan will involve a set of integrated and well co-ordinated components and sub-components covering technological, socio-economic, environmental and economic aspects.

4.1 Technology

Use of science and technology relating to IFFM have to be appropriate to the situation and the human resource (and local community) involved. The causative factors, both near (including those within forest, like fuel accumulation) and far, and natural and anthropogenic, and related fire suppression measures have to be given due importance. The science and technology aspects of IFFM cover a wide range: fire monitoring/warning, fire surveillance and detection, equipment and technology development/acquisition, data management and communication, information about fire dynamics in different land classes and vegetational types (e.g. peatlands, secondary hill forests) and appropriate fire protection and suppression measures; assessment and control of ignition sources; planning and co-ordination of fire-fighting activities; post-fire monitoring and impact

assessment; salvage operations and rehabilitation silviculture; and a system of feed back for continuous refinement of the system. It is necessary to guard against the tendency to concentrate on high technology inputs, to the neglect of equally (if not more) important field actions such as fire protection measures.

From the point of view of technology improvement, some examples are: use of RS and 015; quick and precise (also uncomplicated and ready to understand) information transmission to the site (i.e. the forest-end); rationalised stages/channels of communication; satellite based fire surveillance system as is being tried in SRFAs (ASEAN sub-regional fire-fighting arrangement In Sumatra and Kalimantan); design and development of field equipment and hand tools; design of silvicultural strategies of fire protection(e.g. planted tree belts, logging area enclosed by belts of primary forest); reduced impact logging combined with environmentally sound road construction; zero burn methods of land clearance and such other tilling practices as an economically viable system; fire-fighting logistics and regular drills/practices; post fire inventory to classify areas by actions needed (e.g. natural regeneration for lightly damaged areas; and artificial tree planting for severely damaged sites); use of portable equipment such as chippers and helicopters (a possibility in Sarawak) to salvage utilisable materials; mechanical land clearing and artificial reforestation; a demonstration area of adequate size (500 to 1 000 ha) to illustrate model fire management system; and a collaborative network for information exchange (including global initiatives and developments) and related facilitating mechanisms.

It is vital to note that widespread future outbreaks of fire will be encouraged by ongoing degradation of forests, whether it be by felling or fire. In contrast, wise and attentive management of forest resource, involving the reduction of the possibility of fire, and the limitation of its impact, will help sustainable forestry development.

4.2 Socio-Economic Aspects

These refer to the influence of socio-economic situations such as: poverty, access or otherwise to land and natural resources; economic exploitation of local community; tenurial problems faced by forest farmers and shifting cultivators. There are no technical fixes for this situation and it is to be addressed by improving the socio-economic condition of the people through: appropriate enterprise development, promotion of crafts and culture; development of non-wood forest products; rationalisation of sifting cultivation; tenure security; conflict resolution (e.g. between traditional *adat* laws and official agrarian laws); preventive legislation and appropriate incentives (e.g. possibility of share holding and supplementary income from forest-based employment).

4.3 Environmental Implications

One of the important cost of fire is: carbon release or loss of carbon sink capacity. COP3 had attracted world-wide attention since the participants were committed to initiating tangible, time-bound targets for lowering levels of greenhouse gases. This gives an added global environmental responsity for ensuring proper and effective FFM. Wildfires escaping from land-use fires may become more and more regular. The impact of land fires and wild forest fires are detrimental to biodiversity and the regional atmospheric chemistry. In Indonesia, and within the ASEAN region, a joint and concerted approach is needed to cope with the problem of transboundary pollution caused by vegetation burning. However, since fire is an essential tool in landuse 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.

4.4 Institutional Strengthening

Institutional aspects of IFFM covering policy, laws and regulations, enforcement mechanisms; planning and implementation; data and information system; organisational structure and position, level of regular funding for fire protection and control, research, training and skill development, peoples' participation and responsibility, incentive system and effective coordination are of crucial importance.

Policy objectives and measures relating to forest fire management need to be clearly spelled out, and in tune with the nation's environmental and socio-economic policies. Forest fire laws and regulations should be developed to be capable of enabling policy objectives to be translated realistically into action and linked to overall environmental and forest laws. There should also be a mechanism with adequate capability and powers to deal with environmental crimes relating to fire. Introduction of a fire permit system for managed/prescribed burnings (without creating procedural hardships and causing harassment) deserves serious consideration. A system of landscape planning (covering an entire specified geographic area, and not just the forest area within it) for IFFM on a comprehensive scale, suitably supported by updated maps, data and information, and integrated with related natural resources management plans with clear implementation guidelines, is essential. This should incorporate a preparedness planning to facilitate proactive responses to fires. And, fire protection standard needs to be incorporated into the criteria and indicators of SFM. In this regard, it is imperative that people are consulted regarding their needs and concerns vis-à-vis the forest fire regulations.

Organisational structure and linkages of components, and decentralisation of roles and responsibilities, should be clearly defined and be capable of involving (and obtaining constructive co-operation of) people. While decentralisation in the form of delegation of authority and decision powers to the local units is effected, it should also ensure that adequate number of staff are physically present and active at the decentralised level. The potential and feasibility of establishing a system of honorary fire wardens with a reserve fire protection force provided with training and periodical upgrading of skills should be investigated and acted upon.

Funding for IFFM related activities (as in the case of many other forestry activities) should be available in an adequate scale and timely manner. It is to be noted that a cost effective management is not necessarily a low budget plan. For mobilising funds, if necessary, the feasibility of a small tax or surcharge, without requiring an elaborate system for its collection (e.g. surcharge on stamps or on air/train fares), and which will also serve as a means of awareness creation, can be considered. In Indonesia, IFFM should be a prime candidate for use of the reforestation fund/tax collected for every cum of timber extracted. Often, a distorted incentives system can work counter to the objectives envisaged. The unnecessarily large size of forest concessions, lack of control over concessions operations, inattention to the hardships caused to people due to tenurial inequities and conflicts are some of the details which require close attention. An additional incentive component is creation income earning opportunities for local community. What is needed is to ensure that people do not cause fire due to indifference, ignorance or intentionally to register dissatisfaction or a social protest.

Forest fire related research, extension and training at all levels should be provided the priority it deserves. IFFM is an important component of environmental security and defence and all related activities should be co-ordinated in a suitable manner. The inadequacies of the present efforts at co-ordination is well recognised; it is understood that a new arrangement is being worked out in Indonesia specifying the authority and responsibility of involved institutions. The importance of this initiative is specially underlined. It is necessary to have one single organisation which is armed with special skills and can work professionally in central and provincial levels for preventing and mitigating forest and land fires. For the ease of co-ordination the system should be rationally decentralised.

While assistance projects play a vital role, it is important to ensure that it is fully owned by and integrated into, the national system, such that it can run effectively even after the project is terminated.

4.5 Suggestion for Follow-Up Action on IFFM

Operationalisation of IFFM is to be carried out in a balanced manner, with due emphasis on the relationship of development and short-term objectives, and providing appropriate priority to the components in a timely and dynamic manner. Short-term initiatives which do not fit into the long-term plan and related objectives often may turnout to be ineffective. This should also consider the collaborative efforts at sub-regional and regional levels, to capture comparative advantages and to ensure efficiency. Some of the ideas on action required to fill in gaps or to strengthen the existing initiatives to fit into an overall framework of IFFM are provided below.

4.5.1 Capacity Building

Capacity building facilitates improvement of efficiency. Improved capacity is reflected in effectiveness of action. As a programme area this would cover: science and technology development involving basic and applied research; technology acquisition and transfer; skill development in all aspects of IFFM and related education and training needs; public educ ation and

extension; improved capacity for planning/evaluation/monitoring; updated and strengthened system of FFM information; reorientation and strengthening of institutional instruments, i.e. policy, law and institutional arrangements. The mission was informed that Indonesia's Basic Law on Forestry is being reviewed and revised as part of the overall reforms process; it is hoped that this revision will consider the institutional support required for effective IFFM. The need for detailed manuals on important aspects of IFFM is also underlined in this connection.

4.5.2 Awareness Creation

Among the various underlying causes behind the 1997-98 forest fires in Indonesia, land clearing practice using fire was the foremost. It is therefore, very important to create awareness among the decision makers and common people about various alternative methods of land clearing. It is necessary to develop and disseminate outreach materials such as posters, pamphlets and brochures of some best examples of land clearing practices and fire prevention techniques. Moreover, scientific knowledge and information about forest fires should be developed in multimedia means and broadcast through television and radio. Development and dissemination of short readable summary on lessons learned addressing impacts and possible causes of 1997-98 forest fire will make people aware of the disaster and discourage them to repeat the same activities in the future.

4.5.3 Pilot Demonstration

Apart from inadequacies in fire protection and pre-suppression measures, and weaknesses in the information dissemination relating to theoretical and practical aspects of IFFM, there is lack of periodical practical training (fire drill) for forestry staff and volunteers, who most often face the forest blaze without adequate preparedness. (Except for Malaysia, where the Fire and Rescue Department has responsibility to fight forest fires, the countries in the ASEAN have no forest fire force, kept in readiness). This deficiency can be rectified by establishing a model forest for IFFM, of an extent of 500 to 1000 ha, which can serve as a pilot demonstration/training centre and provide periodic fire-fighting drills.

4.5.4 Community Participation

Informed and organised participation of local community in IFFM along with other forestry activities is a means of achieving SFM. To get the community interested in SFM, it is necessary that they identify their welfare with the sustained existence and management of forests, and that calls for positive incentives. Some of the incentives to be considered among others are: income through collection/processing of NWFPs, forest based small scale enterprises, community forestry, benefit sharing joint forest management systems, share holding in organised operations, involvement in HTI, and employment benefits. Experiences of the past and the present in community participation (e.g. such as those in JICA and GTZ projects in Indonesia) can help replication of participatory measures with modifications needed for each situation. In designing IFFM, it is necessary to accommodate community needs relating to the use of forest and fire for their livelihood activities, and to find solutions for other conflicts. It is also necessary to reconcile the differences on national, donor, and community objectives and views, with regard to IFFM.

4.5.5 Rehabilitation of Burned Areas

Even it we accept the low estimate of the area affected by tire, some of it very severely, the amount of attention and investment required to rehabilitate the forest land is immense. The area to be rehabilitated include plantation forests, peat swamps, mixed hill forests (some having coal seam fires), and protected areas. Each of the different types of forest land require different silvicultural treatments: sanitary felling, cleaning, promoting natural regeneration, enrichment planting and so on in some cases; salvage felling, land preparation, disposal of inflammable materials and replanting in some other cases; and reinforced protection measures as required, in all cases, to ensure that another fire event is avoided.

In East Kalimantan alone it has been estimated that some 95,000 ha of industrial forest plantations meant for supplying raw material to the industrial units, have been burned. A tentative proposal has been made to replant the 95,000 ha, which would provide employment for 35,000 people. A first approximation of the cost of the proposal is around US$ 20 million. The output from the salvage operations would be around 1 million cum of industrial wood and 200,000 cum of charcoal. If markets can be found for this production, either in Indonesia or for export, the revenue at forest gate might be US$ 16 million, (at US$ 10 per cum of timber and US$ 30 per tonne of charcoal). The project could possibly be self financing eventually, but it would need considerable working capital to implement (Pers. Comm. from Alastair Fraser, 10 September, 1998,). Salvaging of the residual stock, depending on the nature of burn, can be in the form of logs, fuel/charcoal, chips or briquettes made out of pulverised wood; in most cases, however it may not be economical and pulverised wood may have to be mixed with soil and allowed to disintegrate.

In all cases, a detailed rehabilitation plan is necessary and it can be made part of an overall IFFM for a defined geographic area.

4.5.6 Rationalisation of Shifting Cultivation

With shortening of fallow cycle and increasing pressure on land, the slash and burn agriculture, the once elegant system, has turned out to be a case of land abuse in many cases. In order to avoid the deleterious effects of slash and burn agriculture, including its potential to cause forest fires, the system is to be rationalised by improving the cropping pattern, introduction of agroforestry, replanting areas degraded by shifting cultivation, providing income earning opportunities for the shifting cultivators, ensuring security of land tenure, establishing infrastructure facilities and providing social amenities.

4.5.7 Optimising the Size of Timber Concessions

In very large timber concessions, the concessionaire often neglects fire protection because of infrastructural inadequacies, difficulty for fire surveillance, and cost involved. Also, fellings often take place in a haphazard and wasteful manner, taking advantage of the concentrated occurrence (or occurrence in easier sites) of timber species, which in turn results in increased fire proneness.

Reduced size of concessions to about 5,000 ha can make the magnitude of maintenance and fire protection operations smaller and effective, particularly if the boundaries of these concessions are kept cleared and free of inflammable materials. MOFEC is known to be considering the feasibility of offering a large number of smaller concessions to the public on the basis of open auction

4.5.8 National Forest Fire Plan

Within the system of ongoing national forest programme and criteria specified for SFM, it is necessary to elaborate a national forest fire management plan, giving due importance to all geographic regions in the country, for a specified horizon (of about 1 0 years), to be revised and updated every 3 to 4 years. The plan should specify the scheduling of actions and activities including technical and institutional aspects. In this regard it may often be necessary to strengthen the national forest programme. The plan should take the special characteristics of the ecosystem into account e.g. peat swamps, mangroves. It should promote complementary activities in the forestry sector e.g. low impact logging. It should also specify the lead agency, to rationalise co-ordination and to avoid co-ordination problems.

4.5.9 Pan-ASEAN Fire Centres

Considering the commonality of forest fire related issues and problems, apart from cost effectiveness, the countries in the region can gain considerable advantages by establishing pan-ASEAN institutions, or strengthening the existing ones, to share facilities, knowledge and experience particularly in aspects such as weather monitoring, fire danger forecasting, fire science and technology, and fire management planning.

4.5.10 ASEAN Forest Fire Bulletin

There is so much information and experience that the ASEAN countries can share with regard to IFFM, including new research results, technological breakthroughs, experience with application of specific technologies, likely weather pattern and such other matters. It will be useful to publish and widely distribute an ASEAN Forest Fire Bulletin on a regular periodical basis, through an appropriate institution in the region.

To summarise, the above are closely linked aspects of IFFM and are not mutually exclusive. The need to focus on *prevention* of (and preparedness to face) forest fires has been recognised as a priority issue at all levels. There has been several evaluations and studies on the causes, consequences and impacts of the 1997-98 forest fires in Indonesia and Sarawak. It will now be possible to view the situation with the benefit of hindsight and to rationalise on how to face such an event if one is to happen again; and the nature of preparedness necessary.

The JICA-ITTO International Cross-Sectoral Forum on South East Asian Forest Fire Management scheduled for 7-8 December 1998 would provide an opportunity to define the way ahead towards appropriate FFM.

4.6 NICHE ROLE OF ITTO IN FOREST FIRE MANAGEMENT

ITTOs niche in the field of forestry is tropical timber. In order to ensure production of timber from sustainability managed forests, it is necessary that all aspects of tropical forestry, including IFFM are given due consideration. On that basis, HO is concerned with all aspects of IFFM and interested to collaborate with agencies! institutions involved in, and providing assistance to, the programme on IFFM.

HO has been very active in the forest fire scene for over 1 0 years. One of the earliest forest tire projects of HO was developed in 1 987 for investigation of the steps needed to rehabilitate the areas of East Kalimantan, Indonesia, seriously affected by fire, and implementation started in 1989. This was followed some 3 years later by the projects The Establishment of a Demonstration Plot for Rehabilitation of Forests Affected by Fire in East Kalimantan. (This demonstration plot was destroyed in the recent fires). In 1992, an HO mission made a consultation visit to Indonesia with regard to ITTO Activity on the Protection of Tropical Forests Against Fire (27 ianuary-7 February 1992). Currently an HO project is ongoing in Indonesia, i.e. Integrated Forest Fire Management in Indonesia Phase I - National Guidelines on the Protection of Tropical Forests Against Fire. In addition, several ITTO projects dealing with SFM include components of forest fire protection.

ITTO has been forest fire project in Sarawak. The ITTO project in Sarawak Model Forest Management it is ii directly concerned with the I ire issue through its activity on reclaiming! rehabilitating shifting cultivation areas.

Pursuant to a decision of the International Tropical Timber Council, HO decided to develop a set of international guidelines for the protection of tropical forests against fire. This resulted in the publication of *"I7YO Guidelines on Fire Management in Tropical Forests"* in 1996. This guidelines are linked to the previously published HO guidelines for Sustainable Management of Natural Tropical Forest; Establishment and Sustainable Management of Planted Tropical Forests; and Conservation of Biological Diversi ty in Tropical Production Forests.

Through its commitment to achieve SFM, HO is deeply concerned with forest fire-related issues. Five of HO objectives brings out its interest in forest fire issues in an implied manner, i.e.

- To enhance the capacity of members to implement a strategy for achieving exports of tropical timber and timber products from sustainably managed sources by the year 2000;

- To promote and support research and development with a view to improving forest management and efficiencyof wood utilisation as well as increasing the capacity to conserve other forest values in timber producing tropical forests;

- To encourage members to support and develop industrial tropical timber reforestation and forest management activities as well as rehabilitation of degraded forest land, with due regard for the interests of local communities dependent on forest resources;

- To encourage members to develop national policies aimed at sustainable utilisation and conservation of timber producing forests and their genetic resources and at maintaining the ecological balance in the regions concerned , in the context of tropical timber trade;

- To promote the access to, and transfer of, technologies and technical co-operation to implement the objectives of this agreement (IHA), including on concessional and preferential terms and conditions, as mutually agreed.

In defining a niche for ITTO in the emerging situation of IFFM, two appropriate considerations will be; (i) areas of past involvement and (ii) relevance to sustainable production of timber. Accordingly, some of the ideas for consideration are these:

- Assistance for preparing national forest fire plan

- Rehabilitation planning for fire affected forest areas

- Pilot demonstration and practical training in IFFM

- Community participation in IFFM

- Manuals covering aspects of IFFM (for ASEAN countries)

- Support for selected components of capacity building

- Integrated forest fire management for eastern Indonesia (Maluku, nan iaya)

- Expand the scope of model forest management in Sarawak to include IFFM.

- Support to and collaboration with national, regional and global initiatives on technology development, and building strategic partnerships with relevant agencies.

To Conclude:

The land and forest fires that ravaged large areas of Sumatra and Kalirnantan in 1997 and East Kalimantan in 1998 have added new urgency to the issue of forest fire prevention and management. The emergency caused by the forest fires, and the associated transboundary haze problem, are now over. The damages and negative impacts caused by the fire events are considerable and their scars remain. Investigations carried out so far on relevant causes, consequences and constraints provide reasonable insight into the serious lapses of the past and

the potential fire threats looming over the future. Actions are urgently required to avoid further recurrence of the devastation from forest fires, and also the complacency and lack of compliance as in the past. There is considerable interest to address the situation on the part of international community, which need to be channelled in a co-ordinated manner; and new assistance needs to be sought for bridging vital gaps. ITTO should play its mandated role to provide the needeo support.

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APPENDIX I: TERMS OF REFERENCE OF ITTO MISSION

- Undertake a mission to Indonesia and Sarawak, Malaysia, 8- 20 September 1998.
- Examine the extent and causes of forest fire during 1997-98, taking into consideration work already done.
- Examine the various national and international initiatives being undertaken on forest fires.
- Based on the findings and information gathered, undertake an analysis of problems and issues.
- Based on relevant reports and publications on forest fire prevention, management and information and data gathered, prepare a comprehensive report on the mission's findings, analysis of problems and issues and recommendations for follow-up action of forest fire prevention and management in the region, focusing on a niche role for the HO. The report to be submitted by 10 October, 1998.
- Liaison and consultation with the Executive Director of ITTO on matters related to the mission.
- Other tasks as necessary to ensure the success of the Mission.

APPENDIX II: ITINERARY OF THE MISSION

Tuesday 8. September, 1 998 Arrival of Mission in Jakarta

Wednesday 9 September, 1 998

10.00	Hrs:	Meeting with Mr. Kuswanda, ITO Resident Advisor
10.30	Hrs:	Meeting with Dr. Alastair Fraser, UK- DfID Programme Co-ordinator of Tropical Forest Management Project.
11 .30	Hrs:	Discussion at BAPEDAL, with Mr. Antung Deddy.

15.00 Hrs: Meeting at KLH with Mr. Effendy Sumardja, Assistant Minister for Planning.

Thursday 10 September, 1998:

09.30 Hrs: Briefing meeting with JICA Project Formulation Mission.

09.00 Hrs: Meeting with Mr. Bambang Murdiono, KLN/MOFEC, along with JICA Project Formulation Mission.

10.30 Hrs: Meeting with Mr. Soemarsono, Director General, PHPN MOFEC, along with JICA Project Formulation Mission.

11 .00 Hrs: Briefing by Mr. John Keating on forestry activities of EU in Indonesia with particular reference to fire protection measures

11 .30 Hrs: Briefing by Mr. Gerhard Dieterle on CGIF and the GTZ projects in Indonesia with special reference to 1997 -1998 forest fires.

14.00 Hrs: Meeting with Mr. Dipo Alam at BAPPENAS along with JICA Project Formulation Mission

15.00 Hrs: Discussions with Prof. Herman Haeruman, Chief of Regional Planning, BAPPENAS.

16.00 Hrs: Meeting at UNDP with Ms. Albrectsen, Dy. Resident Representative and Dr. Budhi Sayoko, Environmental Programme Co-ordinator.

Friday 11 September, 1 998: (Mission Split into Two)

9.00 Hrs: Meeting with experts of the JICA Project: Forest Fire Prevention Management, Bogor along with JICA Project Formulation Mission.

13.30 Hrs: Meeting with the scientists at CIFOR, Bogor along with JICA Project Formulation Mission.

10.00 Hrs.: Meeting at ASEAN Secretariat in Jakarta with Dr. Uriarte, Director of Functional Co-operation Bureau.

14.00 Hrs: Meeting with Team Leader of ADB/RETA Programme Management Unit in Jakarta.

Saturday 12 September, 1998:

10.20 Hrs: Jakarta to Balikpapan

19.30 Hrs: Discussions about the HO Project PD12/193 on National Guidelines on Forest Fire Management for Indonesia with Prof. Gunarwan Suratmo and Prof. Zaharial Coto of IPB, Bogor

Sunday 13 September, 1998:

08.00 Hrs: Field trip to Pt. ITCI concession area
Briefing at the base camp and visit to areas affected by the 1998 forest fire.

17.30 Hrs: Discussion on fire management capability in forest concessions in East Kalimantan.

Monday 14 September, 1998:

13.40 Hrs: Balikpapan to Jakarta.

Tuesday 1 5 September, 1998:

09.00Hrs: Meeting at the office of WWF. Indonesia Programme with Mr. Fernando Gonzales, Forest Fire Project Co-ordinator.

14.30 Hrs: Discussion with Mr. Alf Leslie and Dr. Efransjah at the HO office in Jakarta.

Wednesday 16 September, 1998: Jakarta to Kuching, Sarawak, Malaysia

20.00 Hrs: Briefing meeting and dinner with Mr. James Mamit, Controller of Environmental Quality, NREB.

Thursday 17 September, 1998:

08.00 Hrs: Fly from Kuching to Miri

10.30 Hrs: Briefing by Mr. Arshad, Fire Chief of Miri Division of Fire and Rescue Department regarding fire suppression activities during forest fires in 1998

14.00 Hrs : Visit to Peatland near Brunei border to observe fire damages.

Friday 18 September, 1998:

08.00 Hrs: Visit fire-affected hill forest area near Miri and Bakam Experimental Forest managed by the Japanese Ministry of Education.

12.50 Hrs: Fly from Miri to Kuching.

15.00 Hrs: Meeting and discussion at NREB with Mr. James Mamit and Mr. Jiram Sidu.

Saturday 19 September, 1998:

08.30 Hrs: Meeting with Mr. Cheong Ek Choon, Director of Sarawak Forest Department.

10.00 Hrs: Meetings with Mr. Stephan Andel, Team Leader of ITTO Project: Sarawak Model Forest Management and with Dr. Paul Chai of ITTO Project: Protected Area Management

14.00 Hrs: Round up meeting of the ITTO Mission on report content and outline.

Sunday 20 September, 1998: Completion of Mission and Departure from Kuching

APPENDIX Ill: LIST OF PERSONS MET BY THE MISSION

INDONESIA

MOFEC:

Mr. Soomarsono
Director General
Forest Protection and Nature Conservation
Ministry of Forestry and Estate Crops
Jakarta.

Mr. Bambang Murdiono
Division of Foreign Technical Co -operation
Bureau of International Co-operation and Investment
Ministry of Forestry and Estate Crops
Jakarta.

K.L.H:

Mr. Effendy A Sumardja
Assistant Minister for Planning
The State Ministry of Environment
Jakarta

BAPPENAS:

Mr Dipo AIam
BIRO IPTEK
BAPPENAS
Jakarta.

Prof. Herman Haeruman
Chief of Regional Planning
BAPPENAS
Jakarta.

BAPEDAL:

Ir. Antung Deddy
Directorate For Environmental Degradation Control
The Environmental Impact Management Agency
Jakarta

IPB:

Prof. Dr. F. Gunarwan Suratmo
Faculty of Forestry
Bogor Agricultural University
Bogor

Prof. Zahrial Coto
Dean, Faculty of Forestry
Bogor Agricultural University
Bogor.

Dr. Nengah Surati Jaya
Faculty of Forestry
Bogor Agricultural University Bogor
Bogor.

PRIVATE INDUSTRY

Ir. Deddy Kusmulyadi
Deputy General Manager
Pt. International Timber Corporation Indonesia
Base Camp
Balikpapan, East Kalimantan

Mr. M. Sudijono
Assistant Director, Production
Pt. International Timber Corporation Indonesia.
Head Office
Jakarta

ASEAN:

Dr. F. Uriarte
Director, Functional Co-operation Bureau
The ASEAN Secretariat,
Jakarta

Mr. A. ApichaI Sunchindah
Functional Co-operation Bureau
The ASEAN Secretariat, Jakarta.

EU:

Mr. John Keating
Director
European Union Forest Liaison Bureau,
Jakarta.

Mr. Jozsef Micski
Deputy Director
European Union Forest Liaison Bureau
Jakarta

GTZ:

Mr. Gerhard Dieterle
Team Leader
GTZ~ Strengthening in Management Capabilities of
the Indonesian Ministry of Forestry and Estate C rope
Jakarta

Ms. Angelika Heil
GTZ7 Strengthening in Management Capabilities of the Indonesian Ministry of Forestry and Estate Crops
Jakarta

JAPAN/JICA:
Mr. Shunsuke Miyazawa
First Secretary
(Forestry, Fisheries and Nature Conservation)
Embassy of Japan
Jakarta.

Mr. Miyakawa Hideki
Team Leader
Forest Fire Prevention Management Project (JICA)
Bogor

Mr. Udeh Tome
Early Warning/Detection Expert
Forest Fire Prevention Management Project (JICA)
Roger.

Mr. Otsuka Masahiro
Participatory Methods Expert
Forest Fire Prevention Management Project (JICA)
Jakarta

Mr. Masahiro Tawa,
Asst. Resident Representative (JICA)
Jakarta

Yuichi Sate
Project Co-ordination (JICA)
Jakarta.

JICA Mission on Project Formulation Study on Forest Fires in Indonesia and Malaysia
Mr. Aiichiro Yamamoto
Senior Assistant to the Managing Director,
Office of Evaluation and Post Project
Monitoring, JICA (Mission Leader).

Mr. Hiroyuki Hatori
Development Specialist,
JICA (Sub- Ieader/ Forest Fire Prevention)

Mr Kazuhisa Ito
Assistant Director, Grant Aid Div ision,
Economic Co-operation Bureau,
Ministry of Foreign Affairs
(Co-operation Policy)

Mr. Kojiro Matsumoto
First Protect Formulation Study Division.,
Project Formulation Study Dept., JICA
(Study Planning)

Mr. Yasuyuki Suzuki
Japan Forest Technical Association
(JAFTA) (Forest Management/Environment)

Mr. Katsuhiko Ide
Fire Protection Equipment & Safety Centre of Japan

Mr. Kanako Shinkawa
Global Link Management, Inc.
(Health/Medical Survey)

UK -DfiD:

Dr. Alastair Fraser,
Programme Co-ordinator
UK -ODA, Indonesia Tropical Forestry Management Project
Jakarta.

UNDP:

Mrs. Anne-Birgitte Albrertsen
Deputy Resident Representative
Jakarta.

Dr. Budhi Sayoko
Environmental Programme Co -ordinator
UNDP
Jakarta.

Mr. Ulrik Jacobson
Programme Manager,
OFF Focal Point
UNDFf Jakarta.

Mr. S. Sristanto
Programme Division
UNDP
Jakarta.

Mr. S. Kristanto,
Programme Division
UND~ Jakarta

ADB:

Mr. Enik Scarsborough
Team Leaden
ADB/RETA Programme Management Unit
Jakarta.

Mr. Larry Maramis
Project Manager
ADB/RETA Programme Management Unit
Jakarta.

CIFOR:

In. Bambang Soekartiko
Director, External Relations
CIFOR, Roger.

Dr John W. Turnhull
Chief Scientist
CIFOR, Bogor.

Dr. William Sunderlin
Scientist, CIFOR, Begun:

Dr. Manuel Ruiz Perez
Scientist, CIFOR, Bogor.

Dr. Kuswanta Kartawinata
Director
Bulungan Research Forest
CIFOR, Bogor

ICRAF:

Mr. Fred StolIe
South-East Asian Regional Research Programme
ICRAF, Begun.

WWF

Mr. Fernando Gonzales
Forest Fire Project Co-ordinator
WWF -Indonesia Programme
Jakarta.

Mr. Chris Loin
Forest Fire Project Co-ordinator (Designate)
WWF -Indonesia Programme, Jakarta.

Dr. (MS) Carey P. Yeager
Senior Conservation Biologist
WWF -Indonesia Programme
Jakarta.

ITTO

Dr. Efransah
Projects Manager
Reforestation and Forest Management
ITTO
Yokohama, Japan.

Mr. Alf Leslie
HO Consultant on Reform Process Relating to Forestry in Indonesia

Mr. M. Kuswanda
Resident Advisor
Project PD 89/90 (F)
International Tropical Timber Organisation
Jakarta.

SARAWAK

Cheong Ek Choon
Director
Forest Department
Kuching

Mr. James Dawod Mamit
Controler of Environmental Quality
Natural Resources and Environment Borar
Kuching

Mr. Jiram Sidu
Assistant Controler
Natural Resources and Environment Board
Kuching

Mr. Johari Atok
Assistant Environmental Control Officer
Natural Resources and Environment Board

Mr. Yap Zee Kong
Staff Member
Natural Resources and Environment Board
Kuching

Mr. Dania Godeb Ak Goyong
Regional Environmental Control Officer
Natural Resources and Environment Board
Miri

Mr. Stephen Andel
Team Leader
ITTO Project: Sarawak Model Forest Management
Kuching

Dr. Paul Chai
ITTO Project: Protected Area Management
Kuching

ACRONYMS and ABBREVIATIONS

ACIAR	Australian Centre of International Agricultural Research
ADB	Asian Development Bank
ADPC	Asian Disaster Preparedness Centre (Bangkok, Thailand)
ADTA	Advisory Technical Assistance (of ADB)
AIFM	Asian Institute of Forest Management
AMC	ASEAN Member Country
API	Atmospheric Pollution Index
ASCMG	ASEAN Committee on science and Technology, Subcommittee on Meteorology and Geophysics
ASEAN	Association of South East Asian Nations
ASMC	ASEAN Special Meteorological Centre
ASOEN	ASEAN Senior Officers on Environment
AVHRR	Advanced Very High Resolution Radiometer (of NOM)

BAKORNAS PB	National Co-ordination Agency for Disaster Control (of Indonesia)
BAPEDAL	Environmental Impact Management Agency (of Indonesia)
BAPPENAS	National Planning Agency (of Indonesia)
CFC	Common Fund for Commodities
CGIF	Consultative Group on Indonesia Forests
CIDA	Canadian International Development Agency
CIFOR	Centre for International Forestry Research
COP3	3rd Session of the Conference of Parties to the United Nation Framework Convention of Climate Change, Kyoto, 1 – 10 December 1997
CRISP	Centre for Remote Imaging, Sending, and Processing of the National University of Singapore
CSD	UN Commission on Sustainable Development
DfID	Department for International Development (formerly UK-ODA)
EEPSEA	Economy and Environment Programme in south-East Asia (based in singapore, supported by a consortium of Donors, administered by IDRC)
ENSO	EL NINO Southern Oscillation.
ERS	Earth Resource Satellite
EU	European Union
EUFREG	European Union Forest Fire Response Group
FAO	Food and Agriculture Organisation of the United Nations
FFM	Forest Fire Management
FFPCP	Forest Fire Prevention and Control Program (of KU)
FFPMP	Forest Fire Prevention Management Project (of JICA)
FRD	Fire and Rescue Department (of Malaysia)
ftp	File Transfer Protocol
GEF	Global Environmental Facility
GFMC	Global Fire Monitoring Center
GIS	Geographic Information system
GOI	Government of the Republic of Indonesia
GTZ	Gesellschaft fur Technische Zusammernarbeit (German Technical Co-operation)
HIMAWARI	Japanese Meteorological Satellite
HPH	Concession Holders
HTI	Industrial Forest Plantation

HTTF	Haze Technical Task Source
ICRAF	International Centre for Research in Agroforestry
IDNDR	International Decade of Natural Disaster Reduction
IDRC	International Development Research Centre (of Canada)
IFFM	Integrated Forest Fire Management
IFFMP	Integrated Forest Fire Management Project (of GTZ)
IGAC	International Global Atmospheric Chemistry
1GBP	International Geosphere-Biosphere Programme
1PB	Bogor University of Agriculture
1PF	Inter -Governmental Panel on Forests (of CSD)
IRS	Indian Remote Sensing Satellite.
ISEB	International Society of Environmental Botanists
ITC I	International Timber Corporation Indonesia
ITFMP	Indonesia Tropi.cal Forest Management Programme
ITTA	International Tropical Timber Agreement
ITTC	International Tropical Timber Council
ITTO	International Tropical Timber Organisation
JICA	Japanese International Co -operation Agency
KfW	Germany's Development Aid Bank
KLH	State Ministry of Environment
KLN	Bureau of International Co-operation and Investment (of MoFEC)
Landsat	U.S. Earth Resource Satellite
LAPAN	Indonesian Aeronautics and Space Agency
MOFEC	Ministry of Forestry and Estate Crops (of Indonesia)
M0F	Ministry of Forestry
NASA	National Space Agency (of USA)
NGO	Non-Governmental Organisation
NHAP	National Haze Action Plan
NOM	National Oceanic and Atmospheric Administration
NWFP	Non Wood Forest Product
NREB	Natural Resources and Environment Board (of Sarawak)
OCHA	UN Office for the Co -ordination of Humanitarian Affairs

OFDA	Office of Foreign Disaster Assistance (of USAID)
PARTS	Programme to Address ASEAN Regional Transboundary Smoke
PHPA	Directorate General for Nature Conservation and Forest Protection (of MOFEC)
POSKO	Command Post / Policy Level Crisis Centre
POSKODAL	Field Command Post
PUSDALKARHUTLA	Provincial Co-ordinating Team for Forest and Land Fire Control
PUSDALKARHUTNAS	National Forest Fire Control Centre
RETA	Regional Technical Assistance (of ADB)
RFA	Regional Fire-fighting Arrangement
RHAP	ASEAN Regional Haze Action Plan
RS	Remote Sensing
SAF	Society of American Foresters
SATGAS	Field Fire Control Unit
SATKORLAK	District Co-ordinating Team for Fire Control or District Disaster Management Co-ordinating Team
SATLAK	Sub District Co-ordinating Team for Fire Control
SEA-El	South-East Asia-Environment Initiative (of USA)
SEAFIRE	South-East Asian Fire Experiment
SFM	Sustainable Forest Management
SPOT	Systeme Pour 'Observation de Ia Terre (French Earth Resource Satelíite)
Sq.km.	Square Kilometre

SRFA	Sub-Regional Fire-fighting Arrangement
TKNPKHL	National Co-ordinating Team for Forest and Land Fire Control
UK	United Kingdom
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDAC	United Nations Disaster Assessment and Co-ordination
UNDP	United Nations Development Programme
UNDRO	United Nations Disaster Relief Qrganisation
UNEP	United Nations Environment Programme
UNEP/EAP-AP	UNEP Environment Assessment Programme for Asia and the Pacific (located in Bangkok)
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNICEF	United Nations Children's Fund
US	United States of America
USAID	United States Agency for International Development
USAID-OFDA	USAID - Office of Foreign Disaster Assistance
USDA	United States Department of Agriculture
WALHI	Indonesian Environmental Forum - an Indonesian National NGO
WFC	World Forestry Congress
WHO	World Health Qrganisation

WMO	Word Meteorological Organisation
WWF .IP	World Wide Fund for Nature - Indonesia Programme
WWW	World Wide Web