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The International Boreal Forest Research Association (IBFRA) Fire Working Group

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The International Union of Forestry Research Organizations (IUFRO)
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CONTENTS

→ Due of the timelag between editing and print/distribution of IFFN, readers interested in meeting announcements are kindly requested to visit the Internet version of this issue for update and short-term announcement of meetings (continuously updated) on **<http://www.uni-freiburg.de/fireglobe>**

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All IFFN contributions published between 1990 and this current issue are accessible through 61 country files and other special files on the GFMC website.

Call for contributions

Readers of the International Forest Fire News are warmly invited to send written contributions to the editor at the above address. These may be in the form of concise reports on activities in wildland fire management, research, public relations campaigns, recent national legislation related to wildfire, reports from national organizations involved in fire management, publications, personal opinions (letters to the editor). Photographs (black and white) and graphs, figures and drawings (originals, not photocopies, also black and white) are also welcome. Contributions are preferably received by **e-mail (text as non-encoded ASCII file, Word Perfect 5.1 or Word 6.0, Word97/8; graphic files saved as *.JPG, *.GIF or similar) or on diskettes**. Hard copies of figures and photographs should be submitted by mail (please do not submit by fax).

The deadlines for submitting contributions to the bi-annual issues are: **15 May and 15 November.**

EDITORIAL

2000 – A Year of new Global Fire Partnerships and Initiatives

Careful readers may have noticed that two new logos of partner organizations have appeared on page ii of IFFN, the new logo of the International Strategy for Disaster Reduction (ISDR) and the logo of the German Agency for Technical Cooperation (Deutsche Gesellschaft für Technische Zusammenarbeit – GTZ).

The ISDR logo resembles the former logo of the UN International Decade for Natural Disaster Reduction (IDNDR). In fact, the ISDR is the successor arrangement of the IDNDR and became effective in January 2000. In this issue we present the new logo of a UN programme that is becoming involved increasingly in addressing global problems associated with forest fires and other wildland fires. On 11 October 2000 the first UN inter-agency platform for wildland fires has been created under the ISDR. This decision was made at the second meeting of the ISDR Inter-Agency Task Force for Disaster Reduction (IATF). The IATF is a constituent element of the ISDR and serves, among other, as the main forum within the UN system for devising strategies and policies for the reduction of natural hazards in accordance with the framework laid down in resolutions of Economic and Social Council (ECOSOC) and of the UN General Assembly. The Working Group Wildland Fire is one of four working Groups of the IATF. The Working Group Wildland Fire has been proposed jointly by the World Conservation Union (IUCN) and the Global Fire Monitoring Center (GFMC). Starting in 2001 the GFMC will coordinate new Working Group. We will report in IFFN No. 25.

As expressed in the UN General Assembly Resolution A/RES/54/219, the ISDR Secretariat will continue all promotional and awareness-raising activities carried in strengthening the achievements already made during IDNDR towards achieving a concrete global culture of prevention. The UN 2000 World Disaster Reduction Campaign has been conducted from August to October 2000 around the theme of "Disaster Prevention, Education and Youth" and culminated on 11 October 2000 with the worldwide celebrations of the International Day for Disaster Reduction. Specific emphasis had been placed on forest fires as an illustration of a significant and recurrent threat whose economic and social impact has always been underestimated. The announcement of the UN 2000 World Disaster Reduction Campaign had been circulated worldwide to organizations and individuals dealing with disaster prevention, as well as to young people and schools, in order to encourage national participation in the campaign. A press release announcing the campaign had bee issued through the UN Department of Public Information in Geneva. An information kit in English, French, Spanish and Russian was produced in cooperation with the Global Fire Monitoring Center (GFMC), the Emergency Management Australia, the French Entente Interdépartementale en vue de la Protection de la Forêt contre l'Incendie, the French Conservatoire de la Forêt Méditerranéenne, the South African Government's Ukuvuka Operation Firestop and the Cuerpo de Bomberos del Instituto Nacional de Seguros de Costa Rica. It included scientific articles, a poster and case studies on forest fires and disaster prevention as well as a children's booklet. The IFFN readers are kindly referred to the educational materials presented by the ISDR Secretariat. They are available on the ISDR Website (http://www.unisdr.org).

In this issue we present a GTZ Special. It reveals the high-profile involvement of an agency that has been dealing with wildland fire problems in the frame of bilateral technical, scientific and financial cooperation since many years. A number of reports have been published in the pages of IFFN since the early 1990s. This GTZ Special provides the views of GTZ project staff working all over the globe.

In my last Editorial (IFFN No.22 – April 2000) I reported about an initiative under the UN International Search and Rescue Advisory Group (INSARAG) to establish a wildland fire component that would deal with international assistance to countries that need support in extreme fire emergencies. At the ECE/FAO Baltic Exercise for Fire Information and Resources Exchange 2000 (BALTEX FIRE 2000) in Finland, June 2000, and the 5th INSARAG Regional Europe-Africa meeting in Hammamet, Tunisia, November 2000, further steps were prepared towards implementation. In the next issue of IFFN (April 2001) we will report about BALTEX FIRE 2000 in the frame of a Forest Fire Special on the Baltic Region including the Russian Federation.

Freiburg, December 2000

Johann G. Goldammer

GTZ Special on Wildland Fire

Editorial (I)

Readers of International Forest Fire News (IFFN) may have noted that in the last issue (No. 22, April 2000) the logo of the German Agency for Technical Cooperation – *Deutsche Gesellschaft für Technische Zusammenarbeit mbH (GTZ)* – had entered the assembly of IFFN co-sponsors and partners on page (ii). This move happened after many years of close cooperation between the GTZ and the institute of the editor in which IFFN is prepared since 1988 and which also hosts the *Global Fire Monitoring Center* (GFMC) since its establishment in 1998. This issue provides a GTZ Special on Wildland Fire. The following contributions to this IFFN Special had been prepared in 1999 for a special publication of the GTZ, the *Waldinfo* <*“Forest Info”*>, an internal newsletter of the *GTZ Department Forests and Nature Conservation*. Having in mind that the distribution of *Waldinfo* is limited to the GTZ and its immediate partners it was planned from the very beginning to publish these papers also in IFFN in order to make them available for a broader audience, particularly through the publication on the GFMC homepage. Besides some minor updates or editorial changes the papers are more than one year old. This must be taken into consideration concerning recent developments that are not mentioned in the papers.

With the *Integrated Forest Fire Management* (IFFM) projects and other forest development projects with a wildland fire management component the GTZ has entered the challenging arena of *Community-Based Fire Management* (CBFM) in the developing world almost a decade ago. The IFFM project in Indonesia which is presented in this IFFN Special by several contributions provides outstanding experience in bringing together aspects of IFFM/CBFM with the transfer of technologies adapted to the local situation as well as technological innovations in the development of an advanced Fire Information System. Mr. Georg Buchholz, former staff member of the GFMC and currently with IFFM Indonesia served as technical coordinator of the *Waldinfo* and this IFFN Special.

Johann G. Goldammer
Editor, IFFN

Editorial (II)

Preface to the GTZ *Waldinfo* Special Issue

More than other sectors in natural resources management, forestry faces the ever increasing challenge of harmonising an array of conflicting interests. Interests which range, in a globalizing world, from *Angst* in the Western World pertaining to disrupting the planet’s water cycles, climate functions and evolutionary potential expressed by biological diversity, safeguarded by and associated with forest ecosystems, to defending customary rights of indigenous and other forest dwelling peoples from national and transnational timber companies trespassing their home lands or to pharmaceutical conglomerates creaming off forests in search of that single chemical substance which cures AIDS or cancer, thus, inducing share-holder values to skyrocket in a multi-billion dollar market.

It is for those reasons that forestry, although having a meagre share of 2% at total lending of the World Bank, is considered by Bank officials to cause 98% of the institution's headaches.

Fire is a dominant factor in most vegetation zones throughout the world. It’s use as a land-management tool is an integral part of agricultural and pastoral societies, particularly in the developing world, but also of forest managers in temperate countries.

Forest fires, especially in tropical moist forests, are increasing at alarming rates since the 1980’s both, in extent and intensity, causing multi-billion dollar damages far beyond the confines of the sector. There is little doubt, among specialists, that human induced factors in forest utilisation at local level, e.g. change of land use cover by encroachment, timber harvesting, plantation forestry or settlement schemes, combine with global changes such as the El Niño-Southern Oscillation (ENSO) to make tropical moist forests, hitherto thought to be immune from large-scale fires, ever more prone to that threat.

A vicious circle seems to be under way, intensified and symbolised by large fire events, threatening the very foundations of the earth's life support systems. As Goldammer states in his article below, "fire risk modelling in expected climate change scenarios indicates that within a relatively short period, the next three to four decades, the destructiveness of human-caused and natural wildfires will increase".

The ecological Fire Triangle – fuel, oxygen and heat – is being counteracted upon through the Fire Fighting Triangle composed of intelligence, prevention and suppression of fires. The 18 articles below document project experiences with fire management in German Technical Co-operation. They demonstrate the necessity to develop fire management schemes for such distinct ecosystems as Sub-Sahelian savannahs and tropical moist forests – and testify to approaches successfully implemented in a wide range of ecological, political and institutional conditions.

Fire prevention is the central part of any fire management system, seconded by fire intelligence and fire suppression. Since many different actors are involved, fire management systems must address different sectors of society. Public policies and the institutional framework set the conditions for land use, resources protection and welfare of rural populations, thus being an important facet to be addressed in successful forest fire management systems.

The articles are organised in three parts, following the logic of interventions in natural resources management: "Shaping the Institutional Framework" – part 1, "Mitigating the Impact" – part 2, and "Safeguarding Livelihoods" – part 3.

It is in this sense that authors and editors of this special "Waldinfo" issue hope to sensitise and encourage the various stakeholders in forest utilisation and management, to develop and make efficient Integrated Forest Fire Management Programs work.

Hans Stehling
Bernhard von der Heyde
Peter Saile
Georg Buchholz

PART I Fire Policies : „Shaping the institutional Frameworks"

Global Fire Issues

Introduction

Fire is a dominant disturbance factor in almost all vegetation zones throughout the world. In many ecosystems fire is an essential and ecologically significant force - organising physical and biological attributes, shaping landscape diversity, and influencing energy flows and biogeochemical cycles, particularly the global carbon cycle. In addition, the use of fire as a land-management tool is deeply embedded in the culture and traditions of many societies, particularly in agriculture and pastoralism in the developing world.

Conversely, in some ecosystems fire is an unnatural process that often leads to vegetation destruction and long-term site degradation, yet these regions, particularly in the humid tropics, are becoming increasingly vulnerable to fire due to growing population, economic, and land use pressures. Even in regions where fire is natural, e.g. the northern circumpolar boreal zone, more frequent severe fire weather conditions have created recurrent major fire problems in recent years. Extreme wildfire events are increasing throughout the world, with significant impacts on economies, and human health and safety comparable to those associated with other natural disasters, such as earthquakes, floods, droughts and volcanic eruptions. In many countries, rapidly changing social, economic and environmental conditions suggest that marked changes in fire regimes can be expected, with unknown local, regional, and global consequences.

Fires in forests and other vegetation produce gaseous and particle emissions that have impacts on the composition and functioning of the global atmosphere. These emissions interact with those from fossil-fuel burning and other technological sources which are the major cause for anthropogenic climate forcing. Fire risk modelling in expected climate change scenarios indicates that within a relatively short period, the next three to four decades, the destructiveness of human-caused and natural wildfires will increase. Fire management strategies which include preparedness and early warning cannot be generalized due to the multidirectional and -dimensional effects of fire in the different vegetation zones and ecosystems and the manifold cultural, social, and economic factors involved.

Global fire occurrence

Reliable statistical data on occurrence of wildfires and land-use fires, areas burned and losses are available for only a limited number of nations and regions. Within the northern hemisphere the most complete dataset on forest fires is periodically collected and published for the member states of the Economic Commission for Europe (ECE). It includes all Western and Eastern European countries, countries of the former Soviet Union, the U.S.A. and Canada. Since the dataset is restricted to forest fires, it does not include land-use fires which are also a major source of fire-caused smoke pollution.

Other countries from outside the ECE/EU region report fire statistics in the pages of International Forest Fire News and other published and non-published reports. These statistical data are currently updated at the Global Fire Monitoring Center (GFMC) (see below).

A global dataset of fire activities has been developed on the basis of active fires detected by the NOAA AVHRR sensor. This dataset provides the temporal and spatial distribution of vegetation fires throughout the year. However, it does not yet provide a quantitative database in terms of area burned, vegetative matter combusted, and gas and particle emissions generated. Spaceborne sensors have been used in a large number of case studies to determine land areas affected and emissions produced by fires. Thus, potential tools for a quantitative inventory of fire effects using spaceborne sensors are available (see contribution by Hoffmann, this volume).

Main types of vegetation fires

Wildfires (uncontrolled fires) are common in all vegetation zones. They are mostly caused by negligence and are often associated with escaped land-use fires. Both wildfires and land-use fires can directly or indirectly cause immediate damages or have long-term environmental or humanitarian consequences. Despite the fact that many ecosystems are well adapted to fire and land-use fires often follow traditional and established practices, there is an increasing tendency of fire events causing conflicts with the needs of the rapidly growing populations of the developing countries and at the interface with vulnerable structures of industrialized societies.

Wildfires (uncontrolled fires) in forests

In the temperate and northern boreal forests wildfires are occurring regularly during the dry northern summers. In North America and Eurasia between 5 and 20 million hectares (ha) are burned annually. In the less populated high latitudes the ignition sources are dominated by lightning, while in more frequently populated regions humans become the dominating fire cause. In the Mediterranean region an average of ca. 0.6 million ha of forest and other land is burned annually.

The equatorial rain forests are usually too moist to allow the propagation of wildfires. However, extreme droughts in association with forest exploitation periodically create conditions of flammability, fuel availability and fire spread in the equatorial rain forests. Such events regularly occur in the forests of tropical South Asia in association with cyclic climate variability caused by the El Niño-Southern Oscillation (ENSO) phenomenon. Some examples of large-scale (catastrophic) fire events are given further below.

The largest areas affected by uncontrolled wildfires in tropical forests are in the seasonal forest biomes (deciduous and semi-deciduous forests, sometimes also referred to as "monsoon" forests). Here, the fires are burning in short return intervals of 1 to 3 years. The tropical submontane coniferous forests (pine forests) are also subjected to regular fires.

Wildfires in tropical grass, brush and tree savannas

Tropical savannas cover an area of ca. 2.3-2.6 billion ha worldwide. Savannas typically consist of a more or less continuous layer of grass with interspersed trees and shrubs. There are numerous transition types between savannas and open forests. The surface fuels in these ecosystems which are dominated by grasses and leaves which are shed during the dry season, are burned periodically at intervals which may range from one to four years. This fire frequency has becoming increasing in some regions as a result of increasing population and more intensive use of rangeland. The area of savannas potentially subjected to fire each year is up to several hundred millions of hectares. As a result, savanna burning releases about three times as much gas and particle emissions to the atmosphere as deforestation burning. It is estimated that more than 3 billion tons of vegetative matter are burned in tropical savannas annually.

Conversion of forest and brushland to plantations, agricultural and pastoral systems

Two types of forest clearing for agricultural use are common, predominantly in the tropics: shifting agriculture, where the land is allowed to return to forest vegetation after a relatively short period of use, and permanent removal of forest to be converted to grazing or crop lands. In both instances, the clearing and burning follows initially the same pattern: trees are felled at the end of the wet season. After extraction of marketable and otherwise usable trees, the vegetation is left for some time to dry out in order to obtain better burning efficiency. In shifting agriculture, which is practised by several hundred million people worldwide, the cleared areas are used for agriculture for a few years until yields decline, and then are abandoned and new areas cleared. The generally observed shortening of shifting agriculture cycles is increasingly associated with site degradation and makes this traditional land-use technique one of the leading causes of global tropical deforestation.

The conversion of primary or secondary forest into permanent agriculture and grazing land, including tree plantations, is driven by expanding human populations that require additional food and living space, but also by large-scale resettlement programmes and land speculation.

The net amount of plant biomass which is combusted in the process of vegetation clearing is somewhat in the range of 1 to 2 billion metric tons.

Burning of agricultural residues, control of bush and weeds, nutrient cycling on grazing and croplands

A substantial amount of agricultural residues, e.g. straw and stalks, is disposed off by burning. The magnitude of this practice is extremely difficult to quantify because of its distributed nature. No statistics are available, mostly because no material of direct economic value is involved. It has been estimated that between 800 and 1 200 million tons of agricultural residuals are burned annually, making this practice a major source of atmospheric pollution, mainly in the tropics.

By tradition fire is also a common practice to control bush and weed encroachment and grazing and crop lands.

Recent major fire episodes and losses

Comprehensive reports with final data on losses caused by forest and other vegetation fires (wildland fires), including impacts on human health, are only occasionally available. The main reason for the lack of reliable data is that the majority of both the benefits and losses from wildland fires involve intangible non-use values or non-market outputs which do not have a common base for comparison, i.e. biodiversity, ecosystem functioning, erosion, etc. Market values such as loss of timber or tourism activity have been calculated in some cases:

* The large wildfires in Borneo during the ENSO drought of 1982-83 burned more than 5 million hectares of forest and agricultural lands. In East Kalimantan a fire damage inventory revealed total losses of ca. US$ 9 billion
* First assessment of damages caused by the fire episode of 1997-98 in Indonesia on ca. 8-9 million ha: losses of ca. US$ 10 billion; aprox. 40 million people in SE Asia affected by smoke in various degrees (by increased morbidity and mortality; long-term health effects); more than 250 fatalities due to aircraft and maritime accidents.
* The fires burning in Mexico during the 1998 episode forced the local government to shut down industrial production in order to decrease additional industrial pollution during the fire-generated smog. Daily production losses were ca $US 8 million.
* Australia's Ash Wednesday Fires of 1983:
  - human death toll: 75
  - burned homes: 2 539
  - burned domestic livestock: nearly 300 000
* Extended forest and savanna fires in Côte d'Ivoire 1982-83:
  - human death toll: more than 100
  - burned land area: 12 million ha
  - burned coffee plantations: 40 000 ha

- burned cocoa plantations: 60 000 ha

* Forest fires in the Northeast of the People's Republic of China during the 1987 drought:
  - human death toll: 221
  - burned forest: 1.3 million ha
  - homeless population: 50 000
  - average annual human fatalities 1950-98 (all China): 92 dead, 551 wounded
* Same fire episode in the Soviet Union during the 1987 drought:
  - burned forest: 14.5 million ha
  - burned forest 1998: 7.1 million ha
* Mongolia steppe and forest fires 1996-97:
  - burned area 1996: 10.7 million ha
  - human death toll: 25
  - burned domestic animals: 7 000
  - burned stables/houses: 576/210
  - damage assessment: US$2 billion
  - burned area 1997: 12.4 million ha

Smoke pollution generated by wildland fires occasionally creates situations during which public health and local economies are affected seriously. The smoke pollution in Indonesia and its neighbouring countries is one of the well known cases described by A. Heil (this volume). The WHO *Health Guidelines on Vegetation Fire Events* deal with this problem (http://www.who.int/peh/air/vegetation_fires/htm).

Hazard assessment as the basis of risk analysis

Early warning systems for fire and smoke management for local, regional, and global application require early warning information at various levels. Information on current weather and vegetation dryness conditions provides the starting point of any predictive assessment. From this information the risk of wildfire starts and prediction of the possibility of current fire behaviour and fire impacts can be derived. Short- to long-range fire weather forecasts allow the assessment of fire risk and severity within the forecasting period. Advanced spaceborne remote sensing technologies allow fire weather forecasts and vegetation dryness assessment covering large areas (local to global), at economic levels and with accuracy which otherwise cannot be met by ground-based collection and dissemination of information. Remote sensing provides also capabilities for detecting new wildfire starts, monitoring ongoing active wildfires, and, in conjunction with fire-weather forecasts, providing an early warning tool for escalating, extreme wildfire events. See the contributions by G.Buchholz and D.Weidemann, and by A.Hoffmann (this volume).

Fire prevention and control: The role of communities

At global scale the majority (approximately >90%) of all wildfires start in the context of land use. Negligence, ignorance, and lack of ability (lack of technologies and training) to control escaping fires are the main responsible causative agents. Thus, fires represent a natural hazard which cannot only be predicted and controlled but also prevented. Fire prevention, however, must address different sectors of the society. Public policies which determine land use, resources protection, or welfare of rural populations, create the main underlying conditions of wildfire occurrence. Individuals and groups which use fire in forests, agriculture and pastoralism are the main cause for disastrous wildfires. At the same time they are potentially threatened by wildfire.

Public education programmes for fire prevention address target groups which vary from country to country. Negligent urban people (tourists) which often are main fire starters in the industrial countries, must be targeted by specific public awareness campaigns using mass media or specific advertisements, e.g. in recreation areas, national parks etc. Education programmes for school children involve different media to transport messages of environmental protection including forest fire prevention.

Most important in wildfire prevention is the involvement of rural communities. Experience in community-based fire management shows that incentive programmes create conditions of a positive atmosphere of collaboration and trust between land users and authorities. See the contribution by H. Abberger (this volume).

Towards global programmes in fire research and cooperation in fire management

Despite this high profile, current estimates of the extent and impact of vegetation fires globally are far from complete. Several hundred million hectares of forest and other vegetation burn annually throughout the world; however, a large percentage of these fires are not monitored or documented. Clearly, informed policy decision-making and emergency responses, including humanitarian assistance, require the timely quantification of fire activity and impacts nationally, regionally and globally. Primary policy considerations relate to concerns about the regional and global impacts of excessive and uncontrolled burning, broad-scale trends over time, and the options for instituting protocols that will lead to more efficient control. Key policy questions involve determining whether fire is a sufficiently serious problem to require action and, if so, what factors govern its incidence and impacts, and what are the relative costs and benefits of different options for reducing adverse impacts?

In order to answer the numerous open questions the Global Fire Monitoring Center (GFMC) was established in 1998. It is designed as an information and monitoring facility which national and international agencies involved in land-use planning, fire and other disaster management, scientists and policy makers can utilise for planning and decision making.

The GFMC is hosted by the Fire Ecology and Biomass Burning Research Group of the Max Planck Institute of Chemistry, Biogeochemistry Department, Germany, which also serves as a co-ordination unit of the Biomass Burning Experiment (BIBEX) of the International Geosphere-Biosphere Programme (IGBP), International Global Atmospheric Chemistry (IGAC) Project, and the UN-FAO/ECE/ILO Team of Specialists on Forest Fire. The GMFC was initially sponsored by the Government of Germany, Ministry of Foreign Affairs, Office for the Co-ordination of Humanitarian Affairs, as a German contribution to the UN International Decade of Natural Disaster Reduction (IDNDR). The creation of the GFMC in 1998 was in line with the policies of several international agencies and institutions which developed close partnerships, notably with

- the UN International Decade of Natural Disaster Reduction (IDNDR) and its successor arrangement, the International Strategy for Disaster Reduction (ISDR)
- the World Conservation Union (IUCN)
- the Deutsche Gesellschaft für Technische Zusammenarbeit mbH (GTZ)
- the United Nations Economic Commission for Europe (ECE)
- UN International Search and Rescue Advisory Group (INSARAG), Fire Group
- the International Tropical Timber Organization (ITTO)
- the World Health Organization (WHO)
- the United Nations Educational and Scientific Organization (UNESCO)
- the World Bank, Disaster Management Facility (DMF) and its associated ProVention Consortium on Natural and Technological Catastrophes and the World Institute for Disaster Risk Management (DRM)
- the Technical Assistance to the Commonwealth of Independent States (TACIS) programme in Russia
- the U.S. Bureau of Land Management (BLM)

After the end of the IDNDR (1990-2000) the GFMC continues to support the IDNDR successor arrangement: the International Strategy for Disaster Reduction (ISDR) and the work of the ISDR Inter-Agency Task Force (IATF) which operates under the direct authority of the Under-Secretary General for Humanitarian Affairs of the United Nations. In October 2000 the IATF *Working Group Wildland Fire* was established at the 2nd IATF meeting which will be coordinated by the GFMC (see editorial of this issue of IFFN).

The GFMC fire documentation, information and monitoring system is accessible through the Internet: <http://www.uni-freiburg.de/fireglobe/>

The Fire Ecology and Biomass Burning Research Group and the GFMC are located in the converted Old Airport Tower at the Airport Campus, Freiburg University (Germany). The expertise of the institute goes back to the mid-1970s when global scientific research and development work in the field of fire ecology, cultural history and socio-economics of vegetation fires, science transfer into operational management systems and policy development began at Freiburg University. In the same time period the Max Planck Institute for Chemistry, located in Mainz (Germany) took the lead in investigating the role of vegetation fires in global biogeochemical cycles and atmospheric chemistry.

The two institutions merged in 1990 and created the first interdisciplinary global fire research facility. The information on global fire research programmes of IGAC-BIBEX is accessible through the GFMC website. Since 1999 the GFMC is part of the *German Research Network for Natural Disasters* <http://www.dfnk.gfz-potsdam.de> and is member and closely co-operates with the national German Committee for Disaster Reduction.

The Fire Ecology Research Group/GFMC has provided advisory services for a broad range of bi- and multilateral scientific, technical fire management and fire policy development programmes in all continents. Cooperation with GTZ projects were implemented in Brazil (University of Paraná, Curitiba, 1980-82), Indonesia (Mulawarman University and IFFM, 1987-ongoing), Algeria (Projet Pilote de Développement Forestier du massif de Collo, 1992), Argentina (CIEFAP, Esquel, 1991-97), Sudan (Jebel Marra Forest Circle, 1991); see also Waldinfo No. 13 (1994).

Contact address

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(address on p. iv)

After the Fires in East Kalimantan/Indonesia
Forest Policy Challenged to Support Sustainable Forest Management (SFM)

The background

With some 5.2 million ha fire affected area, about 25% of the area of the province of East Kalimantan has been hit in 1997/98 by a catastrophe of national if not international dimension (Hoffmann et al. 1999). Almost 2.3 million ha of natural forest concession areas (56 concessions), 0.9 million ha of forest plantations (30 concessions) and 0.7 million ha of industrial oil and rubber plantations have suffered losses. Many of the concessions may not survive as such. Forestry - the government as well as the private sector - have to react and to adjust their programs and approaches.

There had been severe forest fires already in Indonesia in 1982/83, 91/92 and 93/94; however, again in 1997/98 extended wildfires occurred in a largely unchanged social, economical and forest policy environment. Some characteristics (at the time of the fires in early 1998) may be mentioned:

* ***Social*** aspects: the local people get little benefit from forestry; deprivation from their traditional uses cause low interest in conservation; numerous land use conflicts between local people and natural as well as industrial forest concessions exist; illegal logging is estimated to exceed 50 % of the officially reported annual timber harvest.
* ***Economical*** aspects: Large timber concessions control forestry; short term exploitation/profit orientation dominates versus a more expensive long term resource management; huge over capacities of the timber processing industries and the need for export earnings cause pressure on forests and on the government; a lack of understanding of forests as a national public asset and renewable natural resource to sustain the national economy exists.
* ***Forest policy*** aspects: Indonesia is committed to sustainable forest management; however, many government regulations favor wasteful exploitation and conversion rather than long-term natural resource development. This results in a lack of incentives for the private sector to do Sustainable Forest Management (SFM). The government with its *Inhutani* / state-owned concessions does not set a positive example for SFM either; law enforcement is lacking.

Under the prevailing conditions and given the economic crisis in Indonesia since 1997, it was not surprising that the government and the forest concessionaires tend to downplay the magnitude of the 97/98-fire catastrophe and, until now, have not planned a comprehensive forestry recovery program after the fires. However, a number of individual measures have been taken for East Kalimantan by the central and provincial authorities, mainly since early 1999. These may point the way to the future. The two Indonesian-German projects *Promotion of Sustainable Forest Management in East Kalimantan Project* (SFMP) and *Integrated Forest Fire Management* (IFFM) could contribute substantially with recommendations, which resulted e.g. in: the directive of the Minister to take regard of the results of the forest fire area mapping for revision of the provincial land use planning; a number of regulations issued by the Forestry Department to carry out forest rehabilitation based on concrete plans, to start with a revision of long-term forest management planning including reduction of harvesting (Annual Allowable Cut [AAC])and, to restrict salvage felling in fire affected areas to dead trees only using reduced impact logging techniques.

The present challenge is the proper implementation of these directives. First experience and observation is not very encouraging. Reality reaches from blunt violation of directives to simple non-action. This shows that the process to adopt "actions after forest fires" as a concept to react to the catastrophe in a coordinated way requires time, new and stronger policy frame conditions and, primarily, an attitude by all stakeholders that understands SFM as a concrete commitment.

The New Indonesian Forestry Act (No. 41, September 1999)

Recent policy development, the new forestry act and a number of other regulations, have created a new situation in Indonesia. The process of policy making is, nevertheless, still ongoing. Only a few points shall be highlighted here, which are relevant for "actions after forest fires". The forestry act, in many of its articles, still leaves much open and stipulates 21 government regulations yet to be prepared on far reaching details. Many of these will be essentially important to support SFM. So, not much can be said about the final quality and eventual effectiveness of the new policy.

Important obligations for forest concessions and other rightholders, however, are in place in the act itself already for "Forest Rehabilitation and Reclamation" (Art. 40-45) and "Forest Protection and Conservation" (Art. 46-51); these include prevention, management of, and actions after forest fires. Article 41 e.g. explicitly prescribes that forest *"Rehabilitation……shall be undertaken in all forests and forest areas except in nature reserves and core zone of national park"*; and in Art. 42: *"…be implemented based on specific biophysics conditions…" "…primarily through participatory approach, in the framework of community development and empowerment"*. Each person holding a license or recognized right on *"…critical or unproductive forests shall be obliged to rehabilitate the forests..."*. Forest Reclamation is defined as *"…an effort to improve and recover damaged land and forest vegetation to restore it to its origin to function in an optimal way."* This *"...include inventory of locations, designation of location, planning and implementation."* (Art. 44). Hence, the law is clear about the obligation and objectives of forest rehabilitation, but nothing is said about how to facilitate such programs.

Regarding forest protection, Art. 46 and 47 aim to *"secure"* the functions of the forests in an *"optimal and sustainable way"* and, e.g. to *"…prevent and limit the destruction of forests…as a result of…fires…",* and Art. 48 states the responsibilities of the Government as the main player to control and undertake protection and the obligation of licensees and right holders as *"…to protect the forests in their working area"* and stipulates local community involvement as a rule. Very little is said in the law about the organizational implications and required capacities of the forest service. The newly created forest police function and some rewards for successful action to recover illegal timber may be seen as first but insufficient steps.

Other parts of the law regulate a number of important issues to secure SFM: e.g. forest area gazettment, land use planning, establishment of forest management areas, forest management planning and the utilization of forest areas. Almost all important articles of the law stipulate the local population to participate in forestry – however, the government retains the final control also over the previously traditionally managed (*adat*) forests. It remains now to be seen, how these frame regulations are filled with life by the policy makers (new government regulations not yet prepared) and, whether this is sufficient to establish a new sense of belonging by the local people and an attitude to protect the forests in a more efficient way.

With the new Act in place, there is also the need to adjust or replace numerous previous government regulations. Regarding "actions after forest fires", e.g. the disputed recent regulation on *HPH Tanaman Campuran* (August 99) may be mentioned. This regulation would allow up to 40 % of the "unproductive forest area" within a natural forest concession to be cleared and used as *perkebunan* (estate crop plantations). If this would be understood to allow oil palm estates within *kawasan hutan* (forest area), the regulation would boost forest conversion. This is probably not compatible with the new forest law: Not only Art. 41 and 43 stipulate rehabilitation of all *"critical or unproductive forests"*, but also by definition of Art. 1, paragraph 3 *"Forest area means a certain area which is designated and/or stipulated by government to be retained as permanent forest"* and (in paragraph 2) *"Forest means a unit of ecosystem….comprising biological resources, dominated by trees in their natural forms and environment…"*.

Crucial issues to be tackled to pave the way for SFM

In practice, the new Indonesian forestry act, e.g. about forest rehabilitation and protection is quite progressive and sets highly ambitious standards. It remains to be seen, how the political will comes down to the ground in form of further regulations and, how implementation in the field can be accomplished. Only this will be the final yardstick to measure success. The absence in the law of any provision of how to fund such huge rehabilitation programs and, when and in which time frame to implement these shows the risk of ineffectiveness of these stipulations.

Keeping in mind the constraints in forestry as mentioned above, there are some crucial issues, in particular:

* What will be the role of the government and of the private sector in contributing to forest rehabilitation and protection against future forest fires? Will the government take a more active part to support the rebuilding of the forest resources after 20-35 years of exploitation?
* Can international programs be tapped (e.g. carbon sequestration and certification / eco labeling) to support SFM after the forest fires?
* How can other incentives be granted by the government for natural forest concessions to invest into SFM after the forest fires, e.g. into natural forest rehabilitation and protection for long-term business certainty / security?

These questions are, certainly, related to forestry in Indonesia in general, not only to the follow up after the fires. The present poor stock condition of huge forest areas after the fires can and must, however, be used to create awareness and accelerate and strengthen the process of forest policy development and implementation to support SFM.

Contributions of the Indonesian-German forestry projects based in East Kalimantan

SFMP and the IFFM-Project have proposed and assisted in implementation of a five step program “Actions after forest fires in natural forest concessions”, which served as basis for several government regulations in 1999 (Daryanto et al. 1998).

The following steps were proposed for the fire affected natural forest concessions:

* Conduct a low intensity fire damage inventory (separately for each fire affected forest concession)
* Develop rehabilitation maps for all heavily damaged areas
* Improve the fire prevention and management system of each forest concession
* Shift logging activities: stop logging in unburned areas and conduct salvage felling of dead trees in burned areas (where possible)
* Adjust the Annual Allowable Cut (AAC) of each fire affected natural forest concession to a sustainable level and revise the long term forest planning accordingly

These SFMP-recommendations were largely adopted and included in government regulations until October 1999 (at the time of writing this manuscript). Although such a program may sound rather self-explanatory and logical keeping in view Indonesia’s official SFM policy, this meant a major policy adjustment and still imply tough government action to deal with the forest concessions and industries. The required substantial reduction of timber harvesting (SFMP proposed a “soft landing” onto a newly calculated sustainable AAC for each of the fire affected concessions) was strongly opposed by the industries with their high demand for timber and important contribution to export earnings for the province and country.

Almost two years after the fire episode of 1998 the majority of the natural forest concessions has not fully reacted to the catastrophe, often not even submitted the required rehabilitation plans. Illegal harvesting goes on of living trees in the fire-damaged areas and threatens to destroy the remaining forests, particularly its potential for natural regeneration. However, the government has now taken strong action to force these companies to come up with rehabilitation plans. Considering this situation SFMP and IFFM have recently recommended:

1. To revise East Kalimantan's provincial spatial planning (RTRWP) with immediate effect taking regard of the 1997/98 fire damage. Stop conversion in unburned areas and concentrate plantation activities in depleted and/or heavily burned areas. Clearly define permanent forests for long term forest management as a basis for rehabilitation planning
2. To test and step-wise implement procedures for improved land use planning at the village level (with the help of the District government) in order to reconcile land conflicts and harmonize interests between companies and local people
3. To consequently implement and control the "Actions after Forest Fires in Natural Forest Concessions" catalogue and the related government regulations. Revise the long term management planning of the fire affected natural forest concessions and connect their logging permit with successful rehabilitation activities. Develop and implement standards and procedures for monitoring and control of salvage felling and rehabilitation activities at the operational level (this could be linked to certification/third party auditing)
4. To stop the illegal cutting of living trees in burnt salvage felling areas to support natural regeneration and successful rehabilitation
5. To develop financial support schemes for large scale rehabilitation activities. Rehabilitation in non-salvage felling areas (where no additional income from harvesting of dead trees can be obtained) will only take place if financial support and investment security is granted
6. To ensure replanting of plantation areas before issuing new land clearing permits
7. To establish a fire management, prevention and fire information system (including early warning) at the regional as well as on concession scale. Most important is fire prevention based on a participatory approach which includes all stakeholders potentially affected by fire and improvement of fire management skills at all levels of fire users. This means support for efforts towards Integrated Forest Fire Management (IFFM) through all involved forestry and regional departments. Finally, establish a consistent land-use policy which includes considerations of fire and smoke management.

Conclusion

The Indonesian government has issued a number of good directives to support SFM after the 1997/98 fires, however, these came rather late and are lacking a comprehensive approach, which would match with the magnitude of the catastrophe that has hit forestry in Indonesia. The process is ongoing. SFMP and IFFM did quite effectively assist in related surveys, provided practical experience and contributed substantially to policy formulation. SFMP has recently been asked by MoFEC to contribute further, specifically to formulate and test practices of natural forest management and procedures how to involve local population in an equitable way. Both the projects already assist implementation "in real life" on large scale in the model concession (100 000 ha), which aims at forest certification in the year 2000. The two projects also promote improved land use planning instruments and procedures through a separate project component in cooperation with the Government of East Kalimantan (a *Public-Private-Partnership* [PPP] with Daimler-Chrysler/Dosar to use latest radar technology for land use and forest planning is on the way).

Howsoever important mere policy formulation and planning may have been as a foundation for further action, the present main challenge for the government lies in the implementation of the programs, e.g. to rehabilitate huge devastated forest lands in an economically, socially and ecologically sustainable way. This includes the creation of required institutional and financing facilities. SFMP and IFFM, therefore, should further offer assistance to identify and remove such constraints which presently still stand in the way of policy implementation to become more effective.

References

Hoffmann, A. A., A. Hinrichs, and F. Siegert. 1999. Fire damage in East Kalimantan in 1997/98 related to land use and vegetation classes: Satellite radar inventory results and proposals for further actions. SFMP-IFFM Doc. 2/99.

Daryanto, H., J. Huljus, and A. Hinrichs. 1998. Actions after forest fires in natural concession areas. SFMP Doc. 11/98.

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Fire in Indonesia and the Integrated Forest Fire Management Project – IFFM

Fire in Southeast Asia's Forests

Fire is a naturally re-occurring phenomenon which significantly affects many of the world's ecosystems, including forests. However, the role which fire plays here, its causes, and the time between one outbreak and the next are quite varied.

In Asia, for example, there are fundamental differences between the fire-related problems in India, China, Korea, Mongolia and Siberia on the one hand, and South-East Asia on the other. Indonesia, Malaysia, Myanmar, Laos, Cambodia, Vietnam and Papua New Guinea are experiencing ever greater problems with uncontrolled forest fire outbreaks. Until a few decades ago, fire was a very rare occurrence in the perhumid tropical rain-forests. With the exception of Thailand, the countries of South-East Asia therefore had no reason to develop either preventative measures or fire-fighting strategies to cope with uncontrolled fires. However, increasing access, use, settlement and transformation of forests have led to fire causing more and more damage in conservation and in sustainable use, and also to the region's natural resources. Human activity and regular dry periods, together with the El Niño-Southern Oscillation (ENSO), are now forming a "hot mix" which has led to devastating forest fires, particularly in Kalimantan (Borneo) and Sumatra. Moreover, long-term climate prognoses assume that El Niño-related phenomena will become both more frequent and more severe. A feedback effect is also to be expected, caused by reduced evapotranspiration in the shrinking natural forests, since a significant proportion of the precipitation in tropical rain forests is generated *in situ*. This is having an increasing affect on the Asian mainland. The problem is anthropogenic, and the current worst case scenario is the "savannization" of the whole of Southeast Asia.

Key connected factors causing fires in land and forest use:

* The opening up and exploitation of forests to serve the wood industry is an important factor in that potentially, the canopy can be opened up temporarily. This considerably reduces in the forest's ability to withstand dry periods. In addition, the remains of trees after felling and secondary vegetation allow combustible biomass to accumulate on the forest floor. Studies conducted following the great fires of 1982/83 in East Kalimantan have shown that the areas most severely affected by fire are those where wood was cleared in the immediately preceding years. Primary forests and those less recently exploited were significantly less affected or classified as only "slightly damaged". Forests that have already burnt once are considerably more likely to be affected again and to eventually degrade into reed-covered savannahs. In Kalimantan / Indonesia, where intensive new access and wood harvesting began in the 1970s in previously undisturbed rain forests, the savannahs now cover an area of several million hectares.
* The arrival of the wood industry is followed by new settlers who use fire to clear the land for cultivation; however, these settlers often lack a traditional relationship with the forests and thus have no interest in preserving it. The form of land law practised in Indonesia to date provides the population with no incentive to preserve the forests or to protect them from fire. However, it will not be possible to control the fire problem unless the population is intensively involved and cooperates.
* Apart from this exploitation of the forests, another important factor is the large-scale transformation from natural forest to woods for industry and oil palm plantations. This is highly profitable and was until recently even subsidised by the state. The instrument of choice for doing this, although officially forbidden, is fire. Indonesia's current forest transformation programme is unrealistic without clearing by fire. This leads to conflicts with the local population over land use, which in turn are fought out with fire. Both large and small-scale land speculation and the use of fire for other purposes in the forest (e.g. illegal felling and hunting), together with carelessness and a lack of awareness of the problems complete the complex picture of a network of causes in each case.

The political situation in Indonesia has only recently made it possible to expose the underlying causes of forest fires and smoke affecting neighbouring countries which are of a deeper structural, institutional or regulative-policy nature. The experience of the last few years and numerous national and international fire management activities have already led to a basic understanding of the problem of catastrophic forest fires in this region and how to tackle it.

It has not yet been possible to turn this basic understanding into a consistent land use policy based on the principle of sustainability. Neither has it led to political changes which would promote forest conservation or involvement of the population in planning the use, conservation and control of the forests. Yet all of these are key elements in the development of an integrated long-term approach to fire management. A corresponding regional strategy incorporating the regional character of the problems and the particular difficulties facing each country – Laos, Vietnam, Myanmar, Cambodia, Papua New Guinea, etc. also has yet to be developed.

Against this background Integrated Forest Fire Management (IFFM) project, an Indonesian-German joint venture supported by the German Agency for Technical Cooperation (GTZ), intends to set up a fire management program in East Kalimantan which not only deals with the symptom fire, but also tries to address the deep-rooted problems that cause fire to occur.

IFFM Project Description

General

The total lifetime of the IFFM project is nine years (1994-2003). During Phase I (1994-1997) of IFFM, an appropriate level of fire protection, training needs, suitable equipment, necessary fire intelligence, institutional and structural support were all evaluated and determined in a pilot area. Cooperation with relevant government agencies and timber concessionaires has been ongoing. At the village level, socio-economic studies have been carried out to elaborate a concept of community-based fire management and to organise volunteer fire response crews. Fire prevention material has been produced to raise public awareness.

Since the second phase, the scheme determined in the *Bukit Soeharto* pilot area has been replicated in other areas of East Kalimantan / Indonesia. Local fire centres at all the ten *Cabang Dinas Kehutanan* (District Forest Offices) as well as the Kutai and Kayan Mentarang National Parks are being established and equipped, and personnel at all levels trained to prevent and respond to wildfires. These local fire centres will form the core of a fire management system for the province. The Provincial Fire Center in Samarinda, located at *DINAS Kehutanan*, will coordinate fire management activities in East Kalimantan. It will collect information from the local offices, provide fire intelligence (fire hot spot locations, fire danger rating, radio communications) and coordinate the sharing of equipment and fire-fighting personnel between fire stations.

Equipment and Fire Operations

The fire equipment provided to the provincial fire center and the 12 local fire centers through a grant of Kreditanstalt für Wiederaufbau (KfW - the German Development Bank) includes roughly 5 000 hand-tools (*Pulaskis*, fire shovels, rakes, swatters), 2000 back-pack pumps, 52 portable high-performance power pumps with 1 300 lengths of hose, 50 jeeps (24 equipped with slip-on pumper units, 26 crew carriers), 26 trail bikes, 4 tank trucks, safety gear for about 2 000 fire fighters, maintenance tools as well as computers, overhead projectors and other office items. The task of the GTZ advisor team is to support the counterpart agencies to set up the 12 local fire centers and train the personnel in managing fires as well as the provided fire fighting equipment. As most of the forest area is managed by concessionaires, one important activity is to strengthen their cooperation with the local fire centers as well as their own capacities to prevent and suppress fires.

Fire Prevention and Community Based Fire Management

Approximately 2 000 hand-tools and 1 000 back-pack pumps have been allocated to equip village fire response crews during the course of the project implementation. But of course this part of the job is not done simply by providing equipment to villagers. Deep-rooted problems like land use conflicts, land speculation and lack of interest or awareness to protect the forests are behind much of Indonesia’s fire problem. Here the way must be set to overcome these problems. The fire prevention and community based fire management programme is planned to extend to all areas, focussing on the most fire prone parts of East Kalimantan. It includes village awareness campaigns, fire prevention and suppression training, school campaigns, leaflets, *Si Pongi* comic books, stickers, posters, hats, shirts and other items that are used to spread the prevention message. For about a year, the famous Indonesian TV Star *Kak Seto* has cooperated with IFFM to help raise the awareness of children and adults alike about forests and forest fires.

Fire Information System

The fire management system introduced by IFFM for the province of East Kalimantan further includes a GIS based Fire Information System (FIS) in the Provincial Fire Center in Samarinda. An Early Warning System based on El Niño predictions, a simple Fire Danger Index and real-time satellite monitoring by NOAA AVHRR imagery are substantial parts of the system. In the meantime ERS radar satellite data (vegetation cover maps, burnt scar maps) have become part of this system together with digitized base maps and GIS layers showing infrastructure, fire hazard, transmigration sites, timber concession and estate crop boundaries. It has now become possible to directly assign “hot spots” to the responsible land-users all over the province. The Fire Information System is expected to provide all the necessary and appropriate information flow between the field-, district-, provincial- and national levels for a more effective fire management in the future.

Further contributions of IFFM include:

- M.Sc. / PhD scholarships in Fire Management for University lecturers and Forestry Officials at Universities in Australia and the USA
- Training of fire fighters (training of trainers) in USA and Australia
- Study tours for policy makers to USA
- Production of training guidelines and fire management guidelines for concession and plantation companies prepared and soon to be published in cooperation with the *Forest Fire Prevention and Control* (FFPC) project in Sumatera (sponsored by the European Union).
- Support timber concessionaires in the field of fire management in general and more intense cooperation with one partner concession in East Kalimantan in conjunction with the GTZ *Sustainable Forestry Management Project* (SFMP).
- Production of fire prevention TV spots in cooperation with EU

Fire Policy

Exposing and discussing the underlying causes and important problems concerning forest and land fires in Indonesia with the concerned agencies has been a substantial activity of the project. Fire is only the symptom of poor and unsustainable land use practices. Another challenge is the confusing number of government institutions that claim responsibility for fire management. The most pressing issues to be addressed by policy makers are:

1. stop conversion of natural forests into plantations
2. stop illegal logging, which is frequently backed by all too well-known people
3. start solving land tenure problems
4. set the course for a forestry policy that creates an interest of the local population to protect the forests and raise the awareness of the public and the media
5. Assign clear and feasible responsibilities in fire management
6. enforce the law which will only become possible by raising the salaries of public servants
7. improve the poor performance in most of the timber concessions in sustainable forest management and adjust (reduce) the annual allowable cut in forests, particularly to adapt forestry planning after the fires
8. develop a binding fire management concept for concession and plantation companies

The Fires in East Kalimantan 1998/99

All the activities to contain the 1997/98 fires were rather pointless, simply because someone wanted these fires to burn. Large and small scale, legal and illegal forest conversion, land use conflicts, illegal logging, hunting with fire and land speculation were the main causes of these fires. The poorly managed and heavily logged forests had become very prone to fire. In East Kalimantan, unlike the other provinces, the drought was four months longer and continued until early May 1998. There the fires became real wildfires and consumed virtually everything from virgin forests to plantations. Again, like during the 1982/83 El Niño event, East Kalimantan was the area worst hit.

A comprehensive evaluation of the 1997/98 fires was made by IFFM combining NOAA and ERS radar satellite data. This new technology proved extremely useful and precise, as radar penetrates clouds and smoke. The results include the total area burnt in East Kalimantan with different damage classes and the type of forest or vegetation burnt. The burnt area and damage classes have also been calculated for every single concession company. One quarter of the province (5.2 million hectares) was torched by the flames. Of this close to 3 million hectares were forests. The results differ considerably from the officially released figure (550 000 hectares of burnt forest). Data and maps of this investigation have been handed over both to the Provincial Government and the Ministry of Forestry and Estate Crops.

The Governor of East Kalimantan in accordance with the then Minister of Forestry wanted to stop both GTZ supported projects (IFFM and SFMP) to further spread those data. Meanwhile hopes that after the fall of the Soeharto regime, things might turn to the better in Indonesia's forests have not been fulfilled. The race to cash Indonesia's remaining forest reserves has got completely out of control. Only substantially increased internal (by NGOs) and international pressure can help to slow down this process again.

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Integrated Fire Management: The Mongolia Experience

Introduction

After a grueling 14 hour drive across seemingly endless expanses of rolling steppe, we arrive at our destination – the outskirts of a small town in northern Mongolia. The temperature is –20°C with stinging winds blowing out of the Northwest at 30 knots. Our small team of eight people is greeted by an even smaller contingency of fire fighters – four men on horseback equipped with wet rags and blankets as their only tools. It is early spring 1998, the beginning of the fire season and we have just arrived at the scene of the first fire in the region. It is also the starting point for the German funded Integrated Fire Management Project. The goal is to develop a fire management concept for one of Mongolia's largest protected areas and its surrounding communities.

The scene we witnessed that spring morning is common, but the fire is earlier than normal. Following a general trend in Asia, fire seasons in Mongolia are starting earlier, lasting longer and are more intense. Recent seasons have highlighted a drastic increase in wildfires. Available statistics indicate that historically an average fire season affected 1.74 million hectares of forest and steppe annually. From 1996 to 1999, more than 30 million ha have gone up in smoke - in four short years, an area larger than Holland or about half the size of France.[1] Some of the hardest hit areas have been the taiga forest regions in the north.[2] In the last four years, more forested areas burned than were harvested in Mongolia over the last 65 years.[3] The brief growing season and low growth capacity of the trees means that these forests may take 200 years or more to regenerate.

Background

Mongolia has two fire seasons – a spring fire season (February to early June) where all fires are human caused, and a short, less intense fall season (September to late October) again entirely human caused. At least 90% of all fires occur during the spring. Lightning strikes during the summer season (when most precipitation falls) can cause fire, but are rare and result in minimal loss. Major fires occur in the steppe zones, the mountain forest steppe transition zones and the primary forested area-the taiga. In the mountain forest and steppes, grass dominates the south slopes while Siberian larch (*Larix sibirica*), Siberian and Scotch pine (*Pinus sibirica* and *Pinus sylvestris*), and White birch (*Betula rotundifolia*) dominate the north and eastern slopes. Fanned by strong spring winds, fires spread quickly in the steppe. Devastating stand replacement fires are common in both the mountain forest steppe and taiga forests.

Until recently, a branch of the military known as the Civil Defense centrally managed fire events in Mongolia. The military maintained all training regimes, equipment, and personnel with virtually no support to local communities. With the transition and associated economic difficulties, this centrally managed fire fighting system has collapsed.

Perhaps the single most important contributor to the *increase in fire spread* is the grounding of the Aerial Patrol Service. In 1969 the Mongolian Fire Protection and Aerial Patrol Service was established to provide early detection and rapid initial attack on fires. The program was a Soviet style aerial detection / airborne firefighting program staffed with 200 to 300 smokejumper / helicopter rappellers and a fleet of helicopters for helitack and tactical aerial support. The aerial forces operated out of seven bases distributed throughout the fire prone regions of northern Mongolia. Smokejumpers on routine aerial patrols detected a high percentage of the fires and handled approximately 90% of the suppression workload. In the early 1990s, when the communist government and Soviet financial support abruptly disappeared, the Mongolian aerial program took a nosedive. At present, Mongolians cannot afford to maintain and fly their aerial patrol aircraft. Instead, they must rely on NOAA satellite imagery as their primary early warning system with a spatial resolution of 1.1 km^2. The decline of the aerial program through the mid-1990s resulted in the creation of a "fire suppression void" and no doubt greatly contributed to the horrendous fire losses experienced in the 1996 and 1997 fire season

The *increase in the number of fires* is related to the opening of markets once highly controlled or restricted. The vast majority of fires are not deliberately set to clear land. Rather, it is a function of carelessness. One example is the collection of elk antlers for sale to European and Chinese markets. During the previous regime, a single, state run enterprise managed this market under strict controls and guidelines. Today, it is open to virtually anyone. Fires start for three reasons: (1) collection starts in the bitter cold of February where fire is simply a survival tool; (2) sparks fly from vehicle exhaust pipes driven into remote forests; and (3) tracer bullets left by the Russian military have entered

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[1] 1996 – 10.7 million ha; 1997 – 12.4 million ha; 1998 – 3.9 million ha; 1999 – 3.1 million ha

[2] Forest fire coverage 1996 – 2 363 600 ha.; forest fire coverage 1997 – 2,710,000 ha. (Report by Erdensaikhan)

[3] Approximately 8.1 percent of Mongolia is forested (17.5 million ha) the vast majority of which is inaccessible

the game hunting market and are used to hunt elk for the blood antlers which have a higher value on the market place.

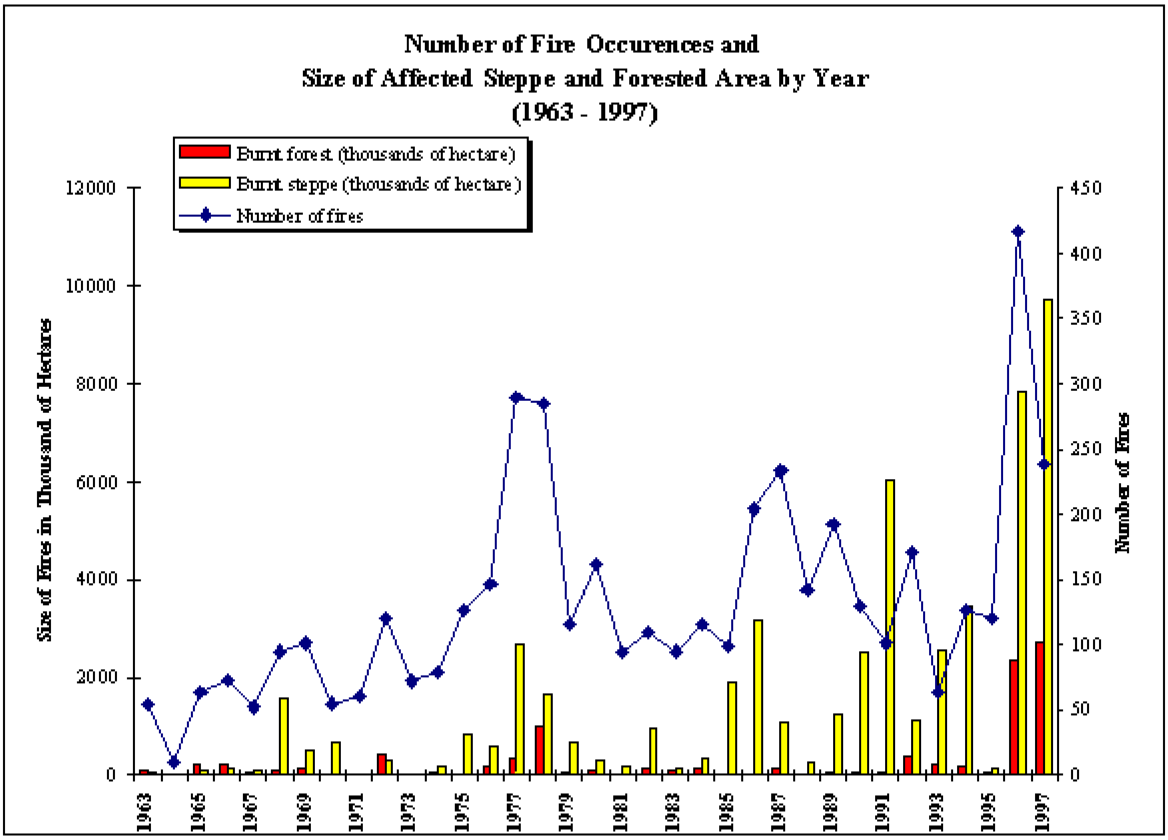

Fig1. Wildland fire statistics (forest and steppe ecosystems) for Mongolia, 1963-1997

Innovative Solutions – an Integrated Approach

Assessment of the devastating 1996 and 1997 fire seasons highlighted the need for decentralizing fire management including the development of locally organized handcrews and implementation of an aggressive grassroots fire prevention / fire fighting program. In February of 1998, the German and Mongolian governments signed an agreement to start an Integrated Fire Management Project to be implemented over the next three years. The priority target areas selected were the buffer zone *Soums* (districts) surrounding the south-end of the Gorkhi-Terelj National Park and Khan Khentii Strictly Protected Area, an area hard hit by the 1996-1997 firestorms.

Defining Integrated Fire Management

Integrated Fire Management, like other community-based programs, focuses on flexible, pragmatic approaches designed to support local people's role in resource management. Specifically it entails the application of the art and science of modern wildland fire technologies and practices to the local fire problem – i.e. the community level.

Fire management is most effectively broken down into three discrete components: (1) *prevention*, (2) *pre-suppression*, and (3) *suppression*.

1. **Prevention** includes all measures that help prevent the outbreak of fires or help the reduction of the fire severity and spread. A comprehensive fire prevention program uses all three elements of education - engineering and enforcement to reduce risk, hazards, and exposures. Education and enforcement programs target risk while engineering targets hazards and exposures.

2. **Pre-suppression** is typically defined as the actions and activities needed to ensure suppression organizations are fully prepared for any required wildfire suppression measures. The central focus of pre-suppression work is the management planning and GIS-based mapping.
3. **Suppression** refers to the activities and actions involved in controlling and extinguishing unwanted wildland fires, including the establishment, training and equipping of fire management units.

The sustainability of this kind of fire management program depends on four factors:

1. Development of methods which focus on the practical capacity of local communities and seek to integrate component activities for fire prevention, pre-suppression and suppression.
2. Development of mechanisms for inter-institutional cooperation between and among all involved and/or affected organizations and individuals
3. Laying the groundwork for effective coordination prior to and during fire events
4. Establishing a framework for appropriate oversight at the national level to integrate the above mentioned components (common goals and activities) as well as to standardize administrative procedures, training programs, strategies, tactics, material and equipment

Local Community Capacity Building

To date, the focus of the IFM Project has been capacity building at the local community level. Using participatory methodologies such as PRA (participatory rural appraisal), participants identified specific activities for prevention, pre-suppression and suppression components.

Fire Prevention

In the development of the program, the IFM Project started with the philosophy that an ounce of prevention is worth a pound of cure. Hence, the most effective fire suppression strategy is an effective fire prevention program. In the summer of 1998, the IFM project began pilot activities in the buffer zone communities surrounding the Khan Khentii Special Protected Area. Specifically targeted were the potential multipliers including, Information Training Center (ITC) "extension" officers, educators, protected area rangers, key community persons. Together with them a number of education materials have been developed and introduced including: (1) a fire prevention curriculum for school children; (2) a fire prevention video; (3) a ranger's handbook to be used as an outreach tool in remote areas; (4) a coloring book for small children; and (5) a fire mascot to carry the prevention message.

Pre-Suppression

The central focus of pre-suppression work has been the drafting of a fire management plan for the protected area administration and local communities. Planning, however, is hampered by history. The planning process was a form of strict control. All plans were in essence a promise to perform. Failure to fulfill the objectives could be dealt with harshly. Managers are naturally tentative when it comes to spelling out activities and tend to convert planning documents to long-winded descriptions of the problem or resource. To overcome these difficulties, the project has worked to redefine the Fire Management Plan as a "Management Guideline" allowing managers to treat the document with the necessary flexibility.

To support pre-suppression activities, the IFM Project has engaged in a comprehensive fire management mapping effort. In an initial stage, NOAA-14 satellite imagery has been compiled to show annual fire coverages with overlays on forest types. In a second phase, the project helped to design fire risk, hazard and danger maps at a scale of 1:100 000 for the entire region. Further development of these maps is in progress.

Suppression

Suppression goals include (1) the establishment of fire management crews, (2) provision of equipment and (3) the development of a locally run "Fire Training Program" customized for Mongolian conditions-its fuels, fire behavior, available suppression resources, and logistics. In the spring of 1998, six Soum (district) governors in the protected area buffer zone formed fifteen-person (15) fire management units (FMUs – or suppression crews) for their respective Soums. The crew consists of a crew boss, assistant crew boss and thirteen unemployed volunteers. The crew is jointly managed through a Memorandum of Understanding between the local community and the protected area administration.

After establishment of the crews, the project identified equipment to match the fuel conditions. Fuel conditions throughout Northeastern Mongolia closely resemble the fuel types of the western United States, British Columbia and interior Alaska-tough steppe grass with deep dense roots, brush, larch, pine, spruce, birch, moss and muskeg like valley bottoms. GTZ equipped the crews with fire swatters, fire shovels, *Pulaskis*, Adze Hoes, fire rake (*Council* type), backpack pump, crosscut saw, a chainsaw and hardhats. Each crew has been equipped with personal portable radios, a vehicle mobile radio and mobile repeaters for communications with the dispatch center. Stationary repeaters are being installed to link the Soum dispatch centers with the national coordination center in Ulaanbaatar.

Starting in March 1999, the project assisted Mongolian fire specialists in developing a series of training materials including a 32 - hour Basic Firefighter Course with accompanying Instructor's Manual, Student Workbook, training videos and Crewboss Manual. The training programs were adapted from existing Mongolian training and the basic courses used to train American wildland firefighters-Introduction to Wildland Fire Behavior (S-190) and Firefighter Training (S-130) and basic Incident Command System concepts. Approximately one half of the course was conducted in the field, including “live burns” for mop-up and a final day live fire exercise. Crews were instructed in the bump-up progressive crew method of fireline construction. A fire instructor’s training course for Mongolian instructors followed this. In a subsequent phase, we observed and coached Mongolian instructors as they trained “rookie FMU crew members” and community (Soum) fire support crews. Due to unusually high precipitation during the winter, however, the project has been unable to evaluate crew performance on fires.

Inter-Institutional Cooperation

Effective resource management requires inter-institutional cooperation in part due to overlapping responsibilities, but also because of the need to share institution or agency resources. This is even truer with fire because, (1) fires can occur anywhere the right conditions exist and (2) unlike some resources (such as forests), fire moves - and its devastating path affects everyone as it inflicts damage to soil, water, wildlife, vegetation, air quality and human beings.

Mongolia has recognized the need for a pluralistic approach to fire management in legislation, however mechanisms for inter-institutional cooperation have not yet been clearly defined. Most actors, particularly in the rural locations where the project is active, remain cut off from regional and national level resources. The IFM Project is assisting with the first moves in the arena by helping to establish cooperative agreements between the protected area administration and local governments for the joint management of the established fire management units. These agreements however are relatively simple in form and function and do not encompass regional or national level agencies.

Effective Coordination

Fire events are life threatening and without proper coordination in the field can be unnecessarily dangerous. It is, therefore, imperative that coordination be spelled out as part of normal planning activities. Several countries achieve this through the Incident Command System. It is essentially a military concept of organization, adapted for disaster management - fire, floods, earthquakes, etc. The organization expands or contracts depending on incident size, needs or complexity. If all the components are in place and everyone is playing the game, the incident is handled efficiently. It is designed to be inter-agency or single agency / small fire or major widespread firestorm. All participating agencies are trained to work together, often on the same team, sharing the resources needed to get the job done. Essential ICS components include:

- common terminology (equipment, strategy/tactics, standards etc)
- modular organization with five functions - Command, Plans, Logistics, Finance/ Administration and Operations (the firefighters)
- Integrated communications
- Unified command if multi–jurisdictional
- Consolidated Action Plan for each work shift

* A designated “span of control” (3 -7 per supervisor)
* Designated incident facilities
* Properly trained and equipped disaster specialists (firefighters)
* Resource management (continual accountability for all resources)

National Oversight

In a decentralized fire management environment, the need to maintain oversight remains. This does not mean direct involvement in implementation, but rather the development of policies, norms, guidelines and procedures that are conducive to or supportive of the initiatives taking place at the regional and sub-regional levels. At a minimum, it means (1) creating an open forum for discussion (open-door policy making) inclusive of all stakeholders, (2) compiling, analyzing and distributing information which support informed decisionmaking, (3) standardizing procedures and practices, and (4) continuous monitoring, evaluation and improvement of existing policies. Without this oversight, fire management initiatives at the community level risk becoming an island solution with little chance of replication in other areas.

Mongolia has recently taken significant steps in this direction through the establishment of a Fire Management Agency. Pursuant to newly enacted legislation, the Mongolian Civil Defense and State Police will transfer their responsibilities to the new agency including associated resources (personnel, budget, and equipment).

Conclusions

After a short two years of project life, it is still too early to claim the successful development of a comprehensive model for integrated fire management.

Areas of particular concern are:

* **National Oversight –** Appropriate oversight will be required (1) to ensure quality control and preparedness; (2) to help with the standardization of training, procedures, and safety; (3) provide technical assistance and specialized training; (4) to facilitate cooperation/coordination between agencies; (5) to evaluate training and determine need for additional training; and 6) to determine fire management program needs.
* **National Level Training Center** - Mongolia has a major and complex fire problem. Only a handful of fighters has received basic fire training. To effectively fight complex and large fires requires training beyond the basic level. Wildland firefighters in developed and some undeveloped countries take several higher courses that are more specialized. Large and complex fires require a higher level of understanding of fire behavior, strategy and tactics and organization. ICS requires multi agency training of ICS principles.
* **Coordination and Cooperation –** A challenge remains the coordination of management planning with other institutions and agencies responsible for fire management at the regional and national levels. The project has not had sufficient time to adequately address this need. Nevertheless, experiences tell us that this kind of coordination is an integral part of the decentralization process in Mongolia and will require profound changes at all levels of affected government.
* **Communications System -** All interagency team members need a common radio system - one they can program to an incident fire frequency. All agencies should be linked to local and regional dispatch centers.
* **Early Warning Systems** - Faster detection means smaller fires, a need for fewer firefighters and greatly reduces expenses associated with firefighting. A system of staffed observers, ground and air, would significantly increase detection capability and significantly speed up fire crew attack and containment time.

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Bushfire Management in Sénégal

Context

Bushfires represent, like in other Sahelian countries, a major reason for degradation of forest resources.

Forest fire statistics of the Forestry Department (DEFCCS[4]) that cover the territory of the country of 196 722 km^2 show a high occurrence of fires. However, daily monitoring of fires by NOAA-AVHRR realised by the *Centre de Suivi Ecologique* (CSE) in Dakar provides a full coverage by recording all fires that have affected an area of more than one square kilometer. Table 1 shows the fire statistical data for the years 1993 to 1999. It must be noted that most of the fires of November and some of the fires of December are *early burning* operations.

Strategies and national policy in Senegal

The forest resources protection against bush fire is one of the major concern in the national Policy (*Plan d'Action Forestier du Sénégal*).The necessity of population involvement has been recognised for several years. A training program on participatory appraisal techniques has been given to the forest guards. However, the involvement of the population is still low.

Since 1997, natural resources management has been transferred to the local communities by the laws within the general frame of *Regionalisation*. But the new tasks of the administration and the communities are still not very clear to the population and their involvement is consequently low.

The forestry department provides two operational strategies:

1. Preventive actions
   - Extension/training : meetings at regional and local level, rural radio broadcasts
   - Rehabilitation and maintenance of firebreaks: 2 724 km carried out by the army, populations, projects and forest service in 1998-99 (828 km in 1997-98)
   - Equipment of firefighting committees
   - Early burning: 887 000 ha in 1998-99 (2 001 400 ha in 1997-98)
2. Active fire fighting
   - Based on the mobilization of the population who fight fire with branches, water basins and machetes. In the zones where fighting committees exist, small equipment is placed at their disposal (rakes, machetes, fire beaters, shovels, buckets, backpack pumps...). The forestry service intervention units, had been equipped with heavy machines, but now those machines are useless.

[4] Direction des Eaux et Forêts, Chasse et Conservation des Sols

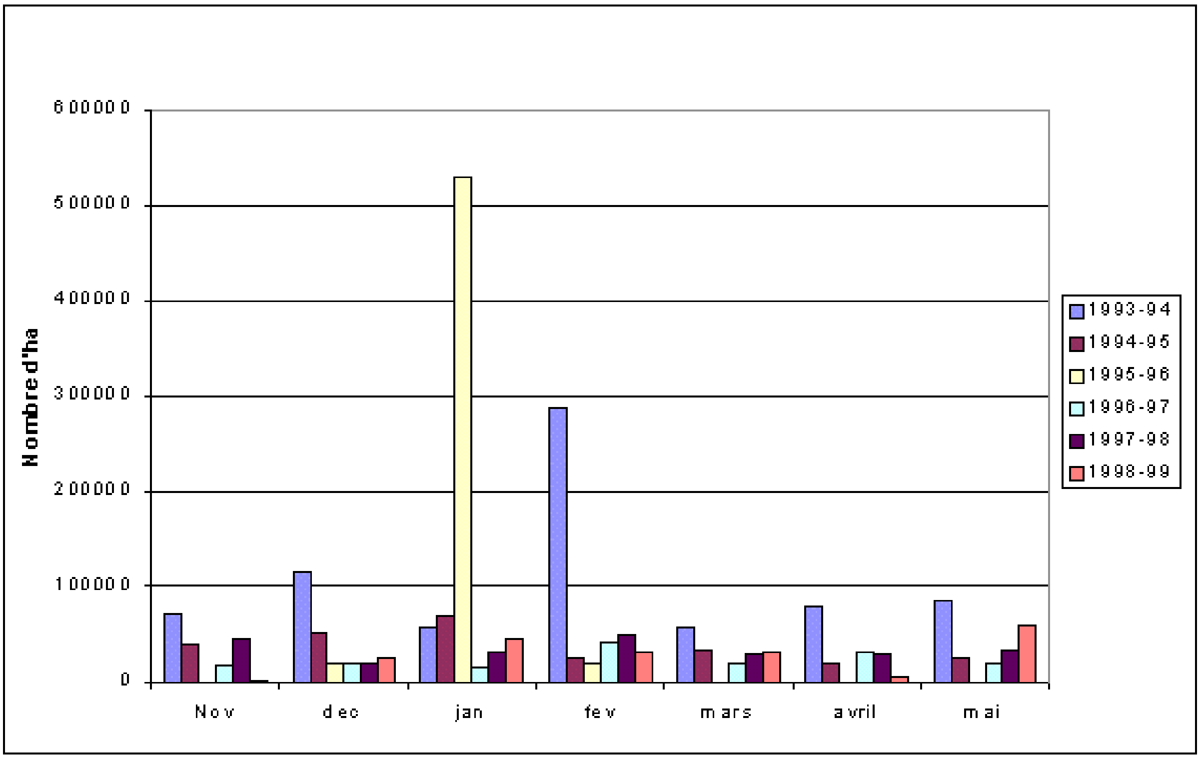

Fig1. Monthly monitoring of burned areas in Sénégal between 1993 and 1999

Considering the limited intervention capacities of the forest service and high costs related to the active fighting, the prevention is privileged. The regional forestry action plans mention the creation and revival of bush fire fighting committees as a priority and the presidents of the Regional Councils were invited to coordinate the actions of prevention through the regional *cadre de concertation*.

Experiences of bush fire fighting program and their assessments

Since 1973, with his partners in development (Canada, Argentina, Germany, France, United-States, African development funds, Japan, Sweden, and the World Bank) the government of Senegal has initiated significant programmes against bush fires. These programs involved the utilisation of heavy machinery and the mobilization of important human and material resources in order to create village committees.

A thorough study of the PROGEDE[5], undertaken in May 1999 by the CSE, made a very mitigated assessment of these programs summarised hereunder :

- Persistence of fires which shows their limited effectiveness
- Impossibility of defining one single strategy because of the eco-geographical diversity
- Fight with heavy machines is not viable, maintenance and operating costs are too high
- Fight with heavy machines inhibits the initiative and the mobilization of the population
- Limited participation of the population who still believe that the State has total responsibility in protecting the forests (shows also limited effectiveness of extension work)
- Durability of the committees not effective after project time
- Mistrust related to the deficit of implication of the decentralized services

[5] Programme de gestion durable et participative des énergies traditionnelles et de substitution - Banque Mondiale

In conclusion, one can say that the interest of the population to protect the forest resources was never considered thoroughly enough in these programs.

The *Centre de Suivi Ecologique* as alarm system operator

As speed of detection and intervention are the key to effectiveness in fire fighting, the CSE could be an important actor. Indeed, the CSE sensor receives twice a day information from the AVHRR instrument on the NOAA satellites. The daily process of the information from the three channels through the thermal infrared sensors make it possible to detect fires even at sizes below the resolution of the sensor (1km x 1km). The use of this information for operational fire fighting is unfortunately not yet explored. A closer cooperation in this field could be developed between the DEFCCS and the CSE to set up a real alarm system.

Importance of fires in the management of the household energy sub-sector

If we consider that the maximum offer is equivalent to the national annual wood productivity of Senegal, between 8.6 and 13.35 million m^3 (according to different studies) could be available. On the other end, the household energy consumption for food cooking is estimated at 4.8 million m^3 (including 3 million m^3 for charcoal production). The annual fellings of timber and construction wood are lower than 100 000 m^3. Notwithstanding that fact forests deteriorate each year in both quantity and quality, the principal causes being the agricultural clearings, the pluviometric deficit and the bush fires.

It is extremely difficult to evaluate the incidence of each one of these factors and thus to develop the most efficient strategies. To satisfy the population needs of energy without touching the "forest capital", most of forest growth should be saved for that purpose.

Moreover the women, who are the most concerned with the household energy supply, experience more collecting difficulties due to repetitive fires. Several studies show that without fires a fair amount of deadwood can be collected and the surplus is even sold (some women got a monthly profit of 25 250 f CFA in the Gambia).

Modeling as decision-making aid

The household energy sub-sector is a complex system with many interrelations. Its management is more difficult since people react differently to the policies practised by the Government.

Good strategy development passes by the simulation of the effects of the measures and regulations suggested. The *Project Sénégalo-Allemand Combustibles Domestiques* (PSACD) proposed, jointly with the University of Stuttgart, a tool for decision-making that makes it possible to model the system. It uses consensual databases.

The model of the loss of volume of the burned surfaces related to the bush fires is available. Table 1 hereafter gives the bases of the model. The statistics of the burned surfaces and the average risks during the year are available for simulations.

The table gives for example in a savanna woodland a lost per ha of 1.16 m^3 of wood (4.5% of 25.72 m^3) when a bush fire occurs in January.

Current strategic orientations

Bush fires fighting cannot succeed without the help of the population. Their interests, compatible with the general interest, must give rise to a strategy. At this end, a progressive appropriation of the forest resources by the bordering villages is encouraged in order to promote the initiatives of protection and rational management of these resources. The motivation of the population will gradually rise to autonomous management. As an important precondition to that, the population will need guarantees to use freely and unhindered the products without any risk of intervention of the administration, favouring thus external operators.

Tab.1. Estimation of the proportion (%) of wood volume (m^3/ha) burned by bush fires in the different month

Months	**Shrub Savanna**	**Tree Savanna**	**Savanna Woodland**	**Open Forest**	**Dense & Gallery Forest**
November	5.0	4.0	3.0	1.0	--
December	6.0	4.5	4.0	2.0	--
January	7.0	5.0	** 4.5	** 2.5	--
February	8.0	6.0	5.5	2.5	--
March	10.0	7.0	6.0	3.0	2.0
April	12.0	8.0	6.5	3.5	3.0
May	14.0	10.0	7.0	4.0	4.0
June	10.0	8.0	** 7.0	4.0	4.0
Mean standing volume in m^3/ha in 1980*	**2.85**	**7.70**	**25.72**	**57.63**	**138.28**

** based on the estimations of Piot, A. Ly, I. Gueye (1991) and pondered by the surfaces of DAT/USAID, 1985*

*** based on permanent sampling plot monitoring in different Gambian forests installed by the author in 1989 and followed until 1995*

A standard agreement was approved in August 1999 by the DEFCCS, and is implemented in the pilot zones of intervention of three GTZ projects in the areas of Kaolack (PSACD, PAGERNA) and Kolda (PSPI). This agreement marks the beginning of official recognition of local resource management rights which will eventually anchor the dynamics of safeguarding forest resources.

Bibliography

Actes de la journée de réflexion sur les feux de brousse du 26.11.99, Tanor Fall DEFCCS

Comptes rendus des échanges avec l'Institut des Sciences de l'Environnement, l'ORSTOM et la Division Protection des Forêts de la DEFCCS, Yanek Decleire PSACD, 1999

"Analyse de l'état actuel du système d'information sur le sous-secteur des combustibles domestiques", PSACD/Programme Energie ENDA, PSACD sep.1996

"Etude diagnostic sur les feux de brousse dans les régions de Kolda et Tambacouda – Stratégies alternatives", PROGEDE/BM, CSE, mai 1999

"La foresterie communautaire, nouvel outil de la politique forestière en Gambie" rapport de stage sur l'analyse de la contribution de la foresterie communautaire à la préservation de la ressource forestière, à la satisfaction de la demande nationale en bois, et au développement rural, ENGREF/GGFP, Pascal Vardon, déc. 1998

"Bushfire damage monitoring", Gambian German Forestry Project, DFS/GTZ, G. Provost, 1995

"Plan d'action Forestier du Sénégal", 3 volumes, Ministère du développement Rural et de l'Hydraulique, juin 1993

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PART II Fire Management: "Mitigating the Impact"

Fire Damages in East Kalimantan in 1997-98 Related to Land Use: ERS-SAR Inventory Results

Background

The province of East Kalimantan was the area worst affected by the fires during the 1997-98 forest and land fires in Indonesia. The daily NOAA-AVHRR hot spot maps provided by the Integrated Forest Fire Management (IFFM) project showed that between late 1997 and May 1998 the fires affected the entire Mahakam basin, its tributaries and spread as far as the Sangkulirang peninsula (Siegert and Hoffmann 1999). Many forest concessions as well as forest and industrial crop plantations were severely affected by wildfires. In August 1998 the Sustainable Forest Management Project (SFMP) proposed an "Actions after forest fire in natural forest concessions program" to the Ministry of Forestry and Estate Corps (see Huljus and Hinrichs, this volume). As a data basis for this five-step proposal IFFM and SFMP jointly conducted on request of the Ministry of Forestry a study using ERS-2 SAR space borne radar images to disclose the size of the fire affected area for the entire province according to all land uses.

The Directorate of Forest Inventory and Land-use Planning and the two projects further agreed to develop a revised forest land use map for East Kalimantan, exposing the actual locations and boundaries of the current forest and industrial crop utilization right holders. An overlay of the radar fire survey results with the actual forest land use boundaries should reveal the fire damages for each land use. This data is intended to support the provincial agencies to revise their current land-use plan of East Kalimantan. It shall furthermore be used as basis for the implementation of correct salvage felling activities, rehabilitation measures and adjustments of the long term forest planning in each natural forest concession. Moreover, the data is needed within the IFFM Fire Information System to point out future fire hazard and fire risk zones in East Kalimantan and hence support fire management planning, prevention work and fire suppression (Hoffmann et al. 1999b).

Assessing the fire damages with ERS-SAR radar technology

Radar technology employs the microwave portion of the electromagnetic spectrum and can therefore penetrate clouds and haze, which hampers the usually in the tropics employed optical sensors. The radar detection process is an active process which entails transmitting short pulses of microwave energy towards the earth's surface and records the reflections received from various objects. The reflection received is the so called radar backscatter. With ERS-SAR radar the loss of biomass due to fire can be assessed by analyzing changes in the backscatter signal in a radar image before and after the fire (Hoffmann et al. 1999a, Siegert and Rücker 1999).

For the study multi-temporal radar images of August 1997 and April/July 1998 of East Kalimantan were purchased. After several calibration flights and field tests 4 damages classes were distinguished:

* 25-50% fire damage
* 50-80% fire damage
* >80% fire damage, dead woody biomass still standing
* >80% fire damage, biomass consumed

Damage class 3 was included in order to justify the conditions mostly found in the (peat-) swamp forest of the Middle Mahakam lake area where almost the entire peat swamp forest was destroyed by fire but mostly dead trees (woody biomass) are still standing. This condition provides a high future fire risk given the immense amount of fuel material remaining after the fires. Furthermore damage level 4 describes the general situation found in forest plantations and areas of already very degraded forest, bush and grassland as well as farmland.

A basic verification was done by overlaying fire locations depicted by NOAA-AVHRR between August 1997 and May 1998 in East-Kalimantan onto the ERS-SAR damage classification result. The outlined area of the ERS-2 SAR burn scar map corresponded well with the fire affected area depicted by the NOAA-AVHRR.

Furthermore a detailed verification was conducted by comparing the radar interpretations with digital video tapes taken during two further flight surveys in March/April 1999. Severe errors like if unburned areas of the video taped flight were classified as burned in the ERS-SAR image, occurred at approx. 5%. Therefore we conclude that the burned area mapped by ERS-2 radar has a high credibility and indicates even a slightly underestimate of the size of the 1997/98 fire affected area in East Kalimantan.

The land status data was gathered with the help of INTAG Bogor and BIPHUT Samarinda and digitized. Several problems arose during compiling the official data due to overlaps, gaps and inconsistencies in the official systems. The results therefore only reflect the best possible data on a provincial scale. The developed land use map was overlaid with the result of the radar burn scar assessment using a GIS in order to determine the damage level per land use right holder.

Results

The results of the ERS-SAR radar inventory showed that the 1997/98 fire was the worst ever fire catastrophe encountered in East Kalimantan. The area affected by fire totalled 5.2 million ha, equalling ca. 25% of the entire province. Almost 2.3 million ha belong to natural forest concession areas (56 concessions), 0.4 Million ha to protected forests, 0.9 million ha of forest plantations (30 concessions) and 0.7 Million Ha to industrial crop plantations. Almost 75% of the plantation areas (forest, oil palm, etc.), that were located within the 1997/98 fire zone, have been fire affected, a large number of them severely. This demonstrates the very high fire risk of all types of plantations. Table 1 shows an overview about the fire damage related to the current land use.

The Ministry of Forestry and Estate Crops received a detailed list of all fire affected areas with the names of the responsible utilization right holder. Active rehabilitation of the 2.3 million ha fire affected natural forest concession areas is mainly needed in forests with a fire damage greater than 50%. It can be expected that most of the former well stocked areas with a 25-50% fire damage will recover naturally, especially if further damage through logging does not occur. This still leaves a rehabilitation area of almost 1.6 million ha in the natural forest concessions alone. Funding (incentive systems) and investment security are the largest obstacles to be overcome before effectively starting forest rehabilitation. In 1982/83 a severe fire catastrophe had already occurred in East Kalimantan, damaging 3.5 million ha of land and forest.

Out of this 0.8 million ha was primary forest and 1.4 million ha was logged-over forest (Lennertz and Panzer 1983). In 1997/98 the area of the 1982/83 fire burned again to an even greater extent. The recent loss to forest economy is immense, considering short and long term economic losses.

Table 2 shows a simple vegetation classification of the 1997/98 fire affected area. The fires mainly occurred in the generally already logged low land Dipterocarp Forest and on open, degraded or converted areas. But also large parts of the wetlands and swamps were for the first time in recent history fire affected, since these areas had almost completely dried up due to the extreme drought.

After the 1997/98 fires the forest is much more susceptible to fire, due to degradation and accumulation of fuel and thus, at present, even during normal dry seasons it will be prone to fires. Furthermore, El Niño events are predicted to occur more frequently than in the past, creating conditions that could trigger even more, and more severe, fires in the future. Under these conditions, land use conflicts between the local people and concession and plantation owners, carelessness and land clearing using fire can easily bring forest activities to an end. Already many degraded and undefined land use areas are prone to grassland (alang-alang) cycles, where fire becomes a part of the succession cycle. Therefore fire management is a key issue in achieving the goal of sustainable forest management.

Tab.1. Overview of area burned in East Kalimantan, Indonesia, in 1997-98 related to land-use classes and damage levels

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

Tab. 2: Damaged areas after land-use and vegetation based on ERS-SAR 2 data from August 1997

Vegetation and land use classes	**Area [ha]**	**Burned [ha]**	**Burned %**
Open land, *alang alang*, bushland	368 860	292 569	79.3
Lowland Dipterocarp forest	5 379 562	2 177 880	40.5
Farmland mixed with degraded forest areas, including Forest and Estate crop plantations *	2 304 263	1 725 735	75.5
Mangrove forest	1 042 127	91 729	8.8
Shrimp ponds	57 187	316	0.6
Swamp (peat swamp) forest	426 051	311 098	73.0
Wetlands	358 750	290 432	81.0
Mountainous region, mainly highland Dipterocarp forest	3 551 826	213 194	6.0
Total	**13 488 626**	**5 102 954**	**37.8**

** Vegetation interpretation with the ERS-SAR allows no clear distinguish between plantations and degraded forest*

References

Hoffmann A. A., A.Hinrichs, and F.Siegert. 1999a. Fire damage in East Kalimantan in 1997/98 related to land use and vegetation classes: Satellite radar inventory results and proposals for further actions. With contributions from G.Ruecker, L.Christy, and B.Yuliarso. Sustainable Forest Management Project (SFMP) & Integrated Forest Fire Management (IFFM) Project, Indonesian Ministry of Forests and Estate Crops (MoFEC) and German Technical Cooperation Agency (GTZ), Samarinda, Indonesia. Report No.1.

Hoffmann, A. A., L.Schindler, and J.G.Goldammer. 1999b. Aspects of a Fire Information System for East Kalimantan, Indonesia. Proceedings of the 3rd International Symposium on Asian Tropical Forest Management, Samarinda, East Kalimantan, Indonesia, 20-23 September 1999.

Lennertz, R., and K.F.Panzer. 1983. Preliminary assessment of the drought and forest damage in Kalimantan Timur. GTZ-TAD Report, Germany.

Siegert, F., and A.A.Hoffmann. 1999. The 1998 forest fires in East Kalimantan (Indonesia): A quantitative evaluation using high resolution, multitemporal ERS-2 SAR Images and NOAA-AVHRR Hot Spot data. Remote Sensing of the Environment (in press).

Siegert, F., and G.Rücker. 1999a. Evaluation of the 1998 forest fires in East-Kalimantan (Indonesia) using multitemporal ERS-2 SAR images. Earth Observation Quarterly 61, 7-12.

Siegert, F., and G.Rücker. 1999b. Use of multitemporal ERS-2 SAR images for identification of burn scars in South East Asian tropical rainforest. Int. J. Remote Sensing 21, 831-837.

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A Fire Information System for East Kalimantan, Indonesia

Introduction

After the severe fire episodes during the El Niño-Southern Oscillation (ENSO) events of 1982-83, 1991 and 1994 a prolonged and extremely severe fire season occurred during the last ENSO of 1997-98 (Goldammer et al. 1996, Goldammer 1999). The Indonesian province of East Kalimantan was the area worst affected by the fires. The daily NOAA-AVHRR (National Oceanic Atmosphere Administration - Advanced Very High Resolution Radiometer) data received and processed by the Integrated Forest Fire Management (IFFM) Project of East Kalimantan show that by the time the rain started at the beginning of May 1998 almost the whole basin area in the district Kutai had been burned. Between February and March 1999 prevailing strong winds, combined with the effects of drought, allowed the rapid spread of wildfires into primary, logged-over and secondary forests, degraded vegetation, plantations and other land use systems. By mid March it became obvious that efforts being made to put out these fires had had only marginal effects. At that time the IFFM NOAA-AVHRR receiving station recorded more than 2 000 High-Temperature Events (HTE) (Siegert and Hoffmann, in press). The two MoFEC-GTZ projects located East Kalimantan, the Sustainable Forest Management Project (SFMP) and IFFM conducted a study using ERS-SAR space borne radar to disclose the size of the fire affected area for the entire province according to land uses. The investigations revealed that a total of 5.2 million hectares (ha) of different vegetation types had been affected by fire (Hoffmann et al. 1999).

The aim of the IFFM project is to support and build up a fire management centre which will create and command the structures that are needed to overcome the fire problem in the province of East Kalimantan. Jointly with fire prevention and suppression the IFFM project currently develops a computer-supported Fire Information System (FIS) in an attempt to prevent such fire disasters in the future. The FIS integrates fire-related data and fire information such as monitoring and detection, to determine fire danger criteria as well as data analysis and information dissemination to support fire management, prevention, suppression and policy decisions. The proposed Fire Information System for East Kalimantan contains three major parts: (1) input data (2) output data and (3) information dissemination.

Design of the Fire Information System (FIS)

The Fire Information System (FIS) is a system, that manages spatial fire-related data and information in an integrated manner. Fire information components are fire monitoring and detection, determining fire danger criteria, data analysis and information dissemination.

Input data

Static and dynamic information is used as FIS input data. Static data are exclusively those that change over a long time such as road infrastructure or topographic data. Also data which does not change weekly or monthly such as forest concession or plantation boundaries, transmigration/settlement data and additionally vegetation data belong to the static data. Dynamic data are those that change continuously like climate data, fuel conditions and fire distribution.

Some of the static and dynamic data are derived from satellite data, such as the HTE depicted by the NOAA-AVHRR and processed by IFFM for near-real time fire information and distribution as well as historical fire data (Hoffmann 1998). The Normalized Difference Vegetation Index (NDVI) derived from AVHRR data as a component of the FIS monitors the seasonal changes in living vegetation moisture and can be used to forecast the long-term seasonal trends in fire potential in East Kalimantan. Vegetation and land use system data can be obtained from Landsat TM 5 (Thematic Mapper (Roy et al. 1991, Saxena et al. 1994, Goldammer et al. 1997) as well as complemented and expanded by the ERS-2 SAR (European Radar Satellite-2-Synthetic Aperture Radar) sensor which is able to penetrate clouds and haze and provides a high spatial resolution (25 m) (Kuntz and Siegert 1999, Siegert and Hoffmann 1999). Furthermore with ERS-SAR data, burned areas, which are future fire prone areas, can be reliably discerned at a scale of 1:200,000 (Siegert and Rücker 1999, Siegert and Hoffmann 1999, Hoffmann et al. 1999).

Static data such as land use (e.g. concession boundaries) as well as transmigration/settlement data have to be taken from various agencies responsible for mapping. All data must be available in digital format to integrate them in the FIS. Simple topographic data for East Kalimantan available can be used to add information on different elevations and the resulting fire conditions.

One important aspect for preventing future fire disasters is the level of awareness which can be gained by an early warning system such as Fire Danger Rating (FDR), based on the Keetch-Byram Drought Index (KBDI) (Keetch and Byram 1968). IFFM has been working with FDR in East-Kalimantan since 1995 (Deeming, 1995). The Fire Danger Rating indicates the fire danger or dryness for a variety of meteorological conditions and is based on only a few meteorological data (see Buchholz and Weidemann, this volume).

In order to support optimal resource allocation and pre-positioning of equipment and human resources such information will be integrated to sustain mobilization planning of the local fire management centres.

Output data

The most important output from the FIS is the early warning information which at first stage comes in form of fire danger rating maps. Weather data are interpolated to generate FDR maps for the whole province of East Kalimantan (see Buchholz and Weidemann, this volume). It will be the basis information for development of fire hazard and fire risk maps.

In addition, land use as well as settlement and road infrastructure information are included to indicate fire risk zones. To a certain extent, the 1997-98 fires were started due to land speculation and large scale forest conversion into plantations. Nevertheless, also in settlement / transmigration areas fires started caused by land use conflicts, ethnic conflicts or hunting of deer and turtles as well as carelessness or agricultural activities. The AVHRR HTE distribution of 1997 clearly demonstrates that the fires from the first period were mostly along rivers and streets and thus set by farmers and accidentally through carelessness. This shows that settlements and transmigration areas play an important role and hence must be considered in the FIS to reveal fire risk areas. Meanwhile the 1998 fire disaster went out of control additionally because of large scale land clearing and forest conversion, needs this a revision of the spatial regional planning. However, towards prevention campaigns and awareness messages transmigration/settlement information assist by identification of sensitive areas were prevention measures should be focused. This will make prevention activities more effective and valuable. Beside that, land status data allows for detection of AVHRR HTE in forest concessions and plantations and is a first step towards more precise locating of fires as well as knowing where to take suppression action.

For strategic planning, having the current information about equipment and human resources at the district centres and the surrounding concessions available would optimise the resource allocation, hence mobilization of suppression activities can be efficiently and economically planned and prepared. Together with information about fire risk areas ensures this effective distribution of resources for fire management where it is needed.

Information dissemination

The most crucial and critical issue of the FIS is rapid and efficient information dissemination. Detection and monitoring information and decisions made based on the FIS should be distributed via telecommunication technology like radio, fax machine or e-mail to the district fire centres. Meanwhile monitoring results (e.g. weather data or fire occurrence) from local level can contribute to the FIS at the provincial level. This presumes a commando structure of responsibility for fire management at the provincial level. It is imperative to know who the involved parties and target groups, including number of concession holders, to build up a communication network for dissemination of fire relevant information. Figure 1 shows the possible information flow and values of fire relevant data of the proposed Fire Information System of East Kalimantan.

The supposed involved parties at the provincial and the local level as well as data quality and quantity are shown with different arrow/box structures. Since the IFFM project is implemented under the structure of the provincial forestry agencies these are the major involved parties at the provincial level. The two provincial forestry agencies (DINAS and Kanwil Kehutanan) in conjunction with IFFM processes, analyses and provides fire relevant data to the local government and more detailed to district forest fire centres (Cabang Dinas Kehutanan). This not only contains reports with e.g., fire locations derived from NOAA-AVHRR but also detailed maps of where the fire risk zone in the district are located and what the suppression capabilities are.

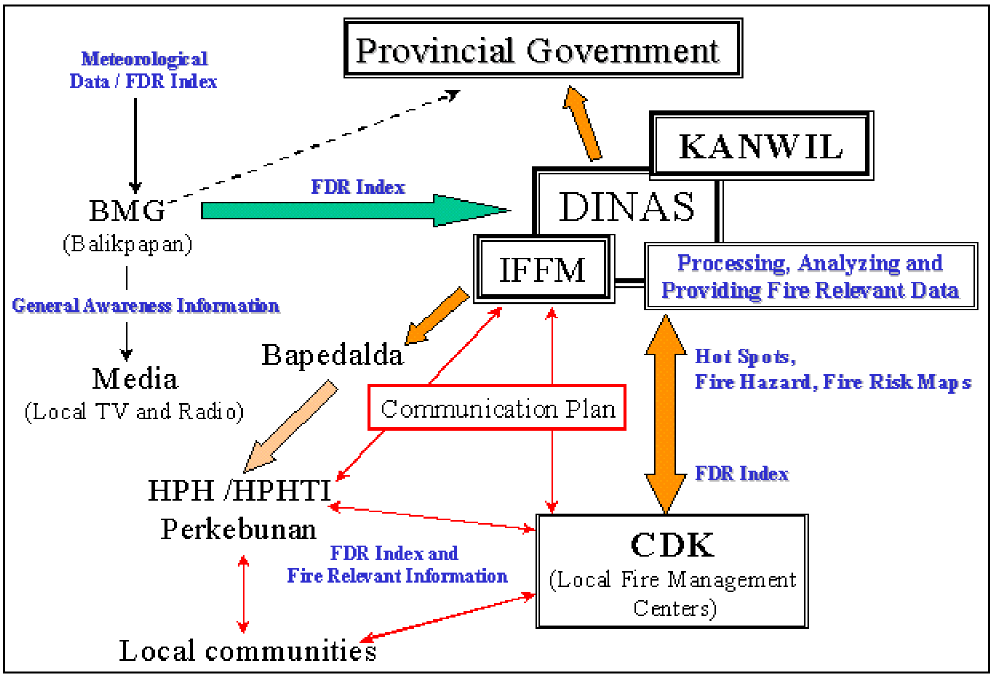

Fig. 1 Possible information flow of the FIS

In combination with the FDR information as well as the vegetation conditions fire risk information will gradually change over the year in relation to the annual natural conditions. The district fire centres disseminate the information to the local community to support the fire village crews and awareness campaigns (Abberger 1999). Additionally the surrounding timber concession and plantation companies should be involved since almost the whole province is covered by forest concessions and forest and estate crop plantations, thus having an important role to play within the fire problem. They are encouraged to calculate their own fire danger rating and to build up communication and action networks with the neighbouring companies and the local villages. Vice versa the information should flow back to the provincial fire management centre in type of weather data or rather FDR index data and fire reports. These, in conjunction with the fire management centre, are the important parties where a communication plan is needed. A communication plan contains first what kind of information is needed and secondly what kind of communication network is available to distribute the information. In consequence a proficient information network from the provincial to the local level/local communities and from there to the concessionaires and vice versa must be build up to guarantee the data flow in all direction both horizontal and vertical.

Further involved parties are the Meteorological and Geophysical Service of Indonesia (BMG) which is supposed to calculate the FDR index for all existing BMG weather stations in East Kalimantan. Furthermore e.g., BMG should transfer general awareness messages to the local TV or radio in form of simple fire danger fore castings telling messages in which areas are medium and high fire danger to point out the dangerous use of fire to the people in these areas. Moreover, the provincial environmental agency (Bapedalda) has to be informed about the monitoring results of fire locations and early warning.

Conclusions

Despite the fact that fire management programs have been conducted in Indonesia since the mid-1980s, there were no country-wide operational fire information and management systems available to cope with the fires during the 1997-98 ENSO. The development of a Fire Information System as is currently underway in IFFM project in East Kalimantan is a move in the right direction. All IFFM modules are providers for and users of information of a FIS. However, without a strong IFFM implementation program the integrated use of information within a FIS as a precursors to the occurrence and effects of fire is of limited value. Most important is fire prevention based on a participatory approach which includes all stakeholders potentially affected by fire, efficient law enforcement, improvement of fire management skills at all levels of fire users. This means support for efforts towards Integrated Forest Fire Management through all involved forestry and regional departments. Finally, establish a consistent land-use policy which includes considerations of fire and smoke management.

References

Abberger, H. 1999. Fire prevention activities from February - July 1998. IFFM Homepage http://www.iffm.or.id

Deeming, J.E. 1995. Development of a Fire Danger Rating System for East Kalimantan. IFFM Report (mimeo).

Goldammer, J.G. 1999. Environmental problems arising from land use, climate variability, fire and smog in Indonesia: Development of policies and strategies for land use and fire management. In: WMO Workshop on Regional Transboundary Smoke and Haze in Southeast Asia, Singapore, 2-5 June 1998, Vol. 2 (G.R.Carmichael, comp.), 13-88. World Meteorological Organization, Global Atmosphere Watch Report Ser. No. 131, WMO TD No. 948, Geneva, 346 p.

Goldammer, J.G., and B. Seibert. 1990. The impact of droughts and forest fires on tropical lowland rain forest of Eastern Borneo. In: Fire in the tropical biota. Ecosystem processes and global challenges (J.G. Goldammer, ed.), 11-31. Ecological Studies 84, Springer-Verlag, Berlin-Heidelberg-New York, 497 p.

Goldammer, J.G., B. Seibert, and W. Schindele. 1996. Fire in dipterocarp forests. In: Dipterocarp forest ecosystems: Towards sustainable management (A.Schulte and D.Schöne, eds.), 155-185. World Scientific Publ., Singapore-New Jersey-London-Hongkong, 666 pp.

Hoffmann, A.A., A. Hinrichs, and F. Siegert, 1999. Fire damage in East Kalimantan in 1997/98 related to land use and vegetation classes: Satellite radar inventory and proposals for further actions. With contributions from G. Rücker, L. Christy, and B. Yuliarso.

Keetch, J.J., and G.M. Byram. 1968. A drought index for forest fire control. USDA Forest Service, South Eastern Forest Exp. Sta. Res. Pap. SE-38.

Kuntz S., and F. Siegert. 1999. Monitoring of deforestation and land use in Indonesia with multitemporal ERS data. Int. J. Remote Sensing, 14, 2835-2853.

Roy, P.S., B.K. Rangaanath, P.G. Diwakar, T.P.S. Vohra, S.K. Bhan, I.J. Singh, and V.C. Pandian. 1991. Tropical forest type mapping and monitoring using remote sensing. Int. J. Remote Sensing, 12, 2205-2225.

Saxena, K.G., A.K. Tiwari, M.C. Porwal, and A.R.R. Menon. 1992. Vegetation maps, mapping needs and scopes of digital processing of Landsat Thematic Mapper data in tropical region of South West India. Int. J. Remote Sensing 13, 2017-2037.

Siegert F., and A.A. Hoffmann. 2000. The 1998 Forest fires in East Kalimantan (Indonesia): A quantitative evaluation using high resolution, multitemporal ERS-2 SAR Images and NOAA-AVHRR hotspot data. Remote Sensing of the Environment 72, 64-77.

Siegert F., and G. Rücker. 1999. Use of multitemporal ERS-2 SAR images for identification of burned scars in South East Asian tropical rainforest. Int. J. Remote Sensing 21, 831-837.

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The Use of simple Fire Danger Rating Systems as a Tool for Early Warning in Forestry

Introduction

More and more foresters realize the importance of developing methodologies for monitoring and predicting fuel conditions in the forest to determine the fire danger in a given area. The intense forest fires raging in the province of East Kalimantan in 1997-98, as well as in Brazil drastically showed that the element fire has to be taken into account for management and conservation of forest resources in the tropics. Many of these forest fires could have been prevented if an effective fire management system had been in place at that time. One important aspect of a fire management system is the integration of early warning to ensure that the organization in charge is prepared for possible upcoming fire calamities. Several countries like Canada, Australia and U.S.A. have developed highly sophisticated Forest Fire Danger Rating Systems. In the setting of developing countries these systems are often very difficult to implement, since they are based on a lot of meteorological data and need complicated calculations. The example of East Kalimantan shows that weather stations and equipment like that which is standard in the countries mentioned above simply does not exist and for the near future will not be operationally in use. This paper intends to highlight very simple and inexpensive methods to determine fire danger and to give assistance in setting up such a system.

The Keetch Byram Drought Index

The Keetch-Byram Drought Index (KBDI) (Keetch and Byram 1968) expresses drought as an index on a scale from 0 to 2000, based on the moisture content of the soil. Zero is the point of no moisture deficiency and 2000 is the maximum drought level possible. For almost 5 years the Integrated Forest Fire Management (IFFM) Project has used the KBDI for Fire Danger Rating in East Kalimantan on an operational basis. In 1995 the index was modified and adapted to the conditions in East Kalimantan (Deeming 1995). The computation for deriving the Index is done in a simple spreadsheet by the staff of IFFM on a daily basis.

The major advantage of the KBDI is that only three variables are required to compute the Drought Index:

Mean annual rainfall of a station,

Today's maximum temperature, and

Todays rainfall

The Drought Factor equation, which has been slightly modified, is now used for the calculation in East Kalimantan:

$$DF = \frac{(2000 - KBDI) \times (0.9676^{(0.0875 \times T_{\max} + 1.552)} - 8.299) \times 0.001}{1 + 10.88^{(-0.00175 \times Ann_{Rain})}}$$

where T_{max} is the daily maximum temperature and Ann_{Rain} is the mean annual rainfall for the area.

The KBDI itself of a given day is the sum of yesterdays rating reduced by 10 times rainfall added to today's Drought Factor (DF). The Fire Danger, which is expressed through the KBDI, can range from 0 to 2000. To start calculating the KBDI for a given region, one has to go back to a period when the KBDI dropped to "0", meaning the soil was saturated by water. Keetch and Byram (1968) indicate that point as the day after a rainy period with 150 to 200 mm rainfall within one week.

The index was originally divided into three fire danger classes, for practical reasons and with the focus on the potential end user concessionaires the fire danger rating class “extreme” will be added to the classes:

Tab.1. Fire Danger Rating Classes

Numeric scale	Adjective scale
0-999	Low
1 000 - 1 499	Moderate
1 500 - 1 750	High
1 750 - 2 000	Extreme

IFFM is currently integrating this information into a GIS to evaluate the various fire danger rating conditions for parts of the province.

The Nesterov Index

Another simple Fire Danger Rating Index was developed by Nesterov (1949). This index is used with slight modifications in Russia as well as in other European countries. The Nesterov Index is based on the following parameters:

1. Days without rain
2. Dry bulb temperature
3. Dew Point temperature (calculated from relative humidity and temperature)

$$N = \sum_{i=1}^{W} (t_1 - D_1) \times t_i$$

where

N = Nesterov Index

t = temperature °C

W = number of days since the last rainfall > 3mm

D = dew point temperature °C

The index requires daily observations of temperature, dew point temperature and precipitation. The difference between daily temperature and dew point temperature is multiplied by temperature and cumulatively added over the days since the last rainfall. Thus the index increases each day until a rainfall of more than 3 mm occurs, at which the index drops back to zero and the process begins again. The system is divided into the following fire danger levels:

Nil	0 - 300
Moderate	301 - 1 000
High	1 001 - 4 000
Extreme	4 001 +

Comparison of the two Indexes during the extreme fire season 1997

The Nesterov Index and the KBDI were tested in the 1997 fire season in East Kalimantan. This year serves as a useful example, since it was characterized by wet conditions at the beginning of the year. In February-March the drought started followed by a small amount of precipitation. Between June and October almost no rain was recorded. In this period of high fire risk most of the forest fires were recorded.

The comparison between the two indexes shows several interesting aspects of these differing fire danger ratings methods. Since the KBDI is a drought index based on the possibility of the soil to hold water, it is limited by the field capacity. The KBDI system in East Kalimantan is based on the assumption of a 200 mm field capacity. The field capacity multiplied by 10 is hence the upper limit (2 000) of the rating. The Nesterov Index does not have this limitation and so has no upper limit, this causes the extraordinary value of 18 000 by the end of September, showing extreme fire danger. Both systems follow the development in the same manner, increasing steadily with no rain, and falling down when rain occurs. The Nesterov Index, by definition, falls down to zero if rain occurs. This is a clear limitation of the Index since it assumes no fire danger on a day with more than 3 mm precipitation. For the tropics this 3 mm is much to small, since 3 mm are by far not sufficient to saturate vegetation and duff with moisture, this figure has to be increased to a higher amount. Another limitation of the Nesterov Index is the decrease of the index to zero, since this only describes the situation where rain occurs. In the tropical region there is a high variability in rainfall, the variation is that many rainstorms are very local with tracks only 5 to 10 km wide, so the assumption that fire danger drops to zero for a larger area is not appropriate for fire management purposes.

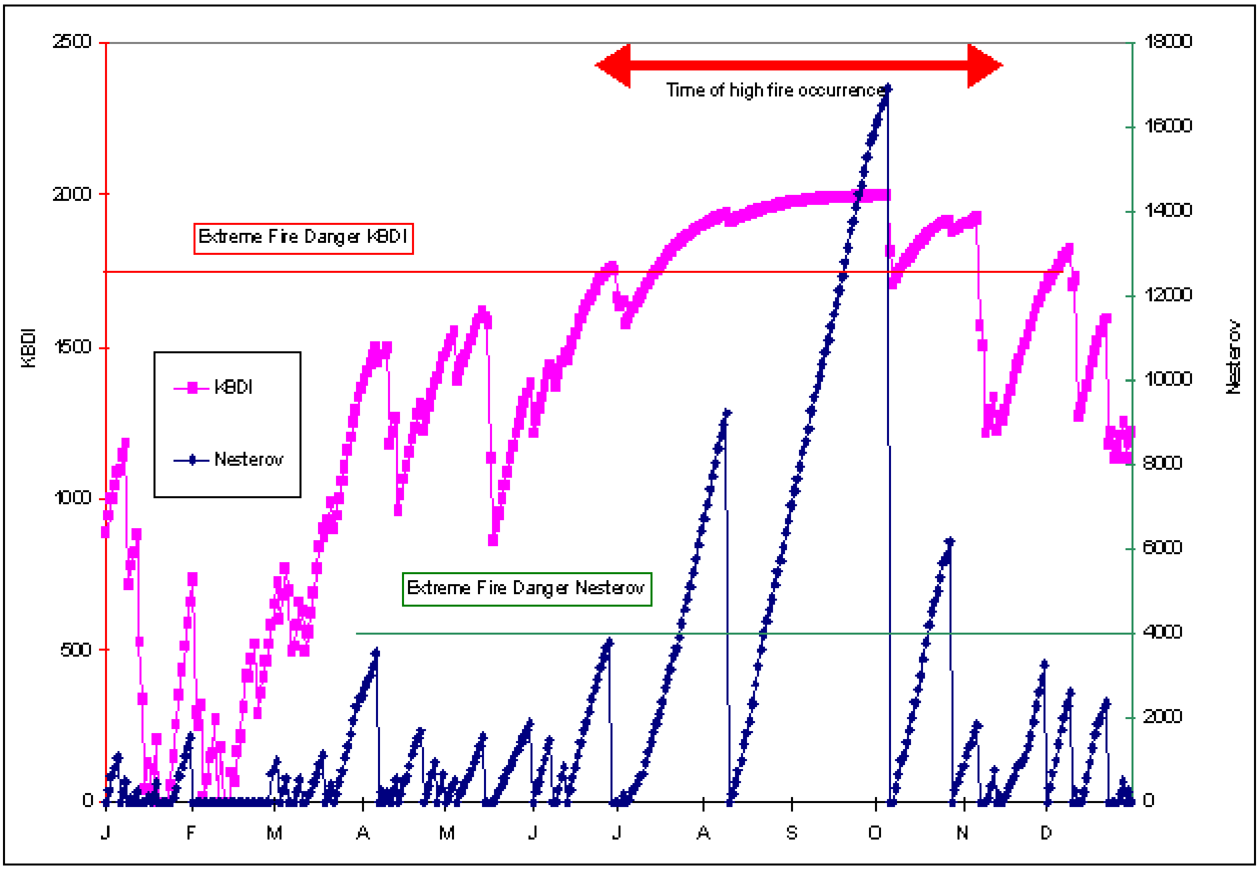

Fig.1. A comparison of the performance of the fire danger rating systems KBDI and Nesterov (note different scaling)

When comparing the number of days within each Fire Danger Rating Class, the similarities of the two systems are obvious; both systems measure approximately 50% of the days in the high fire danger rating class. The difference in the lower classes results from the sharp drop to zero of the Nesterov Index, when rain with more than 3 mm occurs, while the KBDI drops only slightly, often staying in the same class.

The comparison of the two indexes shows that they are both useful tools for early warning. The simplicity of the calculations and the few requirements to measure the input weather data makes both these formulas effective and practicable measures, especially in circumstances where the budget and trained staff is missing. These simple indexes can be calculated by the forest industry as well as the official forestry agencies, requiring only a simple weather station and a spreadsheet programme. The KBDI generally gives a more realistic overview of the fire danger situation due to the only slight decrease if rain occurs, while the Nesterov Index shows the increased fire risk in periods of extreme drought more dramatically. Since the costs for a simple weather station, which can measure relative humidity, rain and temperature in the case of the Nesterov Index, and a weather station that can measure rainfall and maximum temperature for the KBDI are rather small, this methodology is most suitable to the specific circumstances of forest protection in developing countries. An extensive network of simple weather stations that provide data for either index has to be preferred over complex high sophisticated fire danger rating systems like those that exist in western countries like America or Canada.

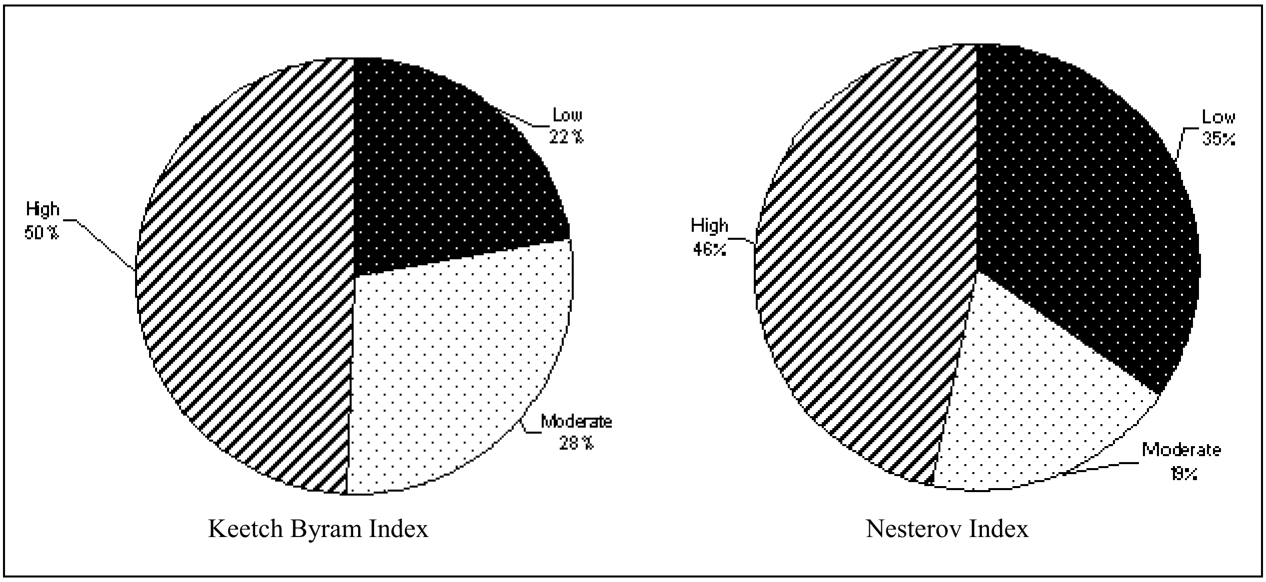

Fig. 2. Amount of days in the three Fire Danger Rating Classes according to the KBDI and the Nesterov Index in 1997

Crucial for effective fire management are the measures taken with this information, data dissemination methods and Standard Operating Systems have to be in place based on the early warning information, to ensure protection of the valuable forest resources.

The spread sheet used to calculate both the formulas and further information on Fire Danger Rating can be obtained from the Integrated Forest Fire Management Project, Samarinda, East Kalimantan, Indonesia. Contact the author at iffmfire@smd.mega.net.id.

References

Chandler, C. 1983. Fire in forestry. Volume 1. John Wiley and Sons, Inc. 449p.

Deeming, J.E. 1995. Development of a Fire Danger Rating System for East Kalimantan. IFFM Report. Contract. No. 1-60134345.

Keetch, J.J., and G.A. Byram. 1968. Drought index for forest fire control, USDA Research Paper SE-38. Southeastern Forest Experiment Station.

Nesterov, V.G. 1949. Combustibility of the forest and methods for its determination, USSR State Industry Press, 1949 <in Russian>.

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Fire Prevention in East Kalimantan

Framework and Background

Wildfires within the rural and wilderness areas in East Kalimantan are virtually all human-induced and most of them are set deliberately. Only in very limited areas burning coal seams, -mostly ignited by previous fires, have sometimes caused wildfires[6]. A large number of fires have been set in order to clear forest land for industrial plantations and got out of control. Fire is still the cheapest tool to reduce vegetation, and for many small farmers there is no alternative to burning.

After the devastating fires of 1997/98 particularly those in the province of East Kalimantan, it has become obvious that fire management is facing numerous constraints such as:

- A general lack of awareness and concern about forest fires on all levels of society;
- Institutional constraints such as the absence of clearly defined authorities and responsibilities as well as law enforcement;
- Insufficiency of available funds at the operational level;
- Conflicting claims on land and forest resources and insecurity of tenure for large companies and small farmers in rural communities in particular;
- Fire-prone vegetation as a result of destructive farming methods that will catch fire more easily and create hazards for future fires over large areas in the province.

The prevention of wildfires under such conditions has become a big challenge. However, human-induced wildfires can be prevented by human resource and institutional development along with campaigns to raise public awareness. Where technical fire management capacities are limited and insufficient to prevent the spread of large-scale fires particularly in ENSO years (El Niño Southern Oscillation), the prevention of wildfires from starting at all may prove to be a more effective and efficient part of a fire management system.

IFFM contributes to the prevention of wildfires by working with three major target groups: local population, concessionaires and the general public.

Community Based Forest Fire Management (CBFFM)

Grass-root approaches are the backbone of fire prevention concepts in East Kalimantan. Many of the local people are upland farmers and use fire to clear land. On the other hand, many of them also have experienced damages and losses due to the fires in 1997/98. Therefore, fire management on village level is first of all a self-help-oriented approach. Local communities in East Kalimantan vary widely in terms of knowledge about forests, agricultural systems, use of fire, traditions, and local regulations etc. Hence, local conditions have to be considered and concepts to be adjusted according to the needs of different community groups: indigenous Dayak communities, spontaneous settlers, and transmigration communities.

IFFM co-operates with local communities living adjacent or inside of forest areas to integrate them into the overall fire management system (fire prevention, fire suppression, fire information). This Community Based Forest Fire Management (CBFFM) approach is crucial for the prevention of forest fires particularly in protected forest areas as well as in concession areas. To implement this program, IFFM works together with all involved government agencies on province, district, and local level, with the private sector, and with several national and international NGOs in East Kalimantan.

Extension work and the provision for training are the first important steps to plant "fire prevention seeds" at village level. A two-days fire prevention and suppression training follows, carried out by an experienced IFFM training team. The program includes also village awareness campaigns, nature camp activities for children, and "roadside campaigns". Materials such as leaflets, comic books, stickers, posters, hats, shirts, and other items are distributed to spread the prevention message. Through the financial contribution provided by KfW, IFFM is in the position to set aside approximately 2000 hand tools and more than 1000 back-pack pumps to equip volunteer village fire crews.

The following is an excerpt of the step-by-step program of IFFM:

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[6] Unintended fires, either natural or human caused (Colfer 1999)

Step 1: Orientation process/identification of villages

* Villages selected according to data provided by the IFFM fire information system (fire hazardous areas, strategic locations etc.), accompanied by information from local government authorities and the forestry department;
* Formal and informal meetings carried out with key resource persons from the local government and communities to discuss fire management approaches.
* Socio-economic studies (RRA) carried out to identify and assess motivation, potential and constraints (problems) of local communities in the project areas with respect to fire management.

Step 2: Fire prevention campaigns

* Extension meetings carried out in up to five villages/locations considered to be pivotal for fire prevention, with participants of up to 20 sub-villages/hamlets;
* Villagers are encouraged to form volunteer village fire crews.

Step 3: Fire prevention and suppression training for volunteer village fire crews

* Hand tools provided to each participating sub-village/hamlet;
* Crews provide for proper storage and maintenance of hand tools (small warehouse, standard operating procedures, etc.).

Step 4: Institutionalizing of fire prevention work at village level

* Participatory planning workshop at village level (with representatives of village fire crews, formal and informal leaders);
* Workshop results proposed to local and province government;
* Province government to should provide legal framework as part of the overall fire management system;
* Village fire crews integrated in "village structure";
* Co-operation and coordination of village crew with other village organizations.

Step 5: Training of Trainers

* Up to five trained villagers per district appointed by village crews to participate;
* Village trainers to extend village fire prevention programs in close co-operation with crews of the provincial forestry service and concession crews;
* Job descriptions provided and compensation for services by local government;

Step 6: Networking

* Regular meetings between representatives of village fire crews, the forestry extension service, and concessions; the forestry service should coordinate network activities together with the local government;
* Set up/Establish a communication network.

The CBFFM will be elaborated in ways that allow for a gender specific approach. Through a study currently in process. Traditional knowledge about "buka lahan" (making a field), methods/techniques to burn, traditional regulations and beliefs are parts in the training and extension manuals. The CBFFM then has to be linked to social forestry programs such as the PMDH[7] program and other government development programs. IFFM closely co-operates with the social forestry unit of SFMP (Sustainable Forest Management Project), the second Samarinda-based forestry project, in this matter.

[7] Pembinaan Masyarakat Desa Hutan (development program for villages in forest concession an plantation areas, carried out by concessionaires;

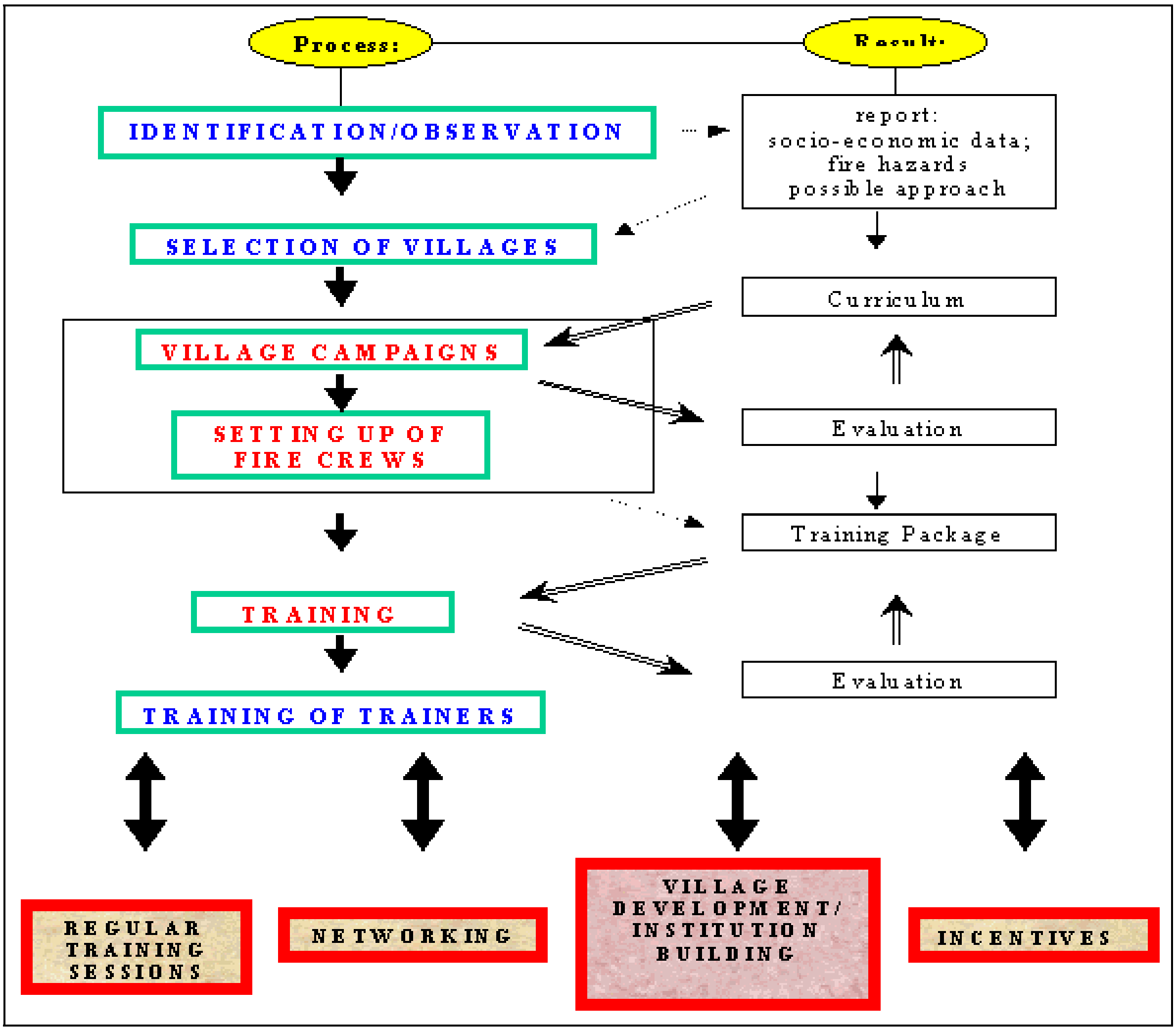

Fig.1. First steps for CBFFM in East Kalimantan

For the success of the program, an incentive system has to be designed benefiting local people who participate in the CBFFM. This also enhances the sustainability of such a program in general. The following incentives have to be part of a CBFFM system along with training and the provision of equipment:

- Village fire crews should have regular access to the fire information system (early warning aspect, communication, coordination and co-operation in the field, etc.);
- Career opportunities in fire management within the forestry department but also job opportunities (volunteer fire prevention crews, village trainers, etc.) have to be created;
- Awards for outstanding fire prevention performance during severe fires given to one village in each district area.

Fire Prevention in Concessions

During the 1997/98 El Niño drought, many forest concession areas were badly affected by raging wildfires, damaging valuable resources in logged over forests and virgin forests as well. Such concessions need technical support and inputs to prevent future fires in their areas. IFFM provides technical advice and necessary training (Nicolas and Beebe 1999) to strengthen and improve fire management on concession level. The successful management of fires in concession areas may be one important step towards the sustainability of forests in this province. Important issues are the building up of a functional fire management organization within a company's structure, the co-operation with local communities and neighbouring concessions, sufficient and proper fire fighting equipment, engineering work such as the modification of coal seams and the preparation of fuel breaks, and professional fire fighting skills of the crews.

IFFM closely co-operates with SFMP to support their partner concession in building-up fire management capacities. A fire prevention plan has been designed, which includes an approach towards the co-operation of the concession with local communities (Abberger and Beebe 1999) in fire management. Training has been carried out and job-descriptions, responsibilities and standard operating procedures are proposed and have to be implemented now. Such a model, if implemented, can serve as a model for other concessionaires in the province.

Forest fires may be a major threat to concession forests in the future, particularly here in East Kalimantan. Hence, fire management in concessions should therefore become an important issue for forest management in general. In the framework of certification of sustainable forest management, fire management must be included in order to become attractive for companies. IFFM is contributing by proposing criteria and indicators for the development of a catalogue towards the certification of sustainable forest management.

Public Work to Prevent Forest Fires

The public awareness of forest fires is still rather small in Indonesia. Only during ENSO years such as 1997/98, fire becomes a "hot" issue. Therefore raising public awareness becomes essential for forest fire prevention. IFFM has been very active in designing and carrying out fire prevention campaigns in East Kalimantan, often in co-operation with local TV and radio stations and a number of newspapers.

To promote the Indonesian fire prevention mascot, "Si Pongi" various extension materials have been produced so far and a school program is in process. The famous Indonesian TV Star "Kak Seto" has co-operated with IFFM to help raising the awareness of children about forests and forest fires for a year. In April 1999, Kak Seto presented "Si Pongi" in a big show in Samarinda together with 3 000 children and adults. Kak Seto and IFFM produced a common "Si Pongi" video clip for the national TV, which aims at introducing the mascot to a broader public and to promote a professionally produced "Si Pongi" music cassette. This video is another step to make the mascot commercially more interesting. A "Si Pongi" doll and other items are very popular with children and "Si Pongi" has of course the potential to become a successful product on the toy market.

Fire prevention must become part of school curricula in Indonesia. Therefore, IFFM is currently designing a school program together with the Department of Forestry and several NGOs. Within the framework of an established environmental education (EE) working group, a "nature camp" concept has already been designed and successfully been carried out. This program may become another promising approach to address fire prevention with children in villages, included in the CBFFM program.

References

Abberger, H. 1999a. Upaya Penyuluhan dalam Rangka Pemberdayaan Masyarakat Terhadap Bahaya Kebakaran Hutan. Samarinda: PPLH & BAPPEDAL (contribution to Training in Fire Suppression and Environmental Management, 26 April – 8 May, 1999).

Abberger, H. 1999b. Operational Plan for the Dissemination of Equipment to Volunteer Village Fire Crews within the Framework of the KfW Financial Grant. Proposal. Samarinda: IFFM.

Abberger, H., and G.S. Beebe. 1999. Fire Protection and Pre-Suppression Strategy for the PT. Limbang Ganeca Concession, KLI Group. Samarinda: IFFM Working Doc. No. 2.

Colfer, C.J.P. 1999. Ten Propositions to Explain Kalimantan's Fires. Bogor: CIFOR.

Hoffmann, A., L. Schindler, and J.G. Goldammer. 1999. Aspects of a Fire Information System for East Kalimantan, Indonesia. Paper, presented at the 3rd International Symposium on Asian Tropical Forest Management, Samarinda, East Kalimantan, Indonesia, Sept. 20 –23, 1999. Samarinda: IFFM Doc. No. 16.

Kleine, M. et al.1999. Report on a Review Mission to the Integrated Forest Fire Management Project, Samarinda, East Kalimantan. Commissioned by Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Unit 206: Indonesia, Malaysia, Singapore. Brand-Laaben/Alcona/Eschborn, September 1999.

Marbyanto, E. 1999a. Pengembangan Focus Area Dalam Community Based Forest Fire Management. Samarinda: IFFM (draft proposal).

Marbyanto, E. 1999b. Konsep Peningkatan Peran Serta Masyarakat Dalam Pengelolaan Kebakaran Hutan dan Lahan. Samarinda: IFFM (draft).

Nicolas, M.V.J., and G.S. Beebe. 1999a. The Training of Forest Firefighters in Indonesia. Forest Fire Prevention and Control Project, Palembang, and Integrated Forest Fire Management, Samarinda. European Union, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH and Ministry of Forestry and Estate Crops, Jakarta, Indonesia.

Nicolas, M.V.J., and G.S. Beebe. 1999b. Fire Management in the Logging Concessions and Plantation Forests of Indonesia. Fire Prevention and Control Project, Palembang, and Integrated Forest Fire Management, Samarinda. European Union, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH and Ministry of Forestry and Estate Crops, Jakarta, Indonesia.

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Rehabilitation of Fire-affected Forests in East Kalimantan

Guiding Principles

After the 1997/98 fires, the project "Promotion of Sustainable Forest Management in East Kalimantan (SFMP)" developed a concept for the rehabilitation of fire-affected areas, which is in line with valid criteria and indicators for sustainable forest management (FSC, Lembaga Ekolabel Indonesia – LEI). This became necessary because since 40% of SFMP's partner concession PT Limbang Ganeca was burnt and many other concessions faced a similar fate in East Kalimantan. The guiding principles for rehabilitation activities are basically:

SFM Principles for the Rehabilitation of Fire-affected Forests:

1. Maintaining the forest area
2. Sustainable management of forest resources: Economically sound management targets should be defined and agreed to by the concession's stakeholders giving consideration to the local conditions and forest functions. Appropriate silvicultural treatments should be performed to reach these management targets.
3. Ecological Sustainability: Management targets should be directed towards the type of forest that is native to the area. Silviculture activities should have minimal negative effects on the remaining stand and soil and should prioritize:
4. Management of the residual stand
5. Natural regeneration
6. Mixed planting using local species suitable to the site
7. Forest Protection: The forest is the foremost asset so it must be protected from pests, disease, illegal logging, fire and other disturbances.
8. Community participation to increase community welfare through benefits from forest resources and support efforts to protect the forest.

Main Technical Aspects

The technical steps listed in Table 1 need to be accompanied by organizational adjustments. Depending on the size of the area affected, rehabilitation projects can mean huge changes to the organizational structure of logging concessions: a significant amount of manpower needs to be added and trained. Furthermore, it requires a gradual shift from a functional towards a regional organizational structure. In the end, a paradigm shift from loggers to planters needs to take place.

Local people's participation becomes a more and more pressing demand in Indonesia's *era reformasi* even for once powerful timber concessionaires and so for future rehabilitation schemes. A lot of models are meanwhile under discussion, which are not yet consolidated and some of them are already subject to misuse. These models range from hiring local labourers or cooperatives as contractors via participatory buffer zone activities to granting shares to local cooperatives. In the partner concession, a participatory buffer zone scheme mainly outside of permanent production forest is presently under discussion, while hiring local cooperatives and labourers faces difficulties due to differing livelihood schemes of the surrounding population.

Frame Conditions and Risks for Successful Rehabilitation Schemes

After the 1997/98 fires, the Ministry of Forestry and Estate Crops (MoFEC) ordered the concessionaires to rehabilitate the burnt areas. SFMP contributed significantly to the development of such a policy. However, it was enacted with delay and its implementation is hampered by overall problems related to law enforcement in Indonesia. The uncertainty of keeping a concession at all is another fact, which significantly hampers the willingness of concessionaires to conduct such long-term investments, since the government is presently embarking on restructuring the concession landscape. Apart from this, an increasing number of land claims on concession land requires to be handled in a partner-like way. However, until now, both, companies and the government are rather confused how to approach this. The project tries to assist here in developing a participatory boundary determination process.

Fire provides another increasing risk in the future, given global warmth, changes in the regional climate and a huge amount of fuel after the 1997/98 fires. This requires integrated company- and community-based forest fire management systems, which are presently developed by the Integrated Forest Fire Management (IFFM) Project.

Given the huge size of the area in need for rehabilitation, funding becomes a prevalent issue to make rehabilitation efforts feasible. Based on project inputs, MoFEC introduced a compulsory "levy and grant" of 8 US$ per m^3 for salvaged timber, which is to be used for rehabilitation purposes in the concession. This scheme, however, covers only those concessions where salvage felling was carried out. For other areas, other schemes need to be developed. One option could be to make "Clean Development Mechanisms" for carbon sequestration available for rehabilitation efforts.

Tab.1. Main technical aspects of rehabilitation of fire-affected forest.
Source: G. Weinland, c/o Forestry Department Headquarters Peninsular Malaysia, Kuala Lumpur.

1. Orientation Survey	* Delineation of burnt areas using Landsat or Radar satellite images * Orientation survey to assess the degree of damage, the potential of the residual stand and the potential for salvage felling. *Design:* line-plot sampling survey, *Unit of assessment:* whole partner concession area (burned and unburned) as a basis to adjust the annual allowable cut to a sustainable level
2. Master Plan Formulation	* Definition of areas and goals for salvage felling / rehabilitation * Time and spatial arrangement of areas for rehabilitation * Fuel break planning: along main roads, particularly in fire-prone areas. Fire strips are to be planted with fire-resistant species (e.g. *Gmelina arborea*) or, if closer to settlements, with agro-forestry and plantation crops to be managed by local people

3. Salvage Felling	* Aim: utilization of dead, but usable timber before it is rotten * Simplified procedure compared to the conventional Indonesian selective cutting and planting system (TPTI) to save time * In the partner concession, reduced impact logging was introduced in order to reduce the damage to the residual stand and thus, reducing the area in need for rehabilitation
4. Rehabilitation Planning	* Done per compartment (100ha) and sub-compartment (≈ 25ha) by extensive inspection from existing roads, which are to be used with natural boundaries as sub-compartment boundaries * Criteria for silvicultural treatments: Forest Condition Silvicultural treatment Non-burnt, lightly burned areas and areas with sufficient living trees (>25 trees / ha >10cm dbh) No planting, but natural regeneration Sufficient commercial Non-Dipterocarps available (>100 trees / ha) Enrichment planting with Dipterocarps (100–200 trees / ha) Pioneer vegetation not available or smaller than 1m Planting postponed for one year Pioneer vegetation higher than 1 m Ready for planting with Dipterocarps (200 – 400 trees / ha) * (Re-)marking of compartment boundaries * Species choice and mixture: faster-growing native species should be reflected in the species choice using previous inventories as information source, if available. In each sub-compartment, at least 2 to 5 species should be planted. Each species is to be planted in strips e.g. 3 to5 planting lines wide
5. Plant Production	* Adjustment of nursery capacities considering as well the time needed for plant production (4 to 6 months) * Sources of plant material: seeds, wildings and cuttings * Dipterocarp seeds and wildings need to be acquired from outside, since most of the mother trees and seed stands are burnt and there was no flowering season since the fires * Production of seedlings for the fuel breaks
6. Planting, Weeding and Tending	* Dipterocarps planting without intensive site preparation only by opening up planting lines. Green spots and areas with still existing mother trees are spared out * Weeding and tending is to be done intensively in the first years in order to ensure the success of the plantation * Fire breaks are planted densely after intensive site preparation

Project Strategy

After the fires, SFMP immediately started the discussion and the activities with the partner company and with MoFEC to deal with the aftermath of the 1997/98 fires. Meanwhile, technical guidelines for the orientation survey, for salvage felling and for rehabilitation in concession areas were developed and partly issued as government decrees. The central and the provincial government are assisted in policy development and in raising awareness about the scope of the problem by building on the experience gained in the field.

Together with the partner concession, technical procedures are refined while trying them out. Hard, but extremely useful lessons are learnt in a permanent dialogue with the partner company's management about the practical and the political obstacles and implications to put such a long-term efforts into practice. Gradually, support for sustainable forest management and certification increases and thus, the motivation for rehabilitation activities. In the future, these valuable experiences can be increasingly shared with other concessionaires.

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Prevention and Control of Forest Fires in the Nature Conservation Area Rio Doce in Minas Gerais, Brazil

In Brazil fire used to be and continues being a traditional tool in agriculture and forestry. It is used in the development of new areas (slash and burn agriculture) or to clean meadows off organic residues, weeds and pests. If these fires run out of control they become forest fires, sometimes with catastrophic dimensions. The Provincial Park Rio Doce (PP Rio Doce) which was established in 1944 in the east of the Minas Gerais state, is an example of how a Protected Area can successfully be protected against fire damages.

The Protected Area, managed by the state-level Forest Institute IEF, is one of three target protected areas of the bilateral technical co-operation project „Doces Matas", in place since 1996, a cooperation between three brazilian institutions and the Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ). These institutions are the federal environmental agency IBAMA, IEF and the NGO *Fundação Biodiversitas*. The project goal is the protection and sustainable development of the three Protected Areas, including their buffer zones. Special emphasis is given to institutional co-operation and the participation of local people.

The area of the PP Rio Doce is part of the Atlantic Rainforest biome, both from the viewpoint of vegetation and site conditions. The Atlantic Rainforest is among the forest ecosystems with the highest biodiversity, worldwide, and, unfortunately, also one of the most threatened. In a landscape totally altered by humans through Eucalyptus Plantations, extensive pasture areas, smallholder agriculture, as well as urban development and steel industry, the Protected Area represents an island of natural vegetation. Covering an area of 35 973 ha, primary and secondary semi-evergreen forests are growing in a mosaic pattern under a subtropical, moderate humid climate (mean annual temperature 21°C, mean annual precipitation 1 160 mm). The secondary forests originate from large forest fires which occurred in the 1960s. The Park shelters the largest continuous area of this vegetation type in Minas Gerais and constitutes the core area of the „Atlantic Rainforest" Biosphere Reserve in this state. Along with the rich flora and fauna, the Park also protects a part of the third biggest lake area in Brazil.

The forest fire history in the central part of Rio Doce started in the early 1940s. It began with large scale forest clearing, especially for charcoal production. At that time fire was still considered as an appropriate tool to shape landscapes. In the 1960s this attitude – along with reforestation –came under increasing criticism, underscored by quantitative calculations of damages from the uncontrolled use of fire. The fire catastrophe of 1967, when 9 000 ha of natural forest inside the PP Rio Doce were destroyed, with additional damages in the buffer zone, represented a sad example of the destroying forces of fire and a turning point. Eleven fire fighter lost their lives. The material losses from theses fires along with the environmental damages to the forest industry, farmers and local people, resulted in a discussion which led to the search for alternatives to the use of fire, and to the development of better fire prevention and suppression methods. Projects and initiatives were implemented focussing on environmental education, law enforcement and regulation of the use of fire in agriculture and forestry. Because of an initial lack of adequate co-ordination, the Protected Area management took over the role to address and integrate the different stakeholders, which led to remarkable success.

Integrated Programme for Prevention, Control and Suppression of Forest Fires

Given the fact that the PP Rio Doce cannot be dealt with in an isolated form from its surroundings, and co-operation with neighbouring communities and stakeholders is essential for effective nature protection, the park management has been working, since the 1990s, on commonly agreed solutions to the forest fire problem. The result is the „Integrated Programme for the Prevention, Control and Suppression of Forest Fires“, established in 1994. The programme is supported by distinct stakeholders such as private companies, local municipalities, military police, and the road construction department. The main goal is the protection of PP Rio Doce and its buffer zone from uncontrolled fires, including 30 900 ha of *Eucalyptus* spp. Plantations of the forest company *Acesita Energética* (a subsidiary of the *Acesita Aços* steel company), as well as 21 000 ha of agricultural lands. Altogether the programme covers an area of 86 973 ha.

While some stakeholders are committed to the programme because of their immediate interests, like in the case of *Acesita Energética*, others co-operate because they want to support the Protected Area, like the metal working company *Usiminas*. This company does not own property in the range of the programme but nevertheless contributes to the running costs. The farmers of the buffer zone do not participate officially in the protection programme, but do collaborate indirectly through the maintenance of fences and access roads, as well as the release of water tanks in the case of a fire, as well as other activities.

The Rio Doce Park Management is responsible for the co-ordination of the programme activities. Beside this, each member of the programme has assumed specific responsibilities for assigned activities, e.g. the monitoring of a given area and the maintenance of facilities. The programme has no rigid structure. Yearly revisions by the stakeholders lead to its adjustment to new circumstances, if necessary.

The table shows, that besides arson, fires used in agriculture, forestry and traditional fishing are the main causes.

On the basis of this analysis the means and strategies for effective fire control and suppression were determined. Watch towers, stations, equipment for fire fighting and personal safety were purchased and established. In addition, a road network (for patrolling and as safety zones in case of a fire) was developed or improved, fire breaks were built and personnel was trained for fire towers and fire fighting crews. Since the establishment of the programme, 250 members of the participating organisations have been trained in fire prevention, fire suppression and first aid. Finally a detailed plan was developed to bring existing information together and for the detection of fire locations.

In addition to fire control and suppression, prevention activities were undertaken from the beginning of the programme. The programme succeeded in reducing the number of fires by a series of activities such as awareness raising of local communities, environmental education through meetings, presentations and flyers.

The establishment costs of the programme run to US$ 229 000 to date. The public member institutions (IEF, military police, road construction department and municipalities) have covered 97% of these costs. Of the yearly operating costs of US$ 157 000, the government pays approximately two thirds, while the private enterprises, *Acesita Energética* und *Usiminas*, pay the rest. Personnel costs represent the biggest share, followed by maintenance costs (fire breaks, streets and roads) and radio operation.

Results

Table 2 clearly shows the noticeable success of the integrated fire protection programme. Since 1993, when the programme started, the area burned inside the PP Rio Doce could be substantially reduced. This means that the measures of fire protection and suppression, through fire towers, improved communication and fire detection systems, road network, fire breaks, fuel reduction, as well as fire crews and equipment, were effective and the results justify the efforts undertaken.

In the buffer zone the results were not as positive as in the PP Rio Doce. Neither the number of fires nor the average area burned could be substantially brought down to acceptable levels. This points to inefficiency, lack of acceptance, unsuitability or simply to the insufficient dimension of the measures undertaken in fire prevention. Consequently, greater efforts from all stakeholders in the areas of law enforcement, awareness raising in forest industry, farmers, fishers, tourists and the local people in general have to be undertaken. The especially high fire occurrence in 1999 can be partly explained by the extreme drought and by the land use change under way from Eucalyptus plantations to agriculture.

With regard to the programme costs, it can be stated that the protection programme is cheaper than the rehabilitation measures of the past. The prevention and control activities in 1993 ran up to approx. US$ 600 000. If the costs of rehabilitation or reforestation of burned areas were to be added the costs would quickly reach millions. Compared to these costs the costs of the establishment and implementation of the protection programme (see above) are minor.

According to the Park management assessment, one of the most important results is that forest fires in and around PP Rio Doce are better understood. This was achieved through the programme's research activities, which lead to a more systematic and planned organization of prevention, control, and suppression activities, instead of the improvised and reactive countermeasures of the past. The experience gained is perceived as so promising that fire protection programmes, following the example of PP Rio Doce, are currently planned in other Protected Areas throughout Minas Gerais.

Tab.1. Fire causes in PP Rio Doce and its buffer zone

Fire Causes	**Number of fires/year**						**Total**	**%**
	1993	**1994**	**1995**	**1996**	**1997**	**1998**		
Arson	17	6	9	2	1	6	41	24.4
Agriculture	13	8	5	1	1	6	34	20.2
Fishery*	11	2	4	1	-	4	22	13.1
Forestry	9	5	-	-	-	3	17	10.1
Pasture	6	1	3	-	-	2	12	7.1
Tourism	3	1	2	-	-	1	7	4.2
Fire work	2	-	3	1	-	-	6	3.6
Garbage burning	-	1	2	-	-	-	3	1.8
Hunting	2	-	-	-	-	-	2	1.2
Unknown	15	3	2	-	-	4	24	14.3
Total	**78**	**27**	**30**	**5**	**2**	**26**	**168**	**100**

In the protected area fishing is generally prohibited except for one lake
Source: database PP Rio Doce

Tab. 2: Development of number and extent of fires

Year	**PP Rio Doce**			**Buffer Zone**		
	Number of fires	**Total area burned (ha)**	**Average size of area burned (ha)**	**Number of fires**	**Total area burned (ha)**	**Average size of area burned (ha)**
1993	5	980	196	73	3 700	50.7
1994	0	0	-	27	1 100	40.7
1995	1	2	2	29	500	17.2
1996	0	0	-	5	150	30.0
1997	0	0	-	2	5	2.5
1998	0	0	-	26	403	15.5
1999*	3	3	1	45	1 000	22.2

** Preliminary data*
Source: data base PP Rio Doce

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Forest Fire Fighting Equipment: What to Buy?

On the surface, buying forest fire fighting equipment for use in Indonesia seems rather straight forward. Equipment to fight forest fires logically would include things like fire pumps and hose to put water on a fire. A variety of simple hand tools such as shovels, rakes and axes might seem appropriate. Perhaps fire trucks would be a good thing. These are all good general statements of what might be appropriate, but what exactly do we need to purchase? This is the question raised by the GTZ-Indonesia Integrated Forest Fire Management (IFFM) Project team in Samarinda when it was decided to purchase, in cooperation with KfW, suitable fire fighting tools to equip field headquarters in East Kalimantan.

To answer the question, many things were considered.

What is the terrain? Is it steep? Will firefighters need to pump water over long distances and up steep inclines? Is there access? Will firefighters have to carry equipment long distances over rough terrain or can they get close to the fire with trucks? Are there water sources suitable to operate portable fire pumps or to fill light back pack pumps or to fill mobile tankers?

What are the forest fuels like? A firefighter looks at the forest, but he doesn't see trees. He sees fuel. Is there a deep layer of fuel on the forest floor? Will shovels work or would one have to dig too deep? Are there areas covered with fine fuels such as grass, where tools like fire swatters can smother the fire? Or, will we be dealing with heavy fuels requiring chain saws to build fire line? Is there a light surface layer of leaves and litter where rakes could be effective? Are there roots to be chopped?

And what about the fire? If fires are intense and fast moving, things like water tankers and fire pumps become more valuable. Water allows a firefighter to tackle a more intense fire. While high intensity fires require water, low intensity fires can be easily and effectively attacked using only hand tools such as shovels and rakes.

All of these things were looked at. All of the questions needed an answer. And in finding the answers, we realized that because East Kalimantan holds a great variety of terrain, fuel, water sources and fire behaviour, no one tool is sufficient to do the job. A mix of hand tools, pumps, hose and water carrying tankers is required for fire suppression in the province.

But there is more. Once one decides on a piece of equipment, such as a truck with a water tank, there are still more things to be considered.

What type of truck will do the job? How large a tank can it carry? How well will it perform in forest conditions? A vehicle designed for quick response on paved highways or city streets would not travel far on the steep terrain and rough roads of East Kalimantan. In the end, four wheel drive, utility pickup trucks with small easily loaded water tanks seemed most appropriate. Highly mobile units with self-contained pump and hose were deemed best for local conditions.

When ordering these "slip-on tanker" units, we wanted to pay particular attention to ensuring safety, ease of operation and maintenance. In addition, we needed to guarantee the slip-on units would be compatible with other portable pumps and hose also being purchased. Although the slip-on units are capable of taking water directly, using their own pump, many water sources are far from the road and are not available for direct water pickup. We asked for connections and fill openings on the tanks which allow filling from a portable fire pump placed at a water source which would be too far from the road for the truck to access.

In our initial evaluation we determined that water, although scarce in many areas and during long lasting dry periods, nonetheless, is available in sufficient quantity to make the portable fire pump a viable piece of equipment. We learned, when visiting local headquarters, that staff would like to have pumps and hose. In areas where pumps and hose have been available in the past, there is a very strong wish to receive additional equipment of this type.

Local firefighters also have a clear opinion on the basic requirements for a fire pump. To be useful, a power pump must be light weight, reliable, easily transported by one person and produce a good working pressure over a long distance.

To meet these needs, a multi-stage centrifugal power pump was selected. A centrifugal pump will allow pumping from natural water sources which might contain some debris. The centrifugal system will allow pumps to be connected in tandem to overcome distance and elevation. Multi-stage is important to ensure the pump will deliver water quickly and will produce adequate pressure over the distances and elevations found in the forests of East Kalimantan.

Spare parts and maintenance are critical things to be considered. Several power pumps were seen in our field visits and in most cases the pumps were in a poor state of repair. District staff were concerned that spare parts and maintenance were not available locally for these pumps. This left us with a dilemma. To do the fire suppression job, the pumps had to be specialized high performance fire fighting units. However, such units are not available locally raising the problem of future service and replacement of worn out or damaged parts. To solve the problem, a supply of spare engine parts, spark plugs, pump grease etc. was identified and ordered to support the main equipment. In addition, suppliers were evaluated on their ability to provide follow-up service and support in East Kalimantan.

Pumps need hose and fire hose comes in many different types and sizes. Large diameter hose will deliver high volume of water with little loss of pressure. Small diameter hose on the other hand is light and easy to manipulate in forest conditions. A compromise had to be struck. Both 25 mm and 38 mm diameter hoses were purchased. In many instances, long hose lays will be required. 38 mm diameter hose lines will provide a reasonable volume and working pressure on these longer hose lays, yet it is light and easy to handle in rugged forest conditions. To ease the work load of the firefighter, especially in mop-up, 25 mm hose was also purchased. In many cases we are expecting that 38 mm hose will be used to deliver water over the longer distance to the fire and then 25 mm hose will be used along the fire's edge.

The high relative humidity typical of a tropical environment makes hose storage difficult. Natural fibre hose although strong, is very susceptible to mildew and rot. For this reason, a synthetic fibre fire hose was ordered. Good quality synthetic hose is available and is very mildew and rot resistant. Synthetic hose has an added advantage of being lighter and easier to package. Synthetic hose does not have the same abrasion resistant characteristics as natural fibre hose. However, because there is little rock in the local terrain, abrasion was not considered to be the most important criterion when selecting hose. We felt the mildew and rot resistant properties of synthetic fibre hose was a more important consideration.

One characteristic of the hose purchased is that it will actually leak a slight bit. It may seem strange to purposely buy leaking hose, but in fact for forest fire fighting, this is exactly what is wanted. The lining of the hose is perforated to allow water to soak through and keep the outer jacket of the hose wet at all times. The wetness protects the hose from burning. On forest fires, hose must often be laid across smouldering or still burning material and so it must be self protecting or it will burn and burst.

As with all of the equipment, hose requires regular maintenance. A complete kit necessary to do hose testing (to make sure it will withstand the high pressure produced by the pump), cleaning, patching and re-coupling was purchased for each location.

Even hose couplings are important and preparing to purchase a large number of them requires some important decisions. There are a number of different thread standards and coupling systems available. A decision on the hose coupling system had to be made. While visiting various areas, we saw a number of different threads in use. This mix of coupling type and thread has the potential to cause problems when pumps and hose are shared amongst neighbouring districts. Some concessions in the Province also own and use portable power pumps and hose. Undoubtedly here again there will be a variety of thread standards depending on when and where the pumps and hose were purchased. Because there is no standard in the Province, we had to adopt our own standard for the current purchase. This decision was not taken lightly. Once a standard has been adopted, it will affect all future hose purchases.

Rather than continuing with threaded couplings, the quarter turn quick connect coupling system, which is becoming a standard in North America, was adopted. There are a number of advantages to this coupling system:

* The couplings mate with only a 1/4 turn allowing quick and easy coupling.
* Quick connect couplings do not damage as easily as threaded couplings. Cross threading is not possible. One does not have to take the same level of care to protect threads.
* The system has no male or female couplings. The couplings on both ends of the hose are the same meaning one always has the proper end of the hose. This simplifies training, operations with the hose and the retrieval and packaging process.
* With the Quick Connect system, we could get away with buying fewer spare couplings. It is not necessary to stock both male and female couplings.
* We wanted to buy both 38 mm diameter hose and 25 mm diameter hose. In the quick connect system, both 25 mm and 38 mm couplings have the same face. This eliminates the need for an adapter to join a 25 mm line to a 38 mm line. The same nozzles, wye, water thief, tandem adapters all work with both 25 and 38 mm hose reducing the numbers of pieces required for purchase and the number of pieces carried into the bush.

Of course, since we know there are other threads and coupling systems in use in the province, we also purchased adapters and additional couplings so that incompatible systems could still be brought together.

Back Pack pumps are small portable bags, to carry water, along with a simple hand pump to direct the water at the fire. They are very effective in forest fire suppression operations. In East Kalimantan, water for pack pumps will come from a number of sources. In many cases, a firefighter will take water from streams and wet swampy areas. We know from experience that using field water sources can lead to blockages and valves sticking in the action of the pump. Single action trombone pumps were chosen for their simplicity and ease of field repair. A mix of soft container and hard container tanks was considered, however, after talking with staff from Dinas Kehutanan, we decided to buy only the soft, collapsible containers. We felt that the advantages of easy storage and shipping were important.

Water supply, although available in many areas, may be a problem, particularly in very dry seasons. Large capacity collapsible water tanks were ordered to supplement tanker, power pump and back pack pump operations. These tanks can be carried right into the forest and used as storage containers close to the fire site. The connections on the portable tanks were specifically selected to be compatible with the pumps and hose. Water can be transported to the portable tanks using large (5 000 litres) water trucks or the smaller slip-on tankers. This should help to assure a constant supply of water at the fire's edge during suppression and mop-up operations.

The terrain, fuel, access, availability of water, availability of manpower and the type of fire behaviour usually experienced combine to make hand tools very effective for fire suppression in East Kalimantan. A variety of hand tools were considered for this purchase. Shovels, *Pulaskis* (a combination axe and hoe), fire swatters and *McLeod* Tools (special fire rakes) were bought.

We took great care to specify a strong, straight, knot free, wooden handle for the hand tools. It seems a simple thing, but fire fighting is hard work. Hard, not only on firefighters, but also hard on equipment. When buying hand tools, high quality is essential. It is bad if you break the handle of your shovel on the fire line. Not only do we have a broken shovel to repair or replace, but perhaps more important, we also have a firefighter who is now taken out of production until a replacement shovel is brought in.

It was obvious during the field visits, that retrieval and maintenance of hand tools will be a challenge. In those headquarters were equipment has previously been supplied, the equipment is not well maintained. We saw many instances where the handles on hand tools were broken. The local staff simply do not have the resources to repair these items. A “Hand Tool Spares and Maintenance Kit” was identified and purchased for each headquarters. Additional kits were bought for the provincial equipment cache. These kits are comprised mostly of replacement handles for each type of hand tool. Additional maintenance items such as files for sharpening tools, brushes for cleaning and tape to protect sharp edges were included in the maintenance spares kit.

Because it is important to provide a good maintenance facility in each headquarters, a number of general maintenance tools will be supplied to provide a start up for equipment recycle and repair. Included are a variety of wrenches, screw drivers, hand drills, wire brushes and other small tools. Undoubtedly there will be other items required. This assortment of equipment is intended to provide a basis on which to build so that equipment can be maintained from the outset.

And so it goes. When answering the question, "What to buy?", alternatives are explored and decisions on exactly what to buy are made. But of course it doesn't end there. The finest equipment in the world is of little value unless there are well-trained firefighters to put it to its best use.

Which of course begs the question . . .

Forest Firefighter Training. What to Teach?

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PART III Fire and People: "Safeguarding Livelihoods"

The Culture of Fire on Southern Africa on Example of Lesotho and Madagascar

An Interim Report of the Working Group Forest Technology

Preface

At the stage of writing this report two countries returned the questionnaires which was circulated to GTZ projects in Southern Africa. Thus, this report is restricted to Lesotho and Madagascar (50% of the island) and a short description for Kenya.

Introduction

The discussion about pros and cons of fire has and is continuing over the decades and still there is no general answer. One of the difficulties for this is, which indicators should be used for evaluation (forest area, growing rate, income etc.), perhaps biodiversity is the best indicator. Concerning this, Pyne (1995) wrote aptly: "… Biodiversity can be lost as surely through fire exclusion as through fire excess".

The contemporary world fire situation is changing dramatically. Two elements have worked to upset any systems. One is climate, the other humanity. The trends are alarming; fire, climate and humanity have begun to interact in new ways. The rapid growth rate of population in the African countries increases dramatically the frequency of fire. This is not a question of a natural process but it is anthropogenic interference into nature. New fire climax vegetation will be created and frequently the degeneration chain will start into progress, especially where the grassland is diminishing.

Fire is a powerful tool in the hands of the farmers. It should not be forgotten that the livestock is the central element in their culture. The last area of the land is sacrificed for the animals. With regular fires the grass will be regenerated faster and succession to shrub land will be interfered with. The forest is the loser. Today in Lesotho, the forest covers only 0.2% of the country and the last forest area will disappear in 15 to 20 years if the present deforestation rate will not slow down.

It is not surprising that wildfire will be seen in the most forest projects as an obstacle. Unfortunately, it is impossible to avoid fire, both the natural as well as the human causes of fire cannot be eliminated.

The intensity and hazard of a forest fire is determined by the weather conditions and the type of vegetation. These already vary strongly on a small area (ecological zone in one country) and regionally the differences are more apparent. Therefore, it is not the task of the report to compare the differences but highlights the common characteristics.

Additional obstacles in the compilation of this article are that no statistical surveys on wildfires are available. But this could be a common problem for most African countries. Therefore, the information presented here for Lesotho and Madagascar (only 50% of the islands) has to be handled with care.

However, Kenya is an exception, as there is some statistical data available (Uvoo 1996). The average area annually affected by fire in last five years (1991-96) reveals that 2 697 ha plantations, 1 378 ha natural forests, and 4 929 ha grassland were affected by fire. The figures for grassland were perhaps underestimated, because the ratio between forest and grassland area is usually around 1 : >10.

Climate and vegetation

The two countries are located within the latitudes 30°S and 15°S. The regional climate features are marked by dry periods in winter and strong westerly winds. The humid summers favour the biological degradation process (humification) so that no tremendous quantity of dead material accumulates in grassland.

In both countries there are favourable climatic conditions for natural forest fires especially in the dry period during the winter. The frost-killed material makes an excellent fire bed.

Also the initial vegetation form of Lesotho "picturesque patches of small trees and shrubs" (Staples 1938) can be explained with the high rhythms of recurring fires. However, the grassland is today the dominating vegetation form. The forest occupies 25% of the territory of Madagascar and less than 1% in Lesotho. The natural succession would allow the formation of shrub land. However, grazing and fire are preventing this development.

Tab.1. Climate conditions of Madagascar and Lesotho

	Madagascar	**Lesotho**
Annual precipitation	Region 1 1 000 mm - 1 500 mm Region 2 > 3 000 mm	600 mm - 900 mm Highland in NW (altitude > 2 000 m in NW) 1 200 mm
Dry period Months	April - November 6-8	April - September 6
Strong wind	Frequently	Often
El Niño influence	Yes	Yes
Lightning	Rare	Frequently
Max. daily Temperature In Summer In Winter	 30°C 25°C	 30°C 25°C

The adaptation of vegetation to fire is reflected in the formation of extensive climax form and they have local terms.

Tab.2. The usual local names

Vegetation form	Madagascar	Lesotho
Grassland	Tanety	Joang
Bush land	Savoka	Lihlahla

Both countries have plantations in order of 5 000 to 10 000 ha. In Lesotho 5 500 ha are distributed over 400 locations.) In the plantations the highest losses by wildfires are to be expected, but unfortunately, there are no statistical data.

Fire behaviour

Forest and grass fires are occurring regularly during the dry period. The affected area per fire varies below 100 ha in Madagascar and below 10 ha in Lesotho. The reason for the small burned area in Lesotho is that this country offers a special superlative. The intensity of grazing by livestock is so high that the germinated vegetation will be browsed immediately. No accumulation of dead material takes place. Therefore, extensive fires are not possible because of lack of fuels. Nevertheless the few afforestation areas are endangered because these areas will be less grazing and dead material will accumulate. In addition fire will be frequently started to restore grassland.

The wildfires are marked generally by a low intensity. There is no acute threat for population. The fires would be able to get easily under control. Correspondingly, the material damage in the wild land is negligible, in the villages or towns the fences are often burned. The burnt area in plantations and the losses cannot be estimated. However, it is to be assumed that the highest losses occur in plantations.

Lightning as a cause of fire can be neglected under the current situation, in Lesotho, too. The vast majority of fires are caused by people, the reason can be grass renewal, country quarrels or negligence by the campfires from herd boys.

Fire control

The legislation sets up the basis for the prevention of wildfires and is in place in Madagascar. The villagers are involved in the protection of forest (Gestion Locale Sécurisée). By contrast, the context in the Forest Act (1998) of Lesotho covers that fires in woodlots are forbidden and the responsible person has to pay a fine for damage caused.

In practice control of wildfires is not actively pursued. There are neither fire brigades nor voluntary units, only ad hoc groups are formed to protect of estates (fence, building). The reaction of people to wildfire is that of indifference because the flames come slowly and with low intensity, the danger is not really appreciated. The fire is never felt as a real threat. Maybe this is the reason why fire control issues is not taken very serious.

The field was neglected up to now. There is no information about fires, affected areas, extend of damage. In this way, no cost benefit analysis can be carried out.

Social Forestry in context of fire

In Lesotho, transfer of the government forests to the communities has been intensely discussed over the past three years, but there has been no actual transfer. Also Madagascar gives too few examples, which can confirm that the transfer of forest to communities changes the attitude of villagers to forest. In such cases protection is realised and the crucial changes can be manifested through fewer fires, lower losses, demand in training courses etc.

Today in afforestation losses by fire occupy the third place in the losses ranking after browsing and damages through dryness. If the browsing problem will be solved, the losses by fire will be occupied the first position.

The extensions service gives advice to the villages about fire risk and prevention measures. But the reaction of farmers is sporadic: sometimes fuel breaks are constructed (Madagascar) or pruning is done at two meters height (Lesotho). However, the prevention measures are labour intensive and expensive. Therefore an immediate change cannot be expected.

The importance of ownership maybe not be immediately understood in this context. However a different situation could be realised where by individual ownership of grazing land was to be effected. The reliance of livestock owners on commoner's land breeds a culture of non-responsibility on the protection of that area. Overgrazing and damage by fire are not under any one’s control as a result.

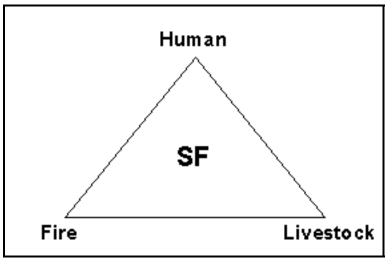
Perspective for Social Forestry

To achieve success in forest preservation and in afforestation two problems must be resolved. One is range management, the other wildfire. It is a difficult task, which cannot be solved by forest administration alone. In

Lesotho, in order to strengthen range issue the "Range Management Department" was found, but its successes so far more localised.

The second topic, the wildfire issue was neglected up to now by the forestry administration and has to be introduced in the extension service. The target group needs to be sensitised on these issues. In the case of higher state of knowledge some favourable prevention measures can be introduced successfully. The Silvopastoral System offers a very attractive and a work extensive form to reduce the fuel in forest.

To explain the control of fire the "fire triangle" (oxygen, fuel, temperature) is used. If one of the three elements is eliminated, fire extinguishes. Analogous, also for Social Forestry (SF) can be constructed a "SF triangle". The big difference in SF is that it is impossible to eliminate any element.



If the elements in some places are out of control the tendency is to upset the cycle. The Social Forestry has to establish a balance. However, fire is only a one of the three factors.

References

Pyne, J.S. 1995. World Fire. The culture of fire on Earth. Henry Holt and Company, Inc., New York, 379 pp.

Uvoo, A.D. 1996. The management and role of fire in forestry management and development in Kenya. The state of forest research and management in Kenya. Proceedings, June 1996, Muguga, p.127-129.

Staples, R.R., and W.K.Hudson. 1938. Ecological survey of the mountain area of Basutholand, Crown Agents for the Colonies, London

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Wildfires in the Andean Patagonia Region of Argentina

The Republic of Argentina has a wide range of climates, from sub-tropical to sub-antarctic, providing for an enormous diversity of flora and fauna. Depending on the time of the year wildfires are common in different regions of the country.

As we start an imaginary journey heading south from the far north, we encounter sub-tropical forests, jagged mountain ranges, immense grassy wetlands, river deltas, vast deserts, and exotic species, until we reach Patagonia. The Patagonian Andean Region extends from 35º30'S to 55ºS. In the West we find the sub-Antarctic forest with its thousand-year old trees and beautiful cold forests covering 75 km wide strip that extends for more than 2 000 km to Tierra del Fuego. In this region, fires are common from October to April.

Argentina is divided into federal provinces, and each province has a legal obligation to ensure the preservation and proper use of its natural resources The provinces are directly responsible for preventing and fighting wildfires. However, when complex fires threaten to overrun the provinces firefighting systems, the law stipulates that assistance can be requested from federal government organizations.

Fires near residential areas or those that threaten valuable economic, ecological or tourist areas, often cause public panic. Panic arises because these fires have been allowed to grow to disastrous proportion in recent years, far beyond the capacities of the firefighting teams.

Due to political and social pressures, firefighting missions have included inappropriate personnel and material resources, compounded by disorganization and a lack of operational plans. Contradictory orders and frequent public controversies among the senior staff have also contributed to the failure such operations. Because of this inefficiency, the public debate focused on the responsibility of politicians an civil servants. The solution was to confront the problem and, finally, to establish a framework for planning and distributing the resources to combat future fires more efficiently and more successfully.

Wildfires and their causes in the Andean Patagonia region

In central and southern Patagonia natural phenomena account for very few fires, since lighting storms are limited almost exclusively to northern regions. Here, as in many other parts of the world, man causes most fires. Andean Patagonian region statistics show 7% natural causes and 93% human causes.

Recent research shows that in prehistoric times, fires in this part of the continent were commonly caused by volcanoes and lighting. Fires increased later, when the first human inhabitants appeared on the scene. Around the end of last century, European settlers used it as the main tool to clear for agriculture uses and livestock and burned away a great expanse of the mountain range forest.

Fortunately, burning to clear land was gradually abandoned after the middle of the present century. In the 1970s, a strong internal migratory current gave way to the almost explosive development of the new residential buildings on natural lands covered with highly combustible grass, bushes and trees.

Since that time, the number of fires has increased steadily, and the presence of a large population in those interface areas undoubtedly influences fires.

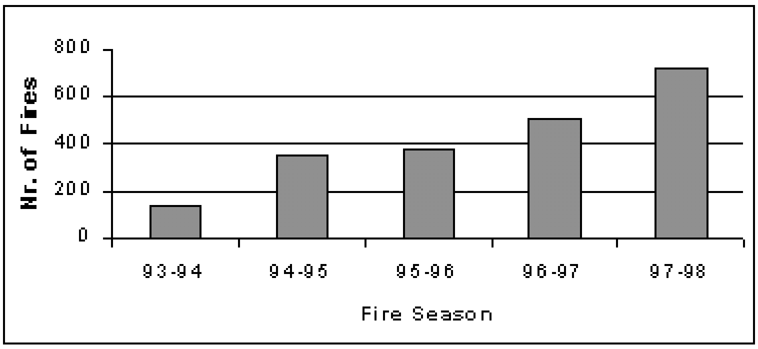

Fig.1. Wildfires in the Andean Region of Neuquén, Rio Negro and Chubut Provinces

Wildfire protection organizations

Unlike other zones in Argentina, each of the provinces in Patagonia, has been able to enact its own laws to create a forest and wildfire protection system. These prevention and fighting units have traditionally been the best structured in the country, and have achieved important organizational and functional results. This protection provincials systems train and move annually 400 firefighters.

Terrestrial firefighting resources

In Andino-Patagónica attempt to solve the organization problems, an initial evaluation revealed the need to improve and consolidate the detection and communication systems, to update firefighting equipment, and to improve the initial attack component and the extended attack organizations.

The National Fire Management Program (Plan Nacional del Manejo del Fuego - PNMF), responsible for federal assistance, purchased materials, transport vehicles, communication equipment, as well as combat elements and delivered them to the provinces. Some provinces and the National Park Management, have allocated increased budgets to infrastructure and improved their facilities and equipment.

The PNMF has also allocated funds to hire, train and equip more than 950 temporary firefighters in new brigades, while the number of personnel in charge of operational and support tasks has also been substantially increased. In fact, for the first time, essential logistical planning functions, as well as land and air operations were finally addressed in some regions.

Airborne resources

Under an agreement with the Argentine Air Force, the PNMF deploys fixed-and rotary-wing air-craft during fire emergencies to complement and support ground-based reconnaissance, detection, transport and firefighting activities. Air equipment consists of Bell 205 and Hughes 500 helicopters equipped with 1 000-litre and 450-litre Bambi buckets, respectively. A Chinook CH-47 (with a 5 000-litre Bambi bucket) reinforces the operations of the smaller aircraft. These helicopters also transport fire brigades, enabling fast access to mountainous and isolated regions without access roads. To make the work of the initial attack land crews easier, the PNMF also operates agricultural aircraft, such as the tough and maneuverable Grumman AG450 and AG6OO, and the Air Tractor AT-602. Light aircraft from the region's flying clubs perform reconnaissance and detection missions.

Air Resources Coordination responsible for all air resources works with the Regional operation Headquarters. This headquarters receives information on the characteristics and evolution of fires, then passes down operational orders to aircraft dispatchers at the different bases.

Fire Research

The Patagonian Andes Research and Extension Center (CIEFAP) is a research center created to make a contribution towards the conservation, expansion and sustainable use of Forest and Natural Resources, by carrying out applied research and technology transfer activities.

CIEFAP has as the main goals:

- To contribute to the development of forestry in Patagonia, through applied research and technology transference activities.
- To provide Andino-Patagónica adequate institutional policy for forestry sustainable development.
- To create a “forestry conscience” not only in the inhabitants of this region, but also at governmental level as well.
- To improve the skill of human resources at all levels: workers, technicians, professionals, managers and rulers.
- To find solutions to the technicians and scientific problems of the forestry sector in Patagonia

An special area, **Forest Protection**, works in wildland fire problems with fire managers and other specialists integrated in a **Fire Group Task**.

Some of the themes addressed include:

* **Prescribed burning**: Through experimental and control burning, feasibility of fire use in silvicultural activities, specially in Ponderosa pine (*Pinus ponderosa*) plantations.
* **Fuel studies**: Basic studies are developed to adapt fuel models to the BEHAVE fuel model system, and other studies including inflammability, caloric power and heat transfer in natural species bark level.
* **Fuel management**: Fuel management including fuel treatment in native and exotic forest are conducted.
* **Support to suppression activities**: Meteorological information is provided for large fires; fire behavior observations, and scientific and technical assistance.
* **Remote Sensing and Geographic Laboratory**: The Integrated Remote Sensing and Geographic Information System (GIS) Laboratory supports forest fire presupression activities, and conflagrations evaluation.
* **Post-fire restoration**: Focus on the native species *Austrocedrus chilensis.*
* **Land owner assistance**: Landowner associations (consortia) in presupression activities are technically supported.
* **Fire danger rating systems**: Different systems are being evaluated to decide for the implementation of a system for the Region.

Fire problems are increasing in Patagonia, thus are following the global tendency. Fortunately the public and authorities concern about fire problem is increasing too, and firefighting organizations are improving their efficiency.

References

Anuarios Estadísticos de la Secretaría de Agricultura, Ganadería, Pesca y Alimentación. SAGPyA 1993-1998 Buenos Aires, Argentina.

Anuarios Estadísticos de la Secretaría de Recursos Naturales, Desarrollo Sustentable y Ambiente Humano. SRNDSyAH. 1996-1998. Buenos Aires, Argentina.

Bunge Carlos A. Prevención y combate de incendios forestales. 1999. Revista Argentina Forestal Nº 3, pp 6-12. Cámara Argentina de Aserraderos de Maderas, Depósitos y Afines. Buenos Aires, Argentina.

Goldammer, J.G.; P. Cwielong; N. Rodríguez, and J. Goergen. 1996. One thousand years of fire history of Andino Patagonian forest recovered from sediments of the Río Epuyén, Chubut Province, Argentina. In: J.S. Levine (ed.), Biomass burning and global change. The MIT Press, Cambridge, MA. ISBN 0262122022

Ivandic, F. L. 1998. Forest fire fighting organization in the Republic of Argentina since 1996. Initial Attack. The Magazine for Wildfire Management. Spring 1999. Canada.

Patagonian Andes Forest Research and Extension Center. 1995. Information Brochure Nº 8. CIEFAP Esquel, Chubut, Argentina.

Rodríguez, N. F. 1999. Several non-published technical papers. CIEFAP Esquel, Chubut, Argentina.

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Community-based Wildfire Management in Mongolia

Preface

It is a fact that the number of wildfires has increased since the early 90s corresponding to changes in social conditions. Though, there are currently three distinct fire seasons which effect the forests of Mongolia, the evolution of the spring and fall fire seasons, accounting for approximately 85-88 per cent (Valendik et al. 1998), is a reflection of increased anthropogenic pressures responsible for wildfire ignition. Hence, the dramatic increase, particularly within the past three to four years, has been "socially" induced by humans. Drastically increased human activities within natural areas have caused a strain on natural environments, effecting an unnatural increase in wildfire occurrence in Mongolia. Recent increased human activity within natural areas has been recognized to be the cause of the current increase in anthropogenic wildfire. The study has revealed that the current problem of wildfire in Mongolia is only a symptom of the dysfunctioning relationship between humans (caused by their activities) and their natural environment. The reasons explaining the causes of human activity responsible for the increase in wildfire occurrence are more indirect and less apparent.

The Social Conditions of Wildfire in Mongolia

Political

For the first time, a nominally democratic system is now in force in Mongolia. A wide range of tasks has thus been decentralized and delegated to local authorities. Many local governments have been overwhelmed by the enormous commitments referred to them by the central government and ministries (Bruun 1996). Responsibilities are neglected and policy implementation has suffered as a consequence. Apparently, the blurred division of authority has made decision-making less transparent and also less legitimate in some localities, as compared to the state of affairs before the introduction of democratic reforms in local governance.

Economic

In January 1991 Soviet aid disappeared and Soviet advisers left the country. As a result, Mongolia has suffered from external shocks to the economy. The loss of trade and aid left large gaps in external trade and fiscal balances which were too wide for Mongolia to cover with stabilization measures alone (Rana 1996). One of the main problems to the implementation of effective economic reforms is the natural geographical barriers of distance. Coupled with very poor infrastructure the country has had to suffer great polarities in economic development distribution. Whereas the command economy in practice suspended the significance of geographical distance by means of cheap and abundant energy supplies, the transition to world market prices on fuel has certainly sharpened the Mongolians' awareness of distance, both within their own country and in terms of their location in the world. Especially those living in rural areas are unable to buy or sell products. The distance and lack of available, or affordable transportation make trading nearly impossible. When trading does occur then only under the conditions as set by travelling merchants, thus rural people are at a highly disadvantaged position for fair trading. In rural areas, only an average of thirty per cent of the total income is said to be in cash while the rest is in kind. In urban areas the average is seventy per cent in cash (Bruun 1996). However, it has been said that semi-nomadic livestock herders tended to suffer less than their urban countrymen during the national crisis of the early 1990s (Bruun 1996) which is perhaps the reason for the fact that herding is becoming increasingly popular during difficult economic times.

Social

The poor economic situation in Mongolia has led to a breakdown of social services which were once heavily subsidized by the state under the socialist system. The lack of income among the increasing number of poor in Mongolia and the limited options available to better the situation has meant a turning toward the only alternative possible under such conditions – dependency on natural resource utilization. The collection of natural resources for both personal consumption as well as sale is often seen as the only option for survival. The result of this dependency on natural resources has led to dramatically increased pressures on natural surroundings and protected areas. The majority of the population now relies on natural resources for its subsistence. It is estimated that particularly the young are forced to sell natural resources to support their families. Some of the main activities conducted for purposes of income generation include logging, fuelwood collection, hay making, hunting and fishing, and, most importantly, non-timber forest product collection. Since the overriding majority of the population heavily depends on these resources for their subsistence and overall survival, issues of natural ecosystem maintenance and sustainability have become a clear concern.

Trends in Findings Pertinent to Anthropogenic Wildfire Occurrence

Increase in Occupational Herding

A direct result of economic and social pressures is the trend toward an increase in occupational herding which heightens the potential risk for anthropogenic wildfire occurrence. Risk factors include intensive natural resource utilization and rangeland preparation - possibly with the use of fire. The growing influence of this group should be recognized when considering the implementation of fire management plans. Hence, it is to be expected that an increase in occupational herding, unless better controlled, will inevitably bear a significant impact on the environment and fire management. Especially due to the recognition of the growing influence of herders, alternatives to this occupation should be sought to alleviate the pressures on natural areas and their resources before problems of natural degradation or wildfire become uncontrollable. Sustainable herding practices would mean a reduction in the numbers of herders and the creation of better infrastructure to better promote avenues for business and trade, while education, particularly targeting male youths must become more accessible to increase levels of qualification for other occupations.

Increased Physical Mobility

A noted increase in migration has been observed in Mongolia particularly within the past five years as the effects of market economy have made their toll. Since the beginning of the transition process, open unemployment emerged for the first time in Mongolia (Schmidt 1995). In rural areas some estimates of unemployment run as high as 80-90 per cent of the population. The trend toward increased physical mobility is economically related. The lack of infrastructure, income, employment opportunities, and means to financial assistance are the primary motivators of physical mobility as individuals seek to improve personal situations. The increase, particularly in urban to rural mobility is a great concern for discussions on wildfire management since this trend is also largely connected to the trend in a return to occupational herding practices, as mentioned above. Urban to rural mobility also has a great impact on the increased numbers dependent on natural resources. When life becomes unaffordable in urban centres people are forced to move into the country where subsistence often does not depend on money but rather on resources for trade and barter.

Increased Social Deviance in the Adherence of Laws

In addition to the problem of poverty is the establishment of new laws that are deemed inappropriate and inapplicable given the current social conditions in these areas[8]. An example is the law prohibiting entry into protected areas for the collection of natural resources from 10 March to 1 June which only serves to eliminate previously established forms of control. Whereby compulsory registration for forest entry and natural resource extraction were commonly practiced, the inappropriate new law now prevents this form of control. Such laws are not only counter productive to ensuring that natural areas be protected, but also undermine the authority of enforcement officers leaving them powerless to control the situation and, in the case of fire occurrence, to detect the person responsible. Hence, the enactment of inappropriate new laws and the inability of locals to change their current behaviour are felt to be a couple of the main problems in the area of law implementation.

As law enforcement officers in natural areas are limited in their means and authority to better control the situation, legal structures are additionally weakened. Law enforcement is largely ineffective as, for some, no "real" punishment can be issued for illegal use or entry into the forest, since often the only risk is confiscation in the amount of fee payment. Permits for forest use and prohibition laws are often of no use and not enforcable under such difficult living conditions. Persons who cause fires cannot be penalized when the individual, as is true in many cases, has no means of paying fines. To make matters worse, enforcement officials are in a position where they are unable to properly enforce laws, as situations are so drastic and the number of those breaking the law greatly outnumber officials. Due to governmental constraints in funding, patrolling must be currently done with privately owned modes of transportation (e.g. using one’s own horses). Even articles for purposes of self defence are the private property of officers. Hence, environmental law enforcement is weakened resulting in haphazard, largely inefficient, and non-standardized practices. During seasons of high fire risk, few rangers are available to patrol vast areas of forest, making it virtually impossible to effectively control trespassers. Given the current state of affairs, assistance to rangers has become practically non-existent as locals are in a position to empathize with each other resulting in conscious inactivity in matters of public control. Enforcement in the prevention or early detection of fires is thereby

[8] From 1990 to mid-1992, over 60 laws had been enacted and more than 500 government resolutions were issued by the Council of Ministers to facilitate the implementation of the various laws (Schmidt 1995).

hindered as enforcement controls are weak at a time when society is simply unable to conform to prescribed regulations, and enforcement officers are limited in their options for penalizing offenders. Environmental lawlessness is born out of the survival needs of the people who are currently living in difficult economic times. Should the above mentioned problems be reduced or eliminated, the natural consequence could very likely be a turn to the adherence of laws.

Discussion

Though considerable progress in wildfire suppression has been recently achieved due to the GTZ Integrated Fire Management (IFM) Project in Mongolia, long distances, restricted access and steep slopes continue to make fire prevention the key to sustainable development. As illustrated, the complexity of the trends is due to the effects of more basic and widespread issues of poverty and inappropriate development. With this recognition, most trends are inherently interrelated. Hence, a reduction in the lifestyle trend toward increased subsistence herding would automatically have an effect on improvements to the implementation and enforcement of environmental laws as current pressures on natural areas would consequently be reduced. In the same way, if the trend toward increased division of urban and rural wealth disparities were to be adequately addressed then changes to the trend in lifestyle would also be noticed. These trends are reflections of ongoing and dynamic social conditions, i.e. the same conditions which effect the current trend in increased anthropogenic wildfire occurrence. Thus, the natural and social environments of Mongolia affect and are simultaneously effected by these current trends.

An understanding of these trends is thereby crucial when considering the implementation of an effective wildfire management plan. The establishment of the office of Ministry for the Protection of Nature and the Environment in Mongolia to address the growing expressions of concern for the natural environment is but only a first step. Proper recognition of the underlying reasons affecting the apparent problems is fundamental for successful and sustainable policy implementation. Similarly, an effective fire management plan greatly depends on how these problems are addressed. In order to do so, the recognition of social trends is necessary to better understand the potential influences and impacts which these trends may have on fire management plans.

Conclusion

The above given trends in human activity show under which social conditions the occurrence of wildfire are dependent for its reduction or increase. Though it is often assumed that the problem of increased wildfires is the result of decreased awareness through reduced propaganda or education warning against fire, the study has revealed that a general awareness of the dangers of fire does exist, but that out of general need, people are currently not in a position to effectively eliminate the occurrence of anthropogenic wildfire. Social need must first be addressed. Hence, awareness, though it does play an important role, is not the key issue to be addressed for the long-term reduction of wildfires. Education is not enough as measures must be taken to ensure a more stable social environment. The true problems must be recognized before they can be suitably addressed. Resonance of the state of the social environment goes on to effect the surrounding humanly-influenced “natural” environment. The uncovered trends serve to assist in the recognition of the social conditions currently having an effect on the increase in anthropogenic wildfire for the areas of Batschireet and Mongonmort in Mongolia.

It must be remembered that wildfire occurrence is only one expression, one symptom of larger underlying problems prevalent within the social environment. Human activity and its effect on natural surroundings can no longer be denied. To ignore the social issues as noted would only result in the generation of new, recurring, and / or continued existence of current undesirable symptoms within the environment in Mongolia – natural or otherwise. Action must be taken or irreparable damage to the natural environment through wildfire occurrence could very well be nature’s final means of addressing the problem for us. A socio-ecological balance must, therefore, be sought.

Literature

Bruun, O., and O. Odgard (eds.) 1996. Mongolia in transition: Old patterns, new challenges. Curzon Press Ltd., Richmond, Surrey. 272p.

Rana, P.B., and N. Hamid (eds.). 1996. From centrally planned to market economies: The Asian approach. Vol. 2. People’s Republic of China and Mongolia. Oxford University Press, New York, U.S.A.

Schmidt, S. 1995. Mongolia in transition. The impact of privatization on rural life. Verlag für Entwicklungspolitik. Saarbrücken, Germany.

Valendik, E.N., G.A. Ivanova, and Z.O. Chuluunbator. 1998. Fire in forest ecosystems of Mongolia. Int. Forest Fire News No. 19, 58-63.

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Twelve Fire Management Centres at District Level within the Province of East Kalimantan, Indonesia

East Kalimantan remains poorly prepared to deal with vegetation fires on the scale experienced during the drought of 1997 and 1998. A similar picture exists in the other provinces of Kalimantan and in Sumatra: few fire crews with poor command and communications structures, insufficient firefighting equipment, and inadequate training.

The German funded Integrated Forest Fire Management and Control Project (IFFM), working with the Provincial Office of the Ministry and Forestry and Estate Crops (MoFEC) in the Province of East Kalimantan, has identified the provision of support to Forestry Districts Offices (Cabang Dinas Kehutanan Tk. II) as the most effective way to strengthen fire fighting capacity - and fire prevention - in the immediate future.

A selective approach to firefighting which gives priority to the District level

The areas potentially at risk are great. There are three categories of land that require priority protection, each of which has a particular management requirement:

- Virgin forests and conservation areas: forest guards from the Ministry of Forestry MoFEC (*Kanwil Kehutanan dan Perkebunan, Dinas Kehutanan* and *Dinas Perkebunan*).
- Commercial forest areas with timber concessions and forest plantations (*HPH*, *HPHTI)* and estate crops: fire management plans (following the example of the timber concession *PT. Limbang Ganeca* in East Kalimantan).
- Zones near to villages: volunteer firefighters and NGOs (the villagers have an extensive knowledge of fire as it is used in traditional land clearing).

The Districts (*Kabupaten Tingkat II*) are the key to the formation of an effective system of fire prevention and control within each Province. The District Forestry Head Offices must be quickly and strongly supported to enable them to provide effective implementation in the field.

Fire crews, equipment and training

Far too little attention has been paid to the practicalities of firefighting in Indonesia. During the last years, it became clear that little importance is being given to the organisation of firefighting and to training and equipment at the field level.

Setting up an efficient fire control organization will take considerable time and funds - more than to install high technology systems - but if nothing exists on the ground, what use are satellites and computers?

Sophisticated techniques, such as Fire Danger Rating Systems, can help firefighters to anticipate risks, but… in many places fire crews do not yet exist in the field.

The fire crews

The fire crews are the foundation of any system to prevent and control fire. Without them, all the provided high technology is useless. The primary need is to form, train and equip District level fire crews.

Step by step, fire bosses and crews will be more successful. Along the way, they will obtain the recognition from the authorities and the community that is so necessary to gain high motivation and good results.

Equipment

Field experience has shown the necessity to keep equipment simple, compatible and adaptable. Over-complex equipment is never used or is quickly broken. Fire equipment, especially pumps, cannot be distributed without training.

For their safety, the fire fighters need proper protective gear.

There is an urgency to constitute, at the national or ASEAN level, a study group to determine and define appropriate standards for firefighting equipment:

- Individual protective equipment (helmets, clothes, boots, gloves)
- Robust, simple and effective hand tools (rake-hoe for fire lines), backpack pumps
- Motor pumps, fire hoses and junction parts (all compatible)
- Adaptable fire tankers (small trucks) and supplementary kits (slip-on tank units)

Standardization will avoid money being wasted on the purchase of equipment that is too complex or slow during use, that is incompatible with other equipment, and that is sometimes hazardous to firefighters. It is incumbent on donors to adhere to the agreed standards.

Training

- **Fire fighting** depends on well-trained crews kept in practice with regular theoretical and practical courses. The IFFM GTZ project (East Kalimantan) and FFPCP European Union project (South Sumatra) have prepared joint guidelines to train forest firefighters. Managerial staff need more advanced training in forest fire management, forest firefighting and ‘tactical reasoning’. They also need an effective radio system adapted for use in fire management. The strategic pyramidal organization and the tactical chain of command are concepts which remain to be developed, but whose absence must not hinder field level development.
- **First Aid** knowledge and training is essential in case of accident. Firefighters must be able to rescue their injured colleagues, or wounded civilians.
- **Discipline** is necessary for firefighting campaigns that require numerous personnel for many days. On a large scale, fire control must be conducted with methods and discipline that resemble to paramilitary procedures.

Twelve Fire Management Centres at District Level

The prime need is to form, train and equip District level fire crews; the foundation of any future system. To this end IFFM has advised on team formation and provided training within the Province. Crew safety is considered paramount: the necessity for protective clothing, risk avoidance and first-aid are stressed. Once understood, training continues in the choice and use of equipment to suppress vegetation fires, and in basic fighting tactics.

With a special grant from the German Development Bank (KfW), twelve Fire Management Centres will be supported in East Kalimantan; ten Forestry Districts Offices and two National Parks. For their efficiency and safety, each fire centre will receive adapted firefighting equipment and proper protective gear;

* Slip-on tank units with pick-up, tank trucks and crew carriers
* Portable power motor pumps, fire hoses and portable tanks
* Backpack pumps, chain saws and hand tools, individual protective equipment (helmets, clothes, boots, gloves, goggles)

The twelve Fire Centres will be also equipped with computers, printers and Internet E-mail system allowing them to receive information as Fire Danger Rating or maps with located fires (hot spots from satellite). Increased success brings recognition from authorities and community and, with this, increased motivation and achievement.

In the longer term there is a need to establish a national fire management organisation which encompasses both prevention and control. Modern methods to anticipate and manage risk, allocate resources, and deal with crises are needed if periodic smoke and haze events are to be avoided. Such an organisation will need continued, substantial donor support. For now, well-trained, simply-equipped district level teams are an effective and realistic beginning.

A modern fire management organisation for both prevention and control

Everybody agrees that now is the time to:

* "Make the decisions when the house is not burning".
* "Catalyze action when it is not an emergency".
* Put in place an institutional structure before the next *El Niño*.
* Reinforce application of the laws.
* Include firefighting methods and equipment within all the different action plans.

There is a need to establish a modern fire management organisation founded on strong, practical District-based solutions. Prevention and control cannot be dissociated. It is necessary to organise an effective command structure, through a single responsible Ministry, with indispensable links to the other concerned authorities and partners: military, police, and the chain 'Governor – Head of District (*Bupati*) – Head of Sub-District (*Camat*) – Head of Village (*Kepala Desa*)'.

Methods to anticipate and manage risk, to allocate resources, and to deal with crises are needed if periodic severe fires and smoke haze events are to be avoided. From the theory, and using the existing regulations at National and Provincial levels, we must now move quickly to activate field level implementation.

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The Impact of Fire on Native Vegetation
The Example of the Cool-Temperate Forest in Patagonia, Argentina

Introduction

Fire plays and will play an important role in forestry and in most forestry projects. However, it is often difficult to determine precisely the role of fire in environmental development. On one hand, regular natural catastrophes including natural fires happen, on the other hand, since thousands of years, men are interfering with natural processes. The current nature presents itself as a result of an adaptation to those external effects. The overlapping of different elements makes it often impossible to define the single cause and its effects. In order to achieve a better understanding of the reciprocal relationship "fire and vegetation" it is advisable to use a model.

One of the few areas on earth, where fire and people were closely interrelated first in the last 200 years, is the southern part of Patagonia. The here presented small section of one great region of temperate southern forest in South America contains approx. 300 000 ha forest and is situated around 42°S latitude in the Andean mountains of Argentina. Of course, there were fires in the past but it generally occurred as disasters like for example due to volcanic eruptions or earthquakes. There were hardly any fires caused by lightning. Between each disaster were long periods of uninterrupted succession. The situation in the northern part of Patagonia and the far south Tierra del Fuego (Fireland) is different from the region described here. The settlement activities in the described region began at the end of the 19th century. This led to fire activity in until this time unknown dimensions. In a few years, blazes affected millions of hectares of native forest.

The weakness of this model is, that the area was grazed. Livestock suppressed regeneration frequently. Nevertheless, it is possible to recognize the human interference, the results of fire abuse and the regeneration dynamics and tendencies in the native forest.

The aim of this article is neither to submit scientific proof nor to show the complex relation between ownership (legal frame) and fire, but to impart a perception of human interference on the forest structure. In order to be brief, relations are presented in a simplified manner. The described process is based on observations and some research but the whole should be understood as a hypothesis.

Climate

The climate is characterized by a particularly extreme distribution of precipitation:

The west-to-east precipitation gradient. Within only 60 km, the annual rainfall declines from 4 000 mm in the West (Andean mountains) to 350 mm in the East (steppe).

Mediterranean-type rainfall seasonality. Winter is the rainy season (70% of the annual rainfall). The summers are very dry. Drought periods of six months are no rarity.

The weather conditions in the region have crucial impacts on the behavior of fire

* Permanent strong western winds (>30 km/h)
* Minimum relative humidity during drought drops frequently below 10%
* Maximum temperatures rise over 30°C

Vegetation

These extreme climatic conditions and rare natural catastrophes (i.e., volcanic activities, earthquakes) in this particular area are certainly responsible for the dominance of few main tree species in a strange stripe form (Fig. 1a). The boundaries are defined by the amount of precipitation and the temperature. Because of the simple structure, the region is just right for the model of fire impact.

Initial situation

The vegetation cover 150 years ago is presented in Figure 1a. The distribution of Ciprés (*Austrocedrus chilensis*) reflects its ability to withstand xeric conditions, it occupied frequently the drier regions (steppe range). This species is growing close to the settlements and is an important supplier of timber.

Lenga (*Nothofagus pumilio*) forms the timberline at 1 000 m a.s.l. in this area. To the south the distribution area falls to sea level. This species supplies an excellent furniture wood and is economically interesting despite of many rot problems.

Between the habitats of Lenga and the Ciprés a transition zone of Ñire (*Notofgaus antarctica*) is observed frequenty. This species is much smaller than the other two. It reaches often only shrub size. But the Ñire occupies an ecological niche, for the Ciprés it is already too cold, for Lenga too dry. The economic benefit of this species is low because it provides firewood only.

First extensive Wildfires

The circumstances of land reclamation in Patagonia takes a similar course like in other parts of the world, e.g. in Australia (Pyne 1991). The first extensive fire took place at the end of 19th century. Pastoralism was the economic and ecological engine of European settlements. The pioneers were looking for new pasturelands and used the power of fire to clear of the land. They knew that the fire could, immediately, transform marginal bush land into pasture. They believed that fire could reduce weeds, control pests and slow down the re-invasion of scrubs.

Cypress was damaged strongest. Fire in the pure and dens stands of *Austrocedrus chilensis* (mesic forest) has an extreme behavior involving high rate of spread, prolific crown fire and spotting. However in the steppe ecotone (xeric woodlands), Ciprés occurs in open woodland but still with high accumulation of fuel (grass, shrubs), enough to create fires with lethal effect. The species reacts sensitive to fire.

However, small “islands” often remained only on rocky (lack of fuel) or wet sites (Fig.1b). These islands secure a fast regeneration. The species shows certain characteristics of a pioneer species, but the seedlings require mostly some protection from desiccating wind and high radiation (Meier 1992, Veblen 1995). For the beginning of regeneration more than 30 years can be necessary before a favorable microclimate has been established.

Lenga was far less damaged if the affected area will be used as parameter. The fire extends here slowly, nevertheless with a catastrophic effect (abundance of heavy fuel). All trees die after fire. It has no coppices, and the regeneration period is very long. Lenga shows in the mesic sites a sharp transition between the intact forest and pasture (= old forest area affected by fire).

Unlike the previous two species the Ñire extended its distribution area. However, this species dies but it has coppices and good regeneration ability too. Unfortunately it forms an extensive shrub land with high fire hazard.

Successive fire (fire intervals less than 30 years)

First fires can be seen as favourable if the bio-diversity is the criterion for the review of the impact of fire. The initial homogeneity was disturbed by fire; the large-areas of "monoculture" were transformed into mosaic structures.

The first colonists used fire in order to win grassland for their domestic animals. The process went haphazardly. Each new fire meant a local drama. The islands of old forest disappeared and the succession was interrupted. The evolution was set back by decades (Fig.3). Successive fires in a short sequence reduced the biodiversity, too. Therefore the subsequent fires have to be seen as negative.

The succession stage is a very crucial period and plays an important role by spreading of fire. Therefore, it should be discussed more detailed. The succession needs decades in this region. Shrubs dominate during this time. The entire increment accumulates in thinner boughs, which die in shadow conditions. In this way, 20 t/ha of dead material (fine and middle material <5 cm diameter) can gather in three decades over the ground. It is an inflammable mixture. No miracle that the subsequent fires expand fast on the regenerating areas. From there, the fire consumed the primeval forests. The primary forest area decreases with every fire, the continuous stripes dissolved (Fig. 1c-d). Less and less “islands” remained on the southern aspect (humid site).

The Ciprés area is reduced strongest by fire, only a fraction of former forest exists at present. In the transition to the steppe (xeric condition), only small, occasional islands with 10 trees on rocky hills testify an ex-distribution area.

Lenga has also been strongly decimated on the drier site (e.g. Pre-Cordillera), from the stripe remained medium-sized islands only.

Ñire is the clear winner; the species regenerated fast on the affected areas and colonized the neighbour areas. An impenetrable shrub sea stretches thousands of kilometers along the cordillera as far as Fireland. Millions of hectares cannot be fully used in an economical sense of view. The wood is suitable for firewood only, but the demand for firewood is little. However, this areas are grazed but with small profit. Approaches to replace this species through exotic ones (e.g. *Pinus ponderosa*) failed mostly due to the high clearance costs (> 400 US$/ha). Currently, it is cheaper to afforest the steppe.

In this context also the influence of livestock should be considered. Just on the xeric sites, the combination animals and fire is a fatal combination for the forest. The regeneration does not get on, but in the meantime fires destroy more and more native forest.

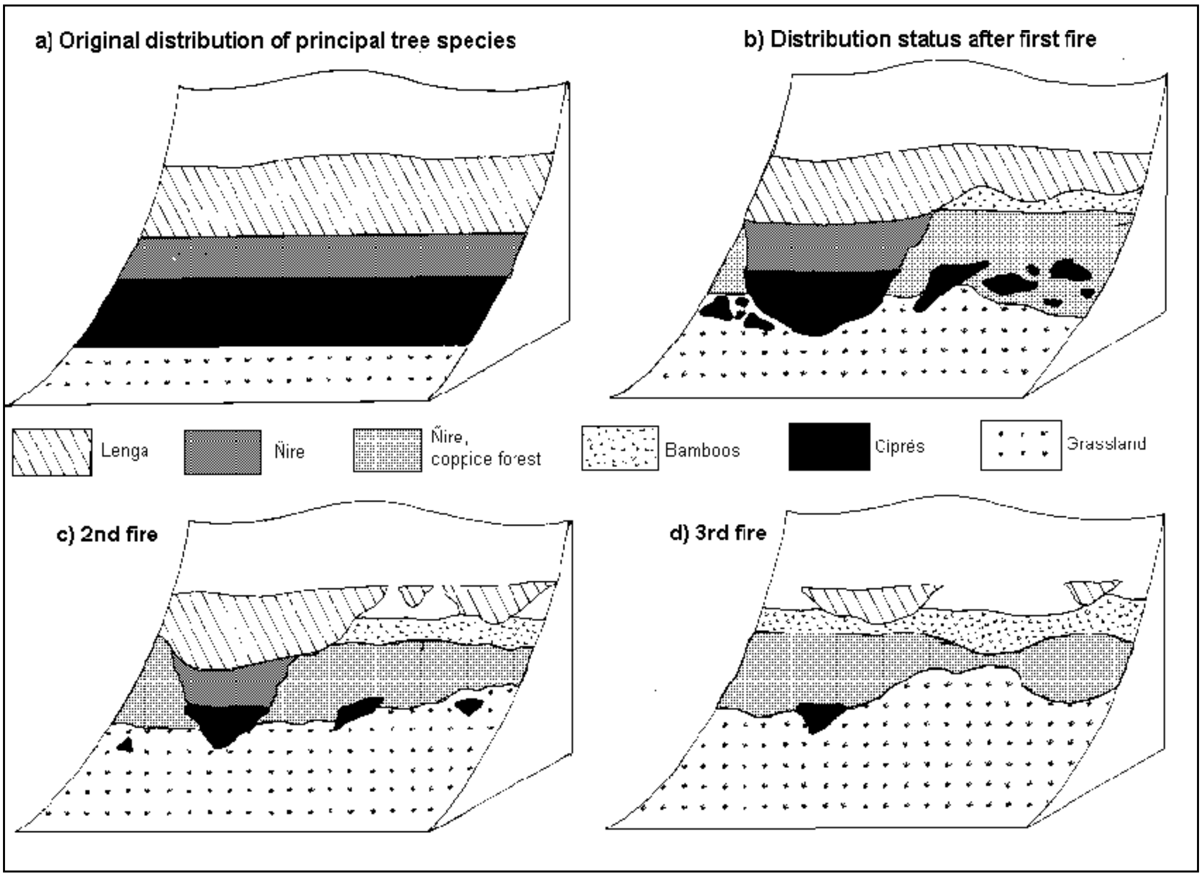

Fig.1. Distribution of the principal trees and fire disturbance in the cool temperate latitudes in the southern Andes (42° S)

Fire and succession

Every plant society reacts differently to disasters. Most of the research in this regard was on Ciprés forests. Of course, there are great local differences. However for didactic reasons, these differences cannot be considered. The regeneration process is shown in an abstract way in Figures 2 and 3. This semi-pioneer species has frequently problems to regenerate immediately the fire affected the areas. Only if protected by other plants, it succeeds finally. 60-100 years might pass until the initial situation will be achieved again (Fig. 2).

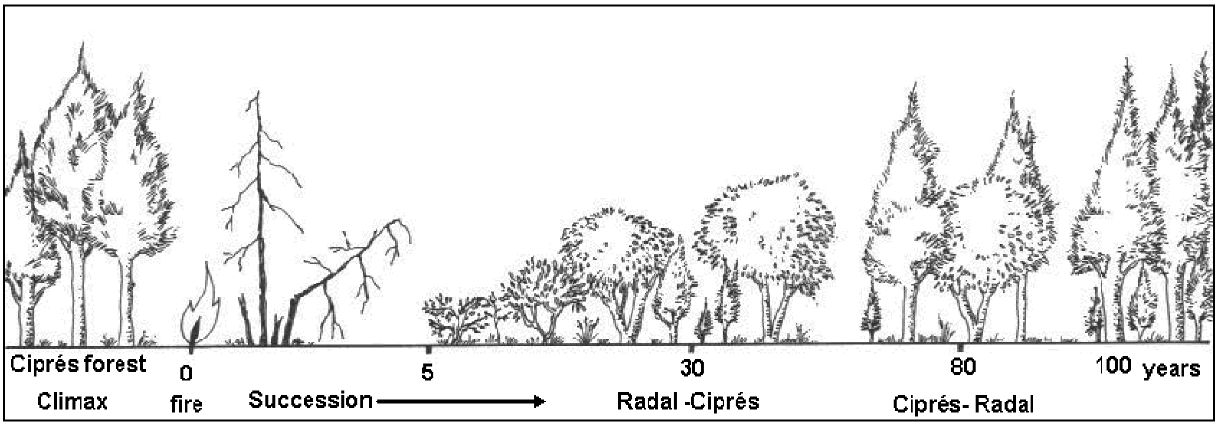

Fig.2. Post-fire succession in Ciprés forest

Indicates Species: Radal (Lomatia hirsuta). Other abundant shrub species in early post-fire stages are Aristotelia maqui, Fabiana imbricata, Schinus patagonicus, Berberis spp. etc. (Meier 1992 and Cwielong 1994).

An indicator species is Radal (*Lomatia hirsuta*). Other abundant shrub species in early post-fire stages are *Aristotelia maqui*, *Fabiana imbricata*, *Schinus patagonicus, Berberis* spp. etc. (Meier 1992, Cwielong 1994).

Succession is disturbed again and again by recurring fires, the result is an artificial stage of development of biota. The seral stage (Fig. 3) is determined by fire regime (fire climax). If the frequency of wild fires occurs every 30-60 years, only shrub vegetation can develop (Fig. 3).

Close to settlements, fire occurs in shorter intervals. The vegetation often burns every 3-5 years. Under such intense fire influence, only grassland can grow (Fig 3).

Conclusions

Fire is burdened with emotion, and there are tendencies to dogmas. On one hand, there is the European point of view, which considers fire as a source of disturbance only. Whereby the "American" movement has an opposite view. Their fire ecologists see the wildfire as a component of the natural system. Every side can be right, but if one side defends an extreme interpretation it can go wrong. All depends on the local situations.

Reality is not white or black but frequently grey. Nature should be considered in a differentiated manner. The results of a fire can be locally devastating, however regionally it can also bring some advantages. Even in a modest through fire-burdened system like the here presented forest in Patagonia, fire can show advantages, e.g., humus decomposition and increase of biodiversity.

Single or sporadic fires normally support a mosaic structure and raise a variety of flora and fauna. The negative balance predominates, if it burns often and uncontrolled. Wildfires in short interval support grassland, that often forms a fire climax. Therefore not a large single fire leads to disaster but the sum of frequent uncontrolled fires. The disaster is not only ecological but often also economic.

In the here presented region, millions of hectares of native forest were lost irretrievably. In the present days, it is realized that this primeval forest would contribute more to GNP as grassland and shrub vegetation. A reasonable action to achieve financial advantage in a short time turned out to be a bad solution on a long-term basis. The pastoral explosion not only destabilized indigenous biota but also modified them in a way that made reconstruction impossible.

It is easy to transform the high-energy forest systems to grassland; wildfire like each chemical reaction follows the enthalpy gradient. However the return to the initial state is difficult and expensive. The transition form grassland to forest leads through a long period of shrub vegetation. However especially this vegetation stage is endangered extremely through fire. In presented area of Patagonia no fire should be given at least 80 years.

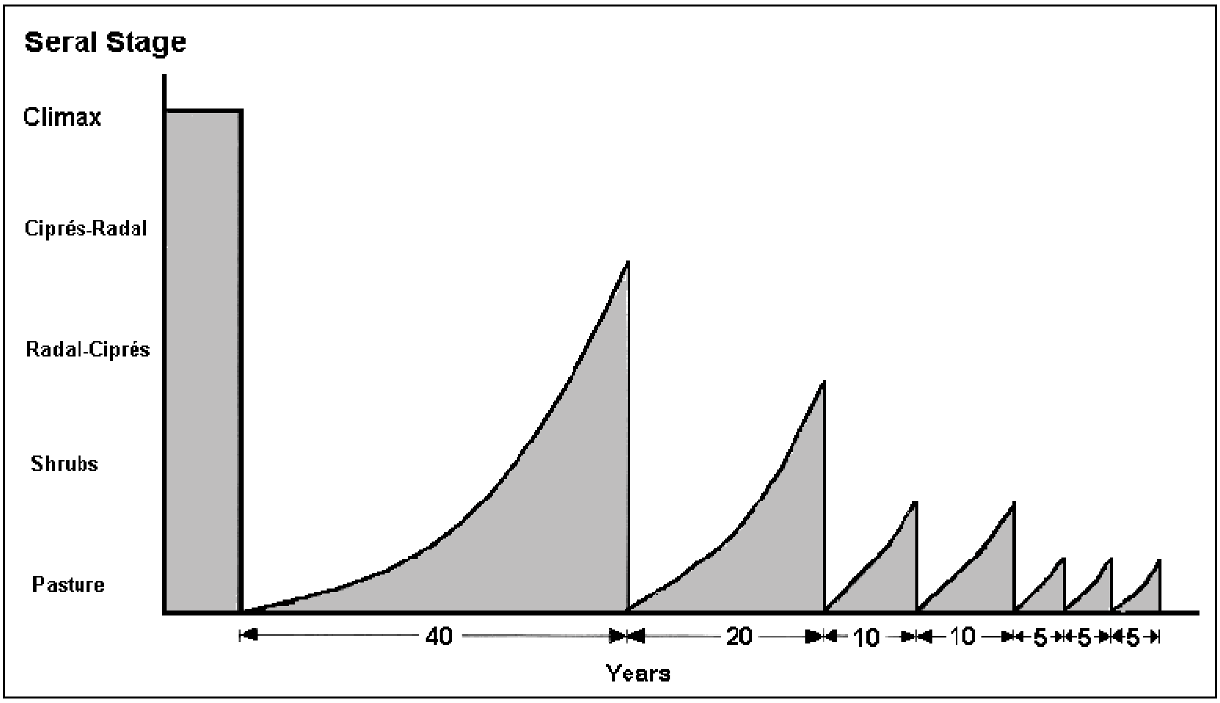

Fig.3. Fire frequency and succession in Ciprés (*Austrocedrus chilensis*) forest

But to claim a fire free region is an illusion today. Three factors are speaking against this:

1. The frequency of the fires often depends proportionally on population density. The extension campaigns can reduce the risk significantly but not completely because of accidents and criminal intentions. Since the population increases constantly, a steep rise of wild fires can be anticipated.
2. The intact primeval forest areas will still be reduced and parallel the fire endangered succession areas (and secondary forests) will be extended.
3. Fire protection (control and prevention) is expensive. The most developing countries because of the increase of population will not be able to find necessary financial funds.

It is still a speculation, but the announced change of the climate could even aggravate the situation in some regions. All signs refer to a further increase of the fire activity.

The future problems of the forest projects will be that the classically European strategy for fire prevention (control and extension) alone will not bring the desired success. One has to think, maybe against the inner conviction, whether it is not more reasonable, to use the instruments of fire ecology to avoid larger disasters.

References

Cwielong P., N.Rodríguez, and G.Meier. 1994. Regeneración post incendios en bosque de Ciprés area Lago Epuyen. Anales 1991-1994, Vol. 1, 116-133. CIEFAP, Esquel.

Meier, G. 1992. Wiederbesiedlung von Brandflächen durch Ciprés (*Austrocedrus chilensis*) und andere natürlich ankommende Baum- und Straucharten in Nordwest-Patagonien. Diplomarbeit. Universität Freiburg, Arbeitsgruppe Feuerökologie.

Pyne, S. 1991. Burning bush. A fire history of Australia. Henry Holt and Company, Inc., New York, 520 pp.

Veblen, T.T., B.R.Burns, T.Kitzberger, A.Lara, and R.Villalba. 1995. The ecology of conifers of Southern South America. In: Ecology of the southern conifers (Enright, N.J. and Hill, R.S., eds.), 120-155. Melbourne University Press, Carlton, Victoria.

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The 1997-98 Air Pollution Episode in Southeast Asia Generated by Vegetation Fires in Indonesia

Introduction

Between July and November 1997, an estimated 45 000 km^2 of forest and land burnt on the islands Sumatra and Kalimantan. In the first half of 1998, another fire episode affected roughly a similar area in Kalimantan alone. The emissions of these fires caused considerable air pollution throughout the Southeast Asian region, notably in Indonesia, Singapore and Malaysia. The air pollutant that predominantly caused violations of ambient air quality standards was particulate matter. Particulate matter may cause acute and chronic respiratory diseases such as bronchitis, asthma and upper respiratory tract infections. Increased ambient particle concentrations are suspected to be linked with increased daily mortality. By scattering and absorbing light, particulates also result in reduced visibility, impairing transportation by air, land and water. Fire-related air pollution episodes are a recurrent phenomenon in Southeast Asia. Nine such incidents have been reported over the last 20 years, of which the 1997/98 smoke haze episode attracted the broadest attention.

In contrast to Singapore and Malaysia, Indonesia does not yet have an integrated air quality monitoring network which could provide real-time, region-covering air quality information. Due to the absence of such information, an assessment of the severity of the fire-related air pollution episodes is limited. As a surrogate, horizontal visibility was frequently used to report the status of ambient air pollution. However, even though sufficient information on the status of air quality was available in Singapore and Malaysia, much uncertainty existed on the impacts of such air pollution episodes and on how to response adequately to them. The governments of the affected countries recommended the public to remain indoors as much as possible, to avoid physical exertion and to wear respiratory masks outdoors. In Kuching, Borneo-Malaysia, the state of emergency was proclaimed for 10 days in 1997, leading to the closure of schools, public offices and factories. Dubious statements in the media on the impacts of the smoke haze were disseminated - such as the daily exposure would equal to 20 to 40 cigarettes; panic easily evolved.

Smoke-haze development in 1997/98

The influence of the 1997 fires in Kalimantan and Sumatra on ambient air quality was discernible by July, peaked in September/October and weakened by November, when the delayed monsoonal rain extinguished the fires and scavenged the atmosphere. During the peak episode, satellite imagery (NASA/TOMS aerosol index maps) showed a smoke haze layer which expanded over an area of more than 3 million km^2, covering large parts of Sumatra and Kalimantan. Its northward extension partially reached Malaysia, Singapore, Brunei and Thailand. During this period, particulate matter concentrations frequently exceeded national ambient air quality standards. Scanty particle measurement data at hand for areas close to fires in Kalimantan and Sumatra indicate that ambient particle concentration was roughly 20 to 40 times the normal (non-haze) background concentration and exceeded levels categorised as 'hazardous' (or 'significant harm level')[9]. Monthly mean horizontal visibility at most locations in

[9] This categorisation is based on the Pollution Standard Index system of the US–Environmental Protection Agency. Pollutant concentrations below the national ambient air quality standards are categorised as 'good' to 'moderate' air quality. With increasing air pollution, the terms 'unhealthy', 'very unhealthy' and 'hazardous' are applied. The upper limit of the 'hazardous' range is the upper limit of the index system, described as the 'significant harm' level.

Sumatra and Kalimantan in September was below 1 km and daily maximum visibility was frequently below 100 metres.

The neighbouring region most affected by pyrogenic transmissions in 1997 was Sarawak, Borneo-Malaysia. In the city of Kuching, ambient particle concentration rose roughly 5 to 20 times above background levels, with in total 32 days in the 'unhealthy to hazardous' range. Visibility decreased from generally above 15 km to below 0.5 km during this period.

In Singapore and Peninsular Malaysia, a 2 to 5-fold rise in ambient particle concentration was recorded. 12 and more than 40 days, respectively, were in the ‘unhealthy' range in Singapore and Kuala Lumpur. Visibility below 2 km predominantly prevailed at both locations during the smoke haze episode.

In contrast to the situation in 1997, the fire-related air pollution episode in the first half of 1998 was essentially restricted to Borneo. This was mainly due to the weakened southerly monsoonal flow by that time. However, again, the population in Kalimantan and Borneo-Malaysia was exposed to distinctively elevated air pollution for a period of months.

Impacts of the smoke haze episodes

In all countries affected by the smoke haze, an increase of acute health outcomes was observed. Health outcomes included emergency room visits due to respiratory symptoms such as asthma, upper respiratory infection, decreased lung function and eye and skin irritation. In Singapore, for instance, health surveillance showed a 30% increase in hospital attendance for haze-related illnesses. Generally, individuals such with pre-existing respiratory and cardiac diseases, but also elderly and children are most susceptible to adverse health outcomes from haze exposure. In addition to the acute effects, chronic diseases are likely follow. The smoke haze episodes add to the urban and industrial air pollution in Southeast Asia, which has reached alarming levels in many metropolitan areas. The synergistic effects of smoke haze and background air pollution are uncertain.

Besides health impacts, impaired visibility seriously affected the economies of Indonesia, Malaysia and Singapore. Among the economic sectors affected most were air, land and sea transportation, construction, tourism and agrobased industry. EEPSEA/WWF roughly estimated the economic value of the damages caused by the 1997 fires and haze. They estimated 1 billion US$ of haze-related damages for Indonesia only. The damages to Malaysia and Singapore are figured at 0.4 billion US$. Including the fire related damages, the total damages are estimated to amount to 4.5 billion US$. However, a variety of the damages such as decreased quality of life, losses of biodiversity and atmospheric impacts are difficult to monetarise.

Fire-related smoke haze episodes also reveal a social component: a large part of the population in Southeast Asia do not have the financial means to buy protective measures such as respiratory masks and air conditioning nor are they able to refrain from outdoor work when air pollution is high. The same applies to medical treatment costs for haze related ailments.

Regional response to the 1997/98 smoke haze episode

The 1997/98 smoke haze episode resulted in an intensification of regional measures towards cooperation in fire and smoke management which were initiated in the aftermath of the 1991 and 1994 smoke haze episodes. These measures include the establishment of ASEAN Haze Technical Task Force and the implementation of Regional and National Haze Action Plans. These plans define the ASEAN’s countries contribution to fire prevention, monitoring, fighting and other mitigation measures. Among others, it is also targeted to upgrade the national air quality and meteorological monitoring networks in order to strengthen the region’s early warning and monitoring system in respect to smoke haze.

The 1997/98 once again made evident that in addition to a sound fire management a fundamental revision of the current land conversion and fire use policies is required to prevent the reoccurrence of similar episodes. Groundbased and airborne investigations of the smoke haze 1997 indicated that fires on peat swamp vegetation made a substantial contribution to the smoke haze development, which, however, are estimated to have contributed only 30% to the total area burnt. Given this apparent particular relevance of peat swamp fires to the development of transboundary smoke haze, emission reduction and control strategies will have to focus on the prevention of fires in this type of vegetation as a matter of priority.

Thus, future land use management will also have to consider 'air use' management. The health impacts and economic damages of the 1997/98 demonstrated that controlling future haze events represents an influencing factor for public and economic prosperity in the Southeast Asian region.

Response of the GTZ to the smoke haze crisis

To improve the preparedness to such kind of crisis, GTZ Indonesia has appointed a Haze Emergency Coordinator (HEC) in 1997 to collect and analyse data on haze development, improve information flow and to give guidance for co-ordinated recommendations to people at risk from haze exposure. During the 1997/98 smoke haze episode, daily status reports for haze-affected project locations were prepared. Leaflets on suitable respiratory masks, air conditioning and other protective measures were distributed. Since only insufficient air quality measurement data were available, the air pollution level was estimated using visibility, satellite imagery and wind maps. Twice in 1997/98, GTZ staff and their families in smoke haze affected regions were advised to leave their project location to haze-free areas.

A key question that came up during these activities was what standards are to be applied for fire-related air pollution episodes. Are air quality standards, which are generally set for urban air pollution, suitable for haze episodes? At what pollution level should people leave to haze-free areas? But also, how should urban air pollution in Southeast Asia, which frequently exceeds levels experienced during haze episodes, be dealt with? A standardised answer can only be given with further input from science and policy. Within the GTZ, the decision on protective measures will be based upon all information available on the pollution levels, the haze development forecasts, the long and risky transport possibilities, organisational and psychological considerations and the costs involved.

The haze related activities on behalf of the Haze Emergency Coordinator supported the overall haze related activities within ASEAN. A regional air quality data base has been established that is used by various agencies attempting to assess the health impacts of the 1997/98 smoke haze. Collecting and evaluating air quality information and disseminating them to the public is essential for broadening the overall awareness towards air pollution, and in particular the connection between smoke haze and vegetation fires.

For further information, please refer to

- Haze Guide as http://www.iffm.or.id/haze.html
- Heil, A., and J.G. Goldammer. 2001. Smoke-haze pollution: A review of the 1997 episode in Southeast Asia. J. Regional Environmental Change (in press).
- Haze-related links at http://www.uni-freiburg.de/fireglobe/se_asia/projects/cgif.html
- Haze Emergency Coordinator c/o Consultative Group on Indonesian Forests/GTZ-SMCP, Manggala Wanabakti Block VII 6th floor, Jakarta 10270.

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COUNTRY NOTES

CYPRUS

The Forest Fire Situation in Cyprus

Introduction

Cyprus is the third largest island of the Mediterranean with a total land surface of 925 148 ha. It is divided into three geomorphological zones with a variable topography: (1) the Pentadactylos mountain range, including the Karpass peninsula; (2) the Troodos mountain range; (3) the Mesaoria plain. The central core of the two mountain ranges is characterized by steep slopes, vertical cliffs, deep gorges, narrow streams, and long mountain ridges, while their foothills are characterized by rounded, trapezoid or conical hills, usually with steep lateral slopes. The Mesaoria plain is situated between the two mountain ranges and it is characterized by extensive flat areas and trapezoid or conical hills, usually with steep lateral slopes.

The climate is Mediterranean, characterized by hot dry summers from mid-May to mid-September and rainy, rather changeable, winters from November to mid-March, which are separated by short autumn and spring seasons of rapid change in weather conditions.

The main forest vegetation types are:

* Forests, dominated by *Pinus brutia, Pinus nigra* ssp. *pallasiana, Cupressus sempervirens, Platanus orientalis,* and *Alnus orientalis*, with an understorey of tall and low shrubs, sub-shrubs and herbaceous vegetation;
* Other wooded land (Maquis and Garrigue), dominated by *Juniperus phoenicea, Ceratonia siliqua, Olea europaea, Pistacia lentiscus, Arbutus andrachne,* and *Quercus coccifera* ssp. *calliprinos*;
* Other land (Phrygana), dominated by sub-shrubs, dwarf shrubs of about 50 cm high, like *Sarcopoterium spinosum, Thymus capitatus, Cistus* spp. etc. These forest vegetation types cover 42.32 percent of the total area of Cyprus (see Table 1).

Acording to the witness of Eratosthenis, quoted in Strabo's Geography, «… in ancient times the plains (of Cyprus) were thickly overgrown with forests and therefore were covered with woods and not cultivated …» (Geography of Strabo 1989). The reverse course for the forests of Cyprus started from the Copper Age onwards. The existing fragmentary evidence shows that they suffered from heavy and uncontrolled fellings, till the end of the Turkish occupation in 1878, but there is no supporting evidence of the contribution of fire to the devastation of the forests. Despite the lack of evidence about fire occurrence, we can not exclude fire from the factors which contributed to their devastation. After the arrival of the British in 1878, the Colonial Government introduced the Forest law. Since that time, extensive areas were officially declared as State Forest lands and their protection was based on the existing laws. The great majority of the State Forest lands consist of large areas with definite boundaries. Although these lands had better management, wildfires continued to affect them in a serious way. The causes were mainly: opposition to the forest laws, political upheavals, the conversion of forest land into agricultural land, grazing, and the production of fuel.

During the last decades, due to the gradual abandonment of the agricultural lands, extensive privately owned areas are covered with forest vegetation. Recent surveys showed that 17.58 percent of the total area of Cyprus are State Forest lands and 24.74 percent are privately owned forested lands (see Tab.1). The privately owned forested lands consist of numerous small holdings, which belong to many individuals scattered all over Cyprus. Hence, they are not officially declared as forest lands. The protection of these areas is not based on an integrated fire management plan and periodically they are subject to destructive fires. The main fire causes are: agricultural activities such as the burning of stubble and grasses, hunting, recreation activities, military exercises, and burning of rubbish.

Tab.1. Percentage of the forest vegetation types based on the total area of Cyprus

Forest vegetation type	State forest lands	Private and other lands	Total
Forest	11.44	7.11	18.55
Maquis and garrigue	3.87	9.76	13.63
Phrygana	1.62	7.87	9.49
Other uses	0.65	-	0.65
Total	**17.58**	**24.74**	**42.32**

Wildfire was one of the major agents that contributed to the degradation of forests in Cyprus. There is a strong relationship between wildfires and forest degradation. The impacts get worst if wildfires are accompanied by grazing. However, the ecological role of wildland fires is different depending on the vegetation type. In *Pinus brutia* forests that represent more than 90 percent of the forest vegetation type, the understory vegetation is totally burned after a fire and bare soil is exposed - a condition that favours natural regeneration. However, a number of other factors intervene that make successful natural regeneration a rare case. These factors include: destruction of mature stands which are able to produce viable seeds, the time period of fire whereby cones are destroyed as they ripen, and the weather conditions during the first summer which affect seedling mortality. In the other forest vegetation types (other wooded land and other land), natural regeneration is successful since coppice and seedlings are easily established. However, the fire frequency along with the slope of the area, grazing practices, and weather conditions can lead to severe degradation of these other vegetation types.

Major wildfire impacts

During the 1990s, the fires affected both privately owned and government owned lands. Some of these fires had serious impacts on climax vegetation. Juniper trees, which are destroyed by fires, do not regenerate. Basic recolonization is usually of poorly diversified shrub associations (Cistus spp.). Fires affect not only forest vegetation but also agricultural crops; and they can cause mental anguish to people and affect their welfare. Productive forests were destroyed resulting in serious economic losses; planted trees and natural regeneration were destroyed; the removal of plant cover in combination with torrential rainfall resulted in excessive erosion and lost of soil; sites of ecological value, sites of aesthetic value, and important flora and fauna species were affected; agricultural crops and other properties were seriously damaged; part of the natural habitat of the endemic moufflon (Ovis gmelini ophion) was affected, and a few animals were burned. Furthermore, houses were partly or totally destroyed; and a Forest Officer lost his life during fire fighting, being the first human loss during the fire history of Cyprus since 1878.

Wildfire database

During the decade 1990-1999, the number of wildfires, in the State Forest lands was 196 and the area burned was 7 770 ha. For detailed information see Table 2. For the time being there are no records for the privately owned forested areas. For comparison with the 1980s: Table 3 shows the wildland fire database for the period 1980-1989.

Operational fire management system and organization

In Cyprus, the Government is responsible for fire prevention, detection, and suppression of wildland fires. Wildland fires in Cyprus are distinguished into two categories: (1) the fires occurring in State Forest land or in the privately owned lands, situated within a distance of 1 km from the boundary of the State Forest land; (2) the fires occurring in the privately owned lands, other than those specified in category (1).

Category 1: The responsible Authority is the Department of Forests of the Ministry of Agriculture, Natural Resources, and Environment. The prevention, pre-suppression, and suppression of these fires are the exclusive responsibility of this Department. Furthermore, the Department is responsible for the detection of forest fires within the State Forest land using a well-organized detection system. All these actions are achieved through the organization and integrated fire management plan of this Department.

Category 2: The prevention and suppression of these fires are based on an action plan. According to this plan, the technical aspect of the suppression of these fires is shared between the Fire Brigade Service of the Ministry of Justice and Public Order and the Department of Forests and other Government Services. The preventive measures and the co-ordination of the suppression are handled by the District Officers of the Ministry of Interior. The detection of the fires in this category is based partly on the detection system of the Department of Forests and partly on other means.

The municipalities and the communities do not participate in the fire management activities, apart from the co-operation, to some degree, with the authorities involved. Furthermore, an effort is made to create voluntary groups in the various communities. There is no fire research program at the present time.

Use of prescribed fire in order to achieve management objectives

The whole structure of the forested areas of Cyprus, in connection with the structure of the agricultural lands, does not favour prescribed fire in order to achieve management objectives. In exceptional cases, the Department of Forests applies prescribed fire in areas adjacent to the State Forests only for the purpose of reducing the fire hazard. Farmers, too, use prescribed fire as a management tool to clear and prepare the land for agricultural purposes.

Sustainable land-use practices employed in the country to reduce wildfire hazards and wildfire risks

Unfortunately, land-use practices are not employed as a tool to reduce wildfire hazards and risks. However, other measures are taken to reduce the wildfire hazards in the State Forest land, including fuelbreaks along ridges, around picnic and camping sites, along boundaries, the construction of roads, the pruning of roadside vegetation and plantations, and thinning operations. Wildfire risks are addressed through education and information, law enforcement, and patrolling.

The reduction of wildfire hazards in the privately owned-forested areas is not sufficient because the owners are not willing to co-operate. The government or the local communities construct fuelbreaks in a few places, but not as a part of agricultural, pastoral, or recreational activities. Wildfire risks are addressed through general education, information programs, and law enforcement.

Public policies concerning fire

Effective protection of the State Forests against fires is provided by the Forest Law. The responsible Authority for the enforcement of this law is the Department of Forests. Fire suppression is governed by a Fire Suppression Action Plan. Furthermore, the Forest Policy and National Program provide for the protection of forests and ecosystems and the suppression of fires in the State Forests. More specifically, the Forest Policy includes these objectives: (a) protection against fires and other hazards, (b) conservation of ecosystems, flora, fauna, and heritage, and (c) watershed management and protection.

The protection of the areas of the countryside, which are not covered by the Forest Law, is covered under the provisions of the Law for the Prevention and Control of Fires in the Countryside. A Fire Suppression Action Plan is in force and the responsible Authority for the co-ordination and administration of the firefighting effort is the District Officer of each District. Fire management in these areas faces many problems. For overall fire management preparedness, it is important to have an integrated set of measures covering prevention, detection, pre-suppression, and suppression.

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Tab.2. Forest fires* in Cyprus for the decade 1990 - 1999

Year	No. of fires	Burnt area in ha			Cause				Known cause				Human causal activity ***
										Human			
		State forest land	Other land	Total	Known	Uknown	Areas under Turkish administration	N/A **	Natural	Negligence	Intentional	Total	
1990	11	9	305	314	4	5	0	2	2	1	1	2	Agricultural activities (2)
1991	14	27	5	32	13	1	0	0	1	10	2	12	Agricultural activities (1), Hunters (2), Visitors (2), Burning of rubbish (1), Forest works (2), N/A (4)
1992	18	9	0	9	15	3	0	0	6	8	1	9	Hunters (5), Visitors (1), Military excercises (1), Other (1), N/A (1)
1993	16	69	1275	1344	15	1	0	0	1	12	2	14	Agricultural activities (3), Hunters (1), Visitors (2), Other (2), N/A (6)
1994	35	178	843	1021	27	7	1	0	18	7	2	9	Agricultural activities (2), Military excercises (1), Other (4), N/A (2)
1995	24	70	239	309	10	14	0	0	4	6	0		Agricultural activities (2), Visitors (1) Military excercises (2), Forest work (1)
1996	20	116	168	284	9	11	0	0	4	4	1	6	Agricultural activities (2), Burning of rubbish (1), Other (2)
1997	19	167	230	397	6	13	0	0	2	3	1	4	Agricultural activities (1), Forest works (1), Other (2)
1998	19	566	3490	4056	12	7	0	0	3	9	0	9	Agricultural activities (3), Hunters (1), Military excercises (1), Other (4)
1999	20	3	1	4	9	11	0	0	5	3	1	4	Visitors (2), Military excercises (1), Other (1)
Total	196	1214	6556	7770	120	73	1	2	46	63	11	74	Agricultural activities (16), Hunters (9), Visitors (8), Military excercises (6), Burning of rubbish (2), Forest works (4), Other (16), N/A (13)

* Includes fires that broke out in State Forest Land, or fires that broke out in the private land within a distance of 1 km from the boundaries of the State Forest lands (the responsibility for suppression of these fires lies under the Department of Forests).

** No records available on fire causes

*** The number in parenthesis indicates the number of fires for each human cause

Note: fires in occupied areas are not included

Tab.3. Forest fires* in Cyprus for the decade 1980 - 1989

Year	No. of fires	Burnt area in ha			Cause				Known cause				Human causal activity ***
		State forest land	Other land	Total	Known	Uknown	Areas under Turkish administration	N/A **	Natural	Human: Negligence	Human: Intentional	Human: Total	
1980	23	97	N/A	97	11	12	0	0	0	10	1	11	Agricultural activities (1), Military excercises (1), N/A (9)
1981	23	16	N/A	16	15	8	0	0	0	14	1	15	Military excercises (3), N/A (12)
1982	32	30	N/A	30	19	13	0	0	7	11	1	12	Burning of rubbish (1), N/A (11)
1983	21	15	N/A	15	6	15	0	0	2	2	2	4	Military excercises (1), N/A (3)
1984	14	160	73	233	7	7	0	0	3	4	0	4	Military excercises (1), N/A (3)
1985	15	46	810	856	12	0	0	3	1	7	4	11	Agricultural activities (3), Visitors (1) Military excercises (2), Other (3), N/A (2)
1986	21	467	403	870	15	5	1	0	5	9	1	10	Agricultural activities (1), Hunyters (2), Visitors (2), Military excercises (2), Other (1), N/A (2)
1987	18	96	57	153	12	6	0	0	0	11	1	12	Agricultural activities (1), Hunters (2), Visitors (2), Military excercises (2), N/A (5)
1988	26	750	1804	2554	21	4	1	0	1	19	1	20	Agricultural activities (1), Visitors (2), Military excercises (3), Other (1), N/A (13)
1989	19	15	50	65	14	4	0	1	2	12	0	12	Agricultural activities (1), Hunters (1), Visitors (2), Military excercises (2), Burning of rubbish (1), Forest works (1), Other (1), N/A (3)
Total	212	1692	3197	4889	132	74	2	4	21	99	12	111	Agricultural activities (8), Hunters (5), Visitors (9), Military excercises (17), Burning of rubbish (2), Forest works (1), Other (6), N/A (63)

* Includes fires that broke out in State Forest Land, or fires that broke out in the private land within a distance of 1 km from the boundaries of the State Forest lands (the responsibility for suppression of these fires lies under the Department of Forests).

** No records available on fire causes

*** The number in parenthesis indicates the number of fires for each human cause

Note: fires in occupied areas are not include

GREECE

Fire Situation in Greece

Introduction

Greece occupies an area of 130 875 km^2 at the southern tip of the Balkan Peninsula. Its population is approximately 10 million. Nearly half of these people live in the two largest cities, Athens and Thessaloniki. The country's topography is mostly mountainous. Small plains and valleys are interspersed between the mountains and constitute the main agricultural areas.

The climate is typically Mediterranean over most of the country, with warm-to-hot summers and mild winters. Usually there is little or no rain in the summer, but quite often the dry season may start as early as April and continue well into fall. Only some of the wettest locations at high elevations have more than 100 days of rain per year. Yearly precipitation may exceed 2 000 mm at those locations. On the other hand, the southeastern tip of Greece, including the area around Athens and the Cyclades Islands in the Aegean Sea, has annual precipitation of less than 400 mm, which is one of the lowest in Europe.

Mean yearly temperature varies between 14.5^o C in the north and 19.5° C on the southernmost island of Crete. Absolute minimum temperatures at high elevations in northern Greece may approach -25^o C. In the summer, maximum temperatures occasionally reach 42-45^o C at various inland locations. The influence of the Mediterranean Sea that surrounds the country on three sides helps moderate the air temperature in most areas.

Forest vegetation

Forest vegetation reflects the climate and topography of the country as well as the soil condition, which is generally quite poor. The influence of man, active in the area for more than three thousand years, is also reflected in the distribution and usually degraded condition of the forests. Drought-resistant evergreen broadleaved species *(Quercus ilex, Laurus nobilis, Ceratonia siliqua, Olea europaea, Arbutus* spp., *Cistus* spp., *Erica* spp., *Pistacia* spp. etc.), mostly forming shrublands, and pine trees (*Pinus halepensis, Pinus brutia, Pinus pinea*, etc.) occupy the lower elevations in the country (up to 300 m above sea level in northern Greece and 800 m in the south). Next, there is a zone of deciduous broadleaved species (*Quercus* spp., *Fagus orientalis, Castanea vesca*, etc.) and conifers (*Pinus nigra, Pinus maritima, Cupressus sempervirens, Abies cephalonica*, etc.) that reaches 900 m in the north and 1 200 m in the south. At higher elevations, up to 1 800 m, vegetation includes cold-tolerant broadleaved tree species (such *as Fagus silvatica, Fagus moesiaca, Quercus sessiliflora, Quercus pedunculata, Populus tremula, Betula pendula, Fraxinus excelsior, Acer* spp., etc.) and conifers (*Pinus nigra, Pinus silvestris, Abies alba*, etc.). Finally, at elevations up to 2 200 m, vegetation mostly includes cold tolerant conifers and a few broadleaved species (*Picea excelsa, Abies alba, Pinus peuce, Pinus silvestris, Pinus heldreichii, Populus tremula, Sorbus aucuparia*).

Forest flammability is generally high. The most flammable types are the pine forests (*Pinus halepensis, Pinus brutia*) and the shrublands at the lower elevations, by the sea, in the middle and southern part of the country. This vegetation is also adapted to fire either through cone serotiny (pines) or re-sprouting (shrubs).

Area, distribution and condition of forests

Approximately 19.8 percent of the surface area of Greece (about 2.5 million hectares) is characterized as forested. However, less than half of this area is covered by "tall" timber producing forests. Most of these are conifer forests. “Low” or coppice forests that mostly produce fuelwood occupy the remaining forest area. In addition to these forested areas, there are approximately 3.2 million ha of partially forested areas and shrublands (occupied mostly by evergreen broadleaved shrubs). There are also approximately 1.9 million ha of grasslands and phrygana (mostly areas covered by the low spiny shrub *Sarcopoterium spinosum* or the non-spiny shrub *Flomis fruticosa*). These shrublands and grasslands are mainly used for grazing.

Destruction of forests started in ancient Greece and took place mainly near highly populated areas, such as Athens and Crete. Clearing of land for use in agriculture, woodcutting for shipbuilding, housing construction, fuelwood and grazing, together with repeated fires through the centuries, resulted in a sharp decrease in the forested area to its present size. The remaining forests are in poor condition. As a result, less than a quarter of the total wood production of Greek forests is suitable for construction and industrial purposes; the rest is used for fuelwood. Many areas have been denuded to such an extent that reforestation is practically impossible.

Most forests in the country are state-owned. Nowadays all forests (state and private) are managed on a "sustained-yield" basis. A management plan is required for all forests larger than 100 ha. At higher elevations, where population density has decreased in the last three decades as people moved to the cities, signs of a forest comeback have started to appear. This is due to reduced grazing and abandonment of marginal agricultural lands. However, at lower elevations close to the sea, the forests are still in danger due to the ever-increasing frequency of wildfires.

Grazing of sheep and goats, traditional in the country, in recent times has become one of the main causes of wildfires. Many areas are overgrazed. Shepherds react to the resulting reduction of feed for the animals by burning to stimulate new growth of shrubs and grasses. However, as desirable plants gradually disappear due to overgrazing, the fire frequency increases. The soil is unprotected by vegetation when it is burned every few years and is soon eroded, resulting in lost site productivity and finally desertification. Often, when an area is denuded, fire is then used to convert forest land into grazing land, and the vicious cycle is repeated.

Forest fire statistics for Greece

The Greek Forest Service, which was responsible for forest fire fighting in Greece until 1997, collected statistics on forest fires for many decades. The data for 1990-1999 are given in Table 1. Forest Service officers at the local offices were required to file a report on each forest fire in their area. The Fire Service, which has become responsible for forest firefighting since 1998, has continued this practice. However, the statistics collected, especially in regard to the number of fires recorded, is not comparable between the two sets of data. Table 2 shows the wildland fire database for the period 1990-2000 for comparative purposes.

Number of fires and burned area per year

The number of fires and the burned area per year are two of the most important forest fire statistics. Table 1 summarizes these two statistics for Greece from 1990 to 2000 and table 2 does the same for the 1980-1989 period.. In a long-term fire analysis (1955-1999) Xanthopoulos (2000) showed that forest fires in Greece burned, on the average, 11 500 ha per year until 1973. Approximately a third of this area was forests. The remaining two-thirds was brushland and grassland of various types. A sharp increase in both the number of fires and the size of burned area was recorded in 1974. At that time, an ever-increasing trend was established that has continued until today.

The increase in the number of fires in the 1980's can be attributed to many factors, one of which is a more thorough effort to record forest fires. However, a large part of this increase is due to increased activity of people in or near the forests and forested lands. New roads and an ever-increasing number of private cars offered easier access to forests. The number of people leaving the cities in the summer, seeking cooler places along the coastline and in the mountain villages for their vacation, has gradually increased, increasing the probability of accidental fires. The same is true for international tourists who visit Greece every summer at the peak of the fire season. Most importantly, a trend that started in the late 1970s of building secondary summer housing along the coasts, accelerated in the 1980s. These housing areas were poorly planned, creating a troublesome urban/wildland interface and increasing the risk of wildfires. The activities of these people, starting with construction and continuing with their everyday activities (barbecues, burning debris, parking cars on cured grass, etc.) have very frequently resulted in accidental wildfires.

Another factor that led to increased forest arson in the 1980s and 1990s is a spin-off of the demand for land to build secondary summer housing and to develop tourist accommodations. This demand far exceeded supply, as most forests in Greece are public and protection laws make change of use very difficult. Furthermore, an exact and complete land register has only recently started to be developed. The lack of land for development drove prices extremely high, and the lack of a land register and poor law enforcement allowed those burning forested lands to illegally occupy them. On more than one occasion, many years later, when the number of people in this category became too many and it was evident that it would be practically impossible to evict them from the areas they had occupied, the Greek government legalized these occupied lands. In this way, a motive for arson was created.

In the 1990s the number of fires continued to increase due to an increase in the factors mentioned. While in the 1980s the average yearly number of fires was 1 264, during the 1990-1997 period this average increased to 1 848 fires per year. A new factor contributing to this increase was fires started by immigrants illegally entering the country, mainly from Albania. Using forest trails high in the mountains, they started fires to cook or to warm up at night and did not properly extinguish them when leaving in the morning.

After 1997 the number of fires, as shown in Table 1, nearly tripled. This is because the Fire Service, which became responsible for forest fires in 1998, records every call that they respond to, while the policy of the Forest Service until 1997 was to only record those fires on which they had to take action because they were spreading toward or burning on forest lands.

As the number of fires increased in the late 1970s and 1980s, the size of the yearly burned area also started to rapidly increase. The larger number of fires, however, was not the only reason. Fires gradually became more difficult to fight due to the changing condition of forests and to the development of urban/wildland interface zones as described above. An example of the latter is the worst fire in 1981, one of the most difficult fire-years in the 1980s, which burned a large area and some houses in the northern suburbs of Athens.

The forests became denser and dead downed woody material increased as a result of the abandonment of villages, especially in mountainous areas, in the 1950s, 1960s and 1970s, as people immigrated abroad or moved to the big cities, mainly Athens. As dead forest biomass, especially around villages, stopped being used for cooking and heating as in the past, either due to decreasing population or due to replacement by oil, electricity and propane gas, it started building-up, making forests flammable right to the first houses of each village. Fires reaching there, rather than slowing down, now often burn homes and occasionally kill people.

In the past, resin collectors contributed to safer forests (mainly those of *Pinus halepensis* and *Pinus brutia*)by maintaining forest trails for their need to move from tree to tree and by managing the forest, selectively removing older trees that were useless to them in order to favour regeneration. Furthermore, since the forests were their field of production and the storage area of their product, they exercised maximum fire prevention care and immediately suppressed any fire. Unfortunately, by the end of the 1970s this profession started to slowly die out as the demand for resin decreased, income dropped, and no subsidies were provided by Greek or European Union policies.

The Forest Service, which is responsible for managing Greek forests, lacks personnel and resources and has concentrated on the management of the more valuable (in regard to timber quantity and quality) high-elevation forests. When the number of resin collectors decreased in the low-elevation pine forests, these forests were practically left unmanaged. Subsequently, they became more flammable, often impenetrable, and fighting fire in them became much more difficult.

In the 1980s, the burned area exceeded the 100 000 ha mark twice. Unfortunately, and in spite of a steep increase in firefighting means, this negative record was repeated again in 1998 and 2000: Unofficial figures bring the area burned in 2000 to more than 150 000 ha.

Another interesting fire statistic is presented in Table 3, which summarizes the frequency of forest fire occurrence by month, as a percent of the total, for 1964-1994. As shown in this table, July, August and September are the three busiest months for the firefighting forces, as is the case for most countries with Mediterranean climates in the northern hemisphere.

Damage to life and property caused by forest fires

Information on loss of life and property in Greece due to forest fires is sparse until 1960. A notable exception is a large wildfire, in a Pinus halepensis forest with shrub understory, that burned 3 000 ha in 1916 at Tatoi, Attica. The forest belonged to the crown. That fire killed three people, injured 300, and destroyed the summer palace and other buildings. Since then, and until the end of the 1970s, there were only a few, isolated cases of property damage due to wildfires. Only a few small, temporary, mostly wooden country buildings used by woodsmen and shepherds are known to have burned in this time period.

From 1950 to 1976 there was no recorded loss of human life due to forest fires. In 1977, however, the death of a nun trapped by a wildfire in a monastery on Mount Parnassos signalled the beginning of a new era in which the loss of human life due to wildfires became quite common. Two people where killed in the 1970s and 37 people were killed in the 1980s, nine in 1985 and 12 in 1988, two of the worst fire years. The reported fatalities included both firefighters (Forest Service personnel, soldiers and volunteers) as well as people trapped by fire. In addition to these fatalities, there were also many injuries during firefighting and the deaths of five Air Force pilots who fly the CL-215 waterbombers that have been used in aerial fire suppression operations since 1973. Four CL-215's were destroyed during the 1980s. There were also losses in the squadron of smaller, single-seat PZL M-18 Dromader planes used since 1984.

Table 1. Wildfire database for Greece for 1990-2000.

Year	Total No. of Fires on Forest, Other Wooded Land, & Other Land No.	Total Area Burned on Forest, Other Wooded Land, & Other Land ha	Area of Forest Burned ha	Area of Other Wooded Land and Other Land Burned ha	Human Causes No.	Natural Causes No.	Unknown Causes No.
1990	1 322	38 593	21088	17 506	643	44	635
1991	1041	23 574	8 000	15 574	539	18	484
1992	2 042	66 346	23 194	43 153	868	61	1 113
1993	2 406	54 049	24 200	29 849	860	61	1 485
1994	1 763	57 908	21 157	36 751	742	84	937
1995	1 438	27 203	9 645	15 541			
1996	1 757	24 000	7 592	17 718			
1997	3 117	41 839	16 760	25 178			
1998	9 282	112 802					
1999	10 723	19 050					
2000	14 650	167 006					
Average	**4 502**	**55 988**	**16 455**	**25 159**			

Source: Forest Service of Greece.

Tab.2. Wildfire database for Greece for 1980-1989.

Year	Total No. of Fires on Forest, Other Wooded Land, & Other Land No.	Total Area Burned on Forest, Other Wooded Land, & Other Land ha	Area of Forest Burned ha	Area of Other Wooded Land and Other Land Burned ha	Human Causes No.	Natural Causes No.	Unknown Causes No.
1980	1 207	32 965	4 355	28 610	850	20	337
1981	1 159	81 417	38 653	42 764	719	12	428
1982	1 045	27 372	10 843	16 529	695	48	302
1983	968	19 613	10 907	8 706	545	38	385
1984	1 284	33 656	12 018	21 639	917	18	349
1985	1 442	105 450	48 631	56 819	804	38	600
1986	1 082	24 514	10 109	14 404	596	30	456
1987	1 266	46 315	13 605	32 711	659	63	544
1988	1 898	110 501	27 370	83 131	898	49	951
1989	1 284	42 364	23 600	18 763	599	48	637
Average	**1 264**	**52 417**	**20 009**	**32 408**	**728**	**364**	**499**

Source: Forest Service of Greece.

Tab.3. Average percentage of fires occurring each month, based on the data from 1964-1994.

Month	Percent of fires
January	1.4
February	2.8
March	4.3
April	3.6
May	2.6
June	6.5
July	15.7
August	24.4
September	22.8
October	12.7
November	2.6
December	0.8

In the 1990s, the death toll was similar to that of the 1980s. A fire on the island of Ikaria in the Aegean Sea cost the life of 13 civilians, creating a nationwide sensation. Three Army pilots and seven firefighters were killed in 1994 when their UH-1H "Huey" helicopter hit power lines on its way back from a fire. Three Fire Service firefighters and a volunteer were trapped by flames and died near Athens in 1998. A fast-moving fire on the island of Chios in 1999 overcame three firefighters. In 2000, seven people died in one night near the Greek border with Albania when a fast-moving fire burned through their sparsely populated villages.

In 1993 and 2000 two more CL-215's were lost, killing four more pilots. The loss of a PZL M-18 on Corfu Island in 2000 cost the life of another pilot.

The development of urban/wildland interface areas, either due to the expansion of large cities or the development of summer housing started in the mid 1970's. This trend coincides with both the increase in forest fire numbers and burned area and the beginning of significant losses in life and property. Loss of property, for a time, was surprisingly low, even during fierce wildfires. This was due to the traditional use of non-combustible building materials for houses (concrete, bricks, stone, clay roof tiles, etc.). Wood is seldom used for building houses, except for certain specific uses (roof support frames, doors, windows, etc.) (Xanthopoulos 1988). However, as the number of houses increased it became impossible for the firefighting forces to defend all of them. As a result, property damage started to rise sharply. For example, a fierce fire in 1981 in the northern suburbs of Athens resulted in the complete destruction of at least two houses and partial damage to others. These losses are surprisingly low in view of the fact that this fire burned approximately 1 120 ha in a wildland/urban interface area in addition to 550 ha of *Pinus halepensis* forest. Fifteen years later, in 1995, a large fire (6 500 ha) on Penteli Mountain near Athens burned about 100 buildings, many of them homes. A second large fire on Penteli Mountain that burned 7 500 ha in 1998 resulted in the destruction of even more homes.

Damage to property due to wildfires is not limited to buildings. Significant economic losses each year result from forest fires that burn agricultural land adjacent to forests. Especially important are orchards, which can be completely destroyed. Production losses include the long time necessary for reestablishment of the burned orchards. Olive (*Olea europaea*) orchards, in particular, are especially susceptible to complete destruction due to their flammability.

Forest fire causes

Data on fire causes after 1998 are quite unreliable. However, the causes are not expected to be drastically different from those indicated by the data previously collected by the Forest Service. Table 4 summarizes the distribution of fire causes in two difficult fire years and also presents average values for 1968-1993 (Kailidis and Xanthopoulos 1991, Markalas and Pantelis 1996).

As Table 4 shows, few forest fires in Greece are due to natural causes. Lightning-caused fires account for less than 3 percent of the total number of fires. The rest of the fires with known causes have been categorized as accidental, due to negligence or deliberately started.

A large number of fires are reported due to "unknown causes". Most of them are suspected to be deliberately set. For example, 428 out of the 602 fires listed in the "unknown causes" category for 1988 are suspected to belong in the "deliberately set" category; 241 of them were probably started for rangeland improvement. A significant number of the "unknown causes" fires may be lightning caused, since determination of this cause can be quite tricky when a fire remains dormant and undetected for some time after a storm and then starts spreading when conditions became favourable.

In terms of importance, arson fires for land use change, fires from burning garbage dumps and power line fires are considered to be the worst since they usually occur on days with high wind. Shepherd fires are also a problem, both due to the cost of fighting them and to the fact that even when firefighting efforts are successful the shepherds merely wait for more difficult conditions and try again.

Fire management organizations

As mentioned earlier, the organization responsible for forest fires in Greece until 1997 was the Forest Service. Then, in May 1998, a new law gave responsibility for forest firefighting to the Fire Service, which until then was responsible for municipal fires but also contributed to forest firefighting. Most aspects of fire prevention remained with the Forest Service. However, the Forest Service was weakened significantly as approximately one fourth of its personnel as well as many pieces of equipment (vehicles, radios etc) were moved to the Fire Service.

The Fire Service clearly failed to control fires in 1998. Forest fires proved to be quite different from municipal fires and this, combined with a difficult fire season, brought the burned area to 112 802 ha. After that, the Fire Service started an effort to prepare for forest firefighting by training its personnel, preparing pre-suppression plans, acquiring appropriate equipment (e.g. 1-inch hoses, backpack pumps, appropriate boots, etc.), creating additional fire stations in previously poorly protected areas and adopting the use of a daily fire danger prediction map through the summer months. The government supported the Fire Service fully, both morally and financially, ordering, among other measures, ten new CL-415 Canadair waterbombers and allowing contracting of additional private aircraft in 1999.

The fire season of 1999 was a relatively mild one and, with the help of the contracted aircraft, the results were extremely good. However, weaknesses still remained. In 2000, predicting a difficult fire season, the Fire Service contracted an even larger number of aircraft. Unfortunately, the difficulty of the fire season often exceeded the capacity of the firefighting forces and on some difficult days fires burned rampant. The burned area, exceeded 160 000 ha, thereof 110 000 ha forest lands and the rest mainly agricultural. At least seven people (civilians) were killed, and hundreds of houses were lost to fires. Two Canadair CL-215 pilots and one PZL M-18 pilot were killed when their planes crashed during firefighting. Also, one Fire Service officer died as a result of injuries sustained by a rock falling down on of the slopes of Taygetos mountain near Sparta in Peloponnesus. Many weaknesses in firefighting became evident and a new circle of improvements is clearly imminent.

The permanent personnel of the Fire Service reached 10 000 in 2000. Four thousand seasonal employees were added in the summer. There were 1 100 fire trucks, including a variety of types and capacities, while the number of support vehicles (vans, mini-buses, off-road 4x4s, etc.) reached 200. Additionally, in fires in the wildland/urban interface, water trucks from the local authorities were available to bring water to the fire trucks.

State-owned aircraft, which are operated by the Greek Air Force, include 4 new CL-415 Canadair waterbombers, 14 older CL-215 waterbombers, 20 PZL M-18 Dromader airplanes (after the loss of one CL-215 and one M-18 in 2000) and 6 Grumman biplanes. Up to two C-130 cargo planes fitted with MAFFS retardant delivery systems can be added to this fleet on short notice. Two Army Chinook CH-47D helicopters with Bambi buckets are also made available when needed.

In 2000, the state aircraft fleet was augmented by 3 contracted CL-215s and 16 heavy-duty helicopters (1 Ericsson Air-Crane, 3 MI-26s, 4 MI-8s, and 8 Camovs). Seven of the Camov helicopters were contracted in mid-July after the first disastrous fires of the season. Also, two light helicopters were contracted for coordination of firefighting forces.

The Fire Service has a top-down structure, one of the few state organizations that has not been broken down into a regionalized structure in the 1990s. This is a significant advantage for the task of firefighting as it allows easy mobility of resources between regions and good central coordination. On the other hand, the military-like structure of the Fire Service that includes Army-equivalent ranks often results in firefighting being coordinated not by the best qualified people but by those of the highest rank.

Tab.4. Distribution (%) of fire causes in Greece in 1988, 1993 and 1968-1993

Cause	**1988 (%)**	**1993 (%)**	**1968 - 1993 (%)**
Lightning	**2.6**	**2.7**	**2.4**
Accidental causes	**3.1**	**2.5**	**3.5**
1. Power lines	0.8	1.0	0.7
2. Engine sparks	1.4	1.0	2.1
3. Use of explosives	0.3	---	---
4. Army target shooting	0.6	0.5	0.7
Negligence	**27.3**	**28.2**	**36.0**
1. Stubble burning	11.8	9.0	16.0
2. Cigarettes	4.0	2.1	8.7
3. Garbage burning	4.2	2.5	3.9
4. Workers in the countryside	3.8	4.0	3.2
5. Recreationists and hunters	1.6	0.8	1.3
6. Other known causes	1.9	9.8	2.9
Deliberate causes	**33.5**	**18.0**	**29.2**
1. Rangeland improvement	15.6	6.6	---
2. Arson			
a. Bad intentions (for profit, revenge, etc.)	17.2	10.8	
b. By people with reduced mental capacity			
-- Children	0.3	0.2	---
-- Pyromaniacs	0.2	0.2	---
-- Other psychopaths	0.2	0.1	---
-- Mentally retarded	0.0	0.1	---
Unknown or suspected causes	**33.5**	**48.6**	**28.9**
Total	**100**	**100**	**100**

The Forest Service, which is responsible by law for fire prevention, has been broken down into a regional structure without provision for effective central coordination. This change has reduced its effectiveness, or at least made it completely variable by region. Also, its personnel have been reduced in number after approximately 1 000 forest guards were transferred to the Fire Service. The remaining personnel are generally over 45 years old and retiring at a high rate. The number of employees is less than 2 800. This is clearly inadequate to successfully carry out all the forest management and protection tasks required. Range management is minimal and prescribed burning is only discussed at a theoretical level. Lack of appropriate funding for fire prevention work (e.g. fuel management) further compounds the problem. With poorly managed forests and fire prevention work practically non-existent the fire problem in the country, in meteorologically difficult fire seasons, can only be expected to worsen.

Another state organization that is involved in forest fires is the General Secretariat for Civil Protection (GSCP). It was established by law in 1995 and was gradually organized in the late 1990s. It is part of the Ministry of Interior and has a coordinating role for all types of disasters, including forest fires. In this area it provides support to the Fire Service from local authorities (Regions, Prefectures, Municipalities) in regard to equipment (water trucks, dozers, etc.) and auxiliary personnel. Its planning includes, among other things, coordination for evacuations.

Both the Fire Service and the GSCP try to mobilize volunteers who will help in firefighting and other disasters. The effort to date has had some results, and the number of volunteers offering serious help in firefighting is estimated at around 500 people.

The Army generally supports firefighting activities upon request. During difficult periods soldiers undertake the task of surveillance and mop-up of fires that have been brought under control, reducing the number of firefighters needed to remain on site for this task. It also offers heavy equipment such as dozers upon request.

The Police are also involved in forest fire related activities. They provide traffic control and, when needed, coordinate the evacuation of villages, camps, etc. They also cooperate with the Fire Service in arson investigations. The Police often undertake surveillance of suspects in order to catch them in the act of arson.

Conclusions and Outlook

As can be seen, Greece has a serious fire problem. The money and effort devoted to coping with the problem is significant. Actually, especially in terms of aerial forces, the country should probably be rated first in the world on a per-hectare-protected basis. However, the poor results of the last few years clearly indicate that there is need for improvement, especially in regard to knowledge and organization of the whole effort. Also, there is a clear need for better managed forests and serious fire prevention efforts. The latter objective requires an upgraded and modernized Forest Service that will work in close cooperation with the Fire Service.

The Fire Service needs to improve its initial attack capability. Indirect attack should be recognized as a true alternative to direct attack and the methods for its application should become part of basic training at all levels. The ground forces should learn to rely less on the help of aerial forces because they may be unavailable under certain conditions (extreme winds, too many simultaneous fires, night hours). Also, the Fire Service should evaluate its pre-suppression planning in order to maximize the effectiveness of its forces, especially the aerial ones. Good cooperation with the Forest Service is clearly necessary.

Some of the improvements needed in the Forest Service are:

- Hiring new permanent, competent staff;
- Changes in structure that will permit a central policy to be applied in all regions, including training in modern concepts and methods;
- A mission for active rangeland management by the Forest Service and education of shepherds; and
- Active management of the low-elevation Aleppo and Brutia pine forests.

Of course, these changes in the Forest Service will require additional funding compared to the current low level, but in the long term will reduce damage and the cost of firefighting . Otherwise, given the natural flammability of Greek forests, the problem may become worse in spite of spending more money in the battle against forest fires.

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References

Kailidis, D. 1990. Forest fires. 3rd edition. Giahoudi-Giapouli editions. Thessaloniki, Greece. 510 p. (in Greek).

Kailidis, D., and G. Xanthopoulos. 1991. The forest fire problem in Greece. Aristotelian University of Thessaloniki, Greece, Department of Forestry and Natural Environment, Forest Protection Laboratory. No. 3. 10 p.

Kapakis, I. 2000. Forest fires in Greece. Pirosvestiki Epitheorisi (Firefighting Review). 81 (B), 10-19. (in Greek).

Markalas, S., and D. Pantelis. 1996. Forest fires in Greece in 1993. Aristotelian Univ. of Thessaloniki, Department of Forestry and the Natural Environment, Forest Protection Laboratory. No 3. 40 p. (in Greek).

Xanthopoulos, G. 1988. Greek forest fires and property damage: A brief history. pp. 199-200. In: Proceedings - Symposium and Workshop on "Protecting People and Homes from Wildfire in the Interior West", October 6-8, 1987, Missoula, Montana, USA. USDA For. Serv. Gen. Tech. Rep. INT-251. 213 p.

Xanthopoulos, G. 1998. Forest fires in Greece: Past, present and future. Epikentra (Foundation for Political Research and Advanced Education). 6: 62-71. (Special issue titled “Greek forests: myths and reality - Proposals for the present and for the future). (in Greek).

ITALY

Fires in Summer 2000

According to the Statistic Bureau of Corpo Forestale dello Stato, over 10 000 wildland fires have burned more than 95 000 hectares across Italy (45 000 of which forested) as of 3 September 2000. Officials are calling it the worst wildfire season in recent history, probably much worse than 1993.

A long, severe drought, with below normal rainfall and air temperature increased in the upper 40's °C in many parts of Southern Italy for days in July and August, with records of 48°C in July, together with winds that made fighting very difficult, have been the biggest influencing factor of this disastrous phenomenon, whose increasing trend is evidenced by Tables 1 and 3. In many days, fire departments were called on more than 170 fires a day.

The problem as been common for other people living in South Europe, suffering under an extreme heat wave. The southernmost Regions (Puglia, Calabria, Campania) together with the islands of Sardinia and Sicily keep the negative record of fires also this year, confirming that fires are usually more numerous in Regions with low forestry ratio, such as Puglia (7.7) and Sicily (10.1) (Tab.2). Most of the fires are believed to be intentionally caused.

In many cases, heavy fires have threatened houses, residential areas and small towns, where residents have been cautioned to leave their homes or evacuated. In addition, wildfires have severely swept many protected areas (namely nature reserves and national parks such as Pollino, Gargano, Abruzzi) and areas of celebrated beauty, such as island of Capri, the pine stand of Ostia, near Rome, the coast near Amalfi.

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Tab.1. Number of fires, surfaces (total and decade averages) in Italy, 1970-2000.
Source: Corpo Forestale dello Stato.

Year	Number of fires	Surfaces affected		
		Forested (ha)	Non-forested (ha)	Total (ha)
Total 1970-1979	64 259	503 409	366 681	870 090
Average 1970-1979	6 426	50 341	36 668	87 009
Total 1980-1989	115 752	534 397	937 101	1 471 498
Average 1980-1989	11 575	53 440	93 710	147 150
Total 1990-1999	111 638	553 059	632 667	1 185 726
Average 1990-1999	11 163	55 305	63 266	118 576
1999	6 932	39 362	31 755	71 117
2000	10 038	44 808	50 768	95 576

Tab.2. Forest fires in Italy in 2000 (1 January – 3 September 2000).
Source: Corpo Forestale dello Stato.

Region	Number of fires	Surfaces affected by fire			
		Foreste (ha)	Non-forested (ha)	Total (ha)	Forestry Ratio
VALLE D'AOSTA	92	9	16	25	29.3
PIEMONTE	366	1 442	3 098	4 540	25.9
LOMBARDIA	317	1 237	1 623	2 860	25.1
TRENTINO A.A.	74	63	46	109	49.6
VENETO	72	125	63	188	19.1
FRIULI V.G.	27	28	19	47	36.9
LIGURIA	363	1 850	888	2 738	69.1
EMILIA. ROMAGNA	138	120	152	272	20.5
TOSCANA	427	1 375	467	1 842	42.7
UMBRIA	117	354	134	488	39.8
MARCHE	61	465	117	582	23.1
LAZIO	615	5 043	2 391	7 434	27.1
ABRUZZO	125	1 599	3 018	4 617	29.8
MOLISE	263	193	1 354	1 547	29.2
CAMPANIA	1 590	5 145	5 195	10 340	27.9
PUGLIA	639	4 615	10 880	15 495	7.7
BASILICATA	342	2 528	2 969	5 517	29.5
CALABRIA	2 091	11 716	5 963	17 679	38.3
SICILIA	844	2 284	3 592	5 876	10.4
SARDEGNA	1 475	4 617	8 763	13 380	40.5
Total	**10 038**	**44 808**	**50 768**	**95 576**	**9.5**

Tab.3. Forest fires in Italy from 1970 to 1999: Number, surfaces per year and decades. Source: Corpo Forestale dello Stato.

Year	Number of fires	Surfaces affected		
		Forested (ha)	Non forested (ha)	Total (ha)
1970	6 579	68 170	23 006	91 176
1971	5 617	82 339	18 463	100 802
1972	2 358	19 314	7 989	27 303
1973	5 681	84 438	24 400	108 838
1974	5 055	66 035	36 909	102 944
1975	4 257	31 551	23 135	54 686
1976	4 457	30 735	20 056	50 791
1977	8 878	37 708	55 031	92 739
1978	11 052	43 331	84 246	127 577
1979	10 325	39 788	73 446	113 234
Total	**64 259**	**503 409**	**366 681**	**870 090**
Average 1970-1979	**6 426**	**50 341**	**36 668**	**87 009**
1980	11 963	45 838	98 081	143 919
1981	14 503	74 287	155 563	229 850
1982	9 557	48 832	81 624	130 456
1983	7 956	78 938	133 740	212 678
1984	8 482	31 077	44 195	75 272
1985	18 664	76 548	114 092	190 640
1986	9 398	26 795	59 625	86 420
1987	11 972	46 040	74 657	120 697
1988	13 588	60 109	126 296	186 405
1989	9 669	45 933	49 228	95 161
Total	**115 752**	**534 397**	**937 101**	**1 471 498**
Average 1980-1989	**11 575**	**53 440**	**93 710**	**147 150**
1990	14 477	98 410	96 909	195 319
1991	11 965	30 172	69 688	99 860
1992	14 641	44 522	61 170	105 692
1993	14 412	116 378	87 371	203 749
1994	11 588	47 099	89 235	136 334
1995	7 378	20 995	27 889	48 884
1996	9 093	20 329	37 659	57 988
1997	11 612	62 775	48 455	111 230
1998	9 540	73 017	82 536	155 553
1999	6 932	39 362	31 755	71 117
Total	**111 638**	**553 059**	**632 667**	**1 185 726**
Average 1990-1999	**1 1163**	**55 305**	**63 266**	**118 576**

LEBANON

Fire Situation in Lebanon

In Lebanon the term forest fire indicates all fires occurring in forests, wildlands, pasture land, and even in agricultural land. Most fire-prone forests are stands of *Pinus pinea, Pinus brutia* and *Quercus* spp. Wildfires occur both on private and government property.

The fire database in Lebanon was established in 1998. However, data are available for the last four years(Table 1.). It is often difficult to determine the causes of fires. It is known, however, that in addition to the traditional and well known causes, the war in Lebanon and all military actions sometimes cause forest fires.

Tab.1. Number of forest fires and area burned in Lebanon,1996 and 1999

Year	Number of fires	Area burned (ha)
1996	79	468.50
1997	127	437.12
1998	195	6 091.27
1999	188	1 521.04

The civil defence, which operates under the Ministry of Interior, is responsible for fire control. The Ministry of Agriculture is also establishing a fire protection unit. It operates a radio communication system for early warning, 26 vehicles for initial attack and four engines with a tank capacity of 7 500 litres. The Lebanese army has three functional *Bambi* buckets that were used for the first time in 2000.

To reduce forest fire risk, the Ministry of Agriculture directs people, NGO's and municipalities to prune forest trees at least near roads to reduce "ladder fuels" and prevent crown fires.

The Ministry of Agriculture intends to build water reservoirs next to forests and lookout towers for fire detection.

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LEBANON

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Prescribed Fire Training in Florida
- The National Interagency Prescribed Fire Training Center (PFTC) -

Remarks on Prescribed Burning

Prescribed fire is described as a land management application that is essential to the practice of forestry, management of wildlife, preservation of endangered plant and animal species, improvement of range conditions and reduction of wildfire damage in the wildland/urban interface. One of the most important reasons for intentionally lighting these fires is to reduce naturally occurring fuels within forest areas, in order to reduce the risk of wildfire and the threat of substantial economic losses of timber and other natural resources. Prescribed fire is one of the least expensive methods of site preparation for reforestation. Certain pathogens that reduce growth in pines and other species can be controlled or eliminated by the use of prescribed fire. Unlike wildfire, prescribed fire is rarely lethal to most forms of wildlife and is therefore an efficient tool for improving habitat for certain wildlife species. Huge and extent areas are burned for grazing purposes and to improve range conditions for livestock. The use of prescribed burning is an irreplaceable tool in maintaining biological diversity and balance, and restoring plant and animal communities which are adapted to the existence of fire. Prescribed fires are set under controlled and monitored conditions and every "prescribed burn"' that land managers undertake is planned in advance with scientific precision.

The Prescribed Fire Training Center (PFTC)

There is no doubt that fire is an important tool of land management in the United States. During the period 1993-1997 the national land management agencies in the U.S. prescribe burned one million acres. In the southeastern part of the United States prescribed burning is a successfully implemented landscape management tool. The justification for prescribed burning lies in the fire history of this region, where a fire return interval less than 10 years exists over several thousand years due to lightning ignition and old land use practices of the natives. A long tradition here led to the birth of the National Interagency Prescribed Fire Training Center (PFTC), a national award winning initiative. Florida was chosen as an ideal site for the PFTC due to the year round burning programs of several agencies. The first organizational meeting of the Center was held in July, 1997. At the beginning it was just a concept on paper, but the concept turned into reality on 5 January 1998 with the start of the first session.

The National Interagency Prescribed Fire Training Center is a unique program for field prescribed burning experience with some classroom instruction on topics of interest to prescribed fire management. The PFTC is headquartered in Tallahassee, Florida. Prescribed fire locations are scattered around Florida, Mississippi, Alabama, Texas and Georgia. The purpose of the training is to get actual field experience for prescribed fire, in order to increase skills and knowledge and to build confidence in the use of prescribed fire. The Florida Division of Forestry, U.S. Forest Service, Florida State Parks, National Park Service, U.S. Fish & Wildlife Service, Florida Water Management Districts, Tall Timbers Research Station, Nature Conservancy, and U.S. Department of Defense, are cooperating with the PFTC and further sponsor the whole program. 2000 was the third year of the PFTC and students from all geographic regions of the United States as well as international students participated in the program. Four sessions were carried out between January and May, 2000. A fifth was cancelled due to extreme wildfire activity in Florida.

The goal of the center is to provide an accelerated learning opportunity for prescribed fire training with a maximum amount of actual prescribed burning. In a normal fire season students can expect to participate in eight to ten prescribed burns during their stay, depending on the weather conditions.

Basic learning topics are:

* Prescribed fire uses
* Monitoring and evaluation of fire effects
* Cooperative arrangements
* Current US fire policy
* Aerial ignition techniques
* Fire ecology/fire effects field trips to local burning sites
* Task book administration
* Risk assessment and burn complexity
* Smoke management
* Firing techniques

After this training experience, participants should understand the concept of prescribed fire in order to have a quality prescribed fire program and be confident in all of the important attributes. Prescribed fire has to be learned, even by fire fighting professionals.

Prescribed burning in Florida

The topography in Florida is generally flat. The vegetation consists of southern yellow pine stands with brushy undergrowth of gallberry and palmetto. The duff layer is extremely thick and covered with moss. All is dry and burns. Most soils are sandy in Florida and most line construction is done with dozer plows, which is a very efficient procedure. Typically for Florida green vegetation burns, especially palmetto and cabbage palm trees, where the fire spreads hot with a rapid rate of speed. The fire spread here is not slope dependent but vegetation and wind driven. Rain-wetted vegetation will burn soon after a rain shower and even after a downpour the vegetation can burn within 24 hours.

PFTC´s training program

Location

The headquarters of the PFTC is located in Tallahassee, Florida. Upon arrival, students will be picked up by their field coordinator (team leader). The first four days involve reception, classroom instruction, some orientation, and field trips. Teams of six will then be stationed at one of several geographic locations (hubs) within Florida or surrounding states. While the groups stay at a hub for a couple of days or a week, they will participate on prescribed burns with a number of different agencies. One day per week is set aside for classroom. The intention is to move the groups weekly to different locations to experience the different variety of fuel types. After two weeks of travelling, the teams return to Tallahassee.

Organization

A group of seven persons - six students and one field coordinator - is the optimum size of one burning team. As the experience also shows, team individuals have different levels of education, experience and qualifications, which lends desirable diversity to team makeup. The field coordinator handles coordination within the group, with other agencies (host agencies), helps with logistical functions, provides a liaison back to the center, and facilitates tracking of task book completion by the trainees. Depending on the field coordinators expertise, they may act as a backup instructor. The field coordinators are not production members of the group, although they may burn with the crew when other duties allow.

During the field work the teams are visited by instructors, who are experts in various aspects of prescribed fire and who teach additional knowledge to the teams. They present short lessons relating to prescribed fire. The lessons are practical in nature and are intended to present material that supplements the standard Prescribed burning (***Rx***) courses. Presenters teach topics such as smoke management, burn planning and goal setting, prescribed fire uses, monitoring and evaluation, cooperative arrangements, and current fire policy. Such lessons will normally be held in the morning. The presence of the presenters at the field burns in the afternoon results in additional discussions and answers to questions by the students. The aim of the prescribed burn training is to experience a variety of burn situations and techniques, from fuel reduction to ecosystem burning. Each unit hosting the teams for a particular burn will likely approach their project differently from everyone's home unit or from another host unit. Knowledge from this variety of approaches is part of the learning experience being advocated by the center.

Logistics

Lodging during the training will be in a variety of shared room facilities, such as bunkhouse type lodging, camp facilities, and motels. It is important to bring a sleeping bag to insure flexibility. Breakfast and lunch goods are provided and these meals are prepared by the members of the teams. Depending on the daily burn assignment, arrangements for evening meals will be set up in restaurants.

Equipment and outfit

Participants should be equipped as they would go on a fire. The gear should include several sets of fire proof *Nomex* shirts and pants, two pairs of leather boots, fire shelter, hard hat, field pack or web gear, etc. Additionally a radio chest harness with a programmable hand held radio is very useful. Since the planned burning schedule of each team can change according to the overall burning weather in Florida, there is always the possibility that groups will be shifted to a colder state north of Florida.

Safety is No. 1

Human life stands before all other things. Safety zones and escape routes, such as roads, plow lines and the fire lines should be kept ever in mind. If participants don't feel comfortable with a situation, they are expected to speak out. The beginning of a disaster is the missing communication between the different parties; contact with all team members must be kept intact. Local experts will inform the teams about the dangers. High leather boots are recommended. Insect repellent, available on every crew, can be very helpful. The high heat and humidity restricts fire fighters' normal production pace. It is very important to take the time to find the personal pace and to acclimate to the surrounding conditions. Heat exhaustion can occur on any fire. It is very important to drink water in huge amounts as well as sports drinks which work well to replace salts and electrolytes.

Relations with Locals

The local professionals are the experts in their area. Respect their judgement and listen carefully to what they have to tell you! These specialists have been fighting fire and have carried out controlled burning in their areas for a very long time. Things may be done differently from everyone's experience, but this doesn't mean that it is wrong. Remember you are guest whenever and wherever you go to burn during the session!

End of the sessions

The closeout starts with the return to PFTC in Tallahassee. The debriefing and the final technical discussions are held in the PFTC Conference Room. Students and field coordinator questionnaires will be filled out. An open, constructive discussion between all the team members and the PFTC officials will follow. All opinions are collected for the future improvement of the whole program. Rx fire handout material can be taken out as desired. The field coordinators are responsible for each member of their team until the team members depart from Tallahassee for their home unit.

PFTCs International Vision

PFTC and international students

Since the beginning of the project international students have been involved. In the first year students from Puerto Rico participated on the program and were followed by students from Germany, Ghana and Nigeria. Future international students are desirable, not only foresters, but people from different land management fields, such as biologists and ecologists.

PFTC and the Global Fire Monitoring Center (GFMC)

There is an idea to extend the prescribed burning activities on an international level. There are other countries which still need assistance on how to bring such a program to fruit. The Global Fire Monitoring Center (GFMC) has worldwide good connections to other interested countries, which could participate in the creation of a Worldwide

Prescribed Fire Training (WWPFT). The GFMC can facilitate an International Section of the Prescribed Fire Training Center (ISPFTC).

There are several countries which are currently conducting or preparing Integrated Forest Fire Management (IFFM) projects or are otherwise actively engaged in building national fire management programmes. These countries could make a first step in this direction by joining the WWPFT initiative. They would not only benefit from the WWPFT. They would contribute and share their own experience with other nations, especially concerning the learning process from traditional burning skills, the manifold social and cultural issues involved in the application of prescribed fire in land-use systems. All countries, including the PFTC and the GFMC as the network nodes would benefit this collaborative process.

Currently we see note high interest in the following regions and countries:

Africa: Namibia, South Africa and Ethiopia

Eastern Mediterranean and Central Asia: Turkey, Mongolia, Kazakhstan, Myanmar, China

South Asia: Myanmar, Indonesia

Central and South America: Brazil, Honduras

The Baltic Region: All countries bordering the Baltic Sea, especially the Nordic countries (Norway, Sweden, Finland), Germany, and the Russian Federation

In a pilot phase of three years, one country in each continent could be selected to test the proposed concept and. On the second stage other countries could participate, building on the knowledge and experience from the already implemented "satellite states" of each continent.

A successful prescribed fire is a good fire! Hazard fuel reduction combined with natural succession and maintenance of healthy fire evolved ecosystems demands the implementation of prescribed burning. **A non-successful prescribed fire is a bad fire**! It turns into a wildfire, an uncontrolled burn, and leaves a path of destruction. It has become more and more apparent to those who work with prescribed fire that there is an urgent need for policy that will further define standards that can be enforced for everyone who uses prescribed burning. When this valuable tool is used carefully and professionally, many beneficial effects will appear.

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NEWS FROM FIRE RESEARCH AND TECHNOLOGY

BELARUS

An Automated Remote Infrared and Television System for Forest Fire and Ecological Monitoring

Introduction

The development of automated systems for monitoring large forest areas and other terrain to detect fires in the early stage and to predict fire spread and fire emissions is a challenge for technological innovations. These monitoring systems must be part of a network for real-time transmission and receiving of data on local, region and national levels.

An automated infrared and television (IR-TV) system has been developed in Belarus for continuous and weather-independent detection of fire in large forest tracts. The system allows the detection of fire in an early stage, thus contributing to prevent large fire disasters and minimise economic losses.

The system allows monitoring of other environment parameters using additional sensors. At present Infrared-Television (IR-TV) systems are set up in the 30-km zone around Chernobyl Nuclear Power Plant accident site, and one in a forest enterprise of Minsk Region. The IR-TV system located in Chernobyl Zone is supplemented with radiation sensors to control the level of background radiation and monitor changes during a forest fire.

System Structure

The system includes a network of IR-TV detection modules placed on watch towers and the Central Point for Information Processing (CPP) (Fig.1). The system consists of three main parts:

* IR-TV automatic detection module (Fig.2).
* Radio network for transmission of digital information
* Central Point of Information Processing

All devices operate automatically. The product of information processing at the CPP is an electronic map (Fig.3). The CPP takes a decision or issues fire alarm.

Description of the system

IR-TV Automatic Detection Module

The system may include up to 128 IR-TV automatic detection modules. The modules scan the terrain, search and identify fire locations by detecting radiation; obtain digital TV images; measure meteorological parameters and radiation.

The IR-TV detection module includes (Fig.2):

* IR-telescopic system (detection of high-temperature events)
* Scanning device
* TV camera with an optical system (black-and-white)
* Microprocessor-based unit of control and processing data (*Advantech*)
* Power supply module (variable electricity supply, including solar panels)
* Radio network (*Motorola*)

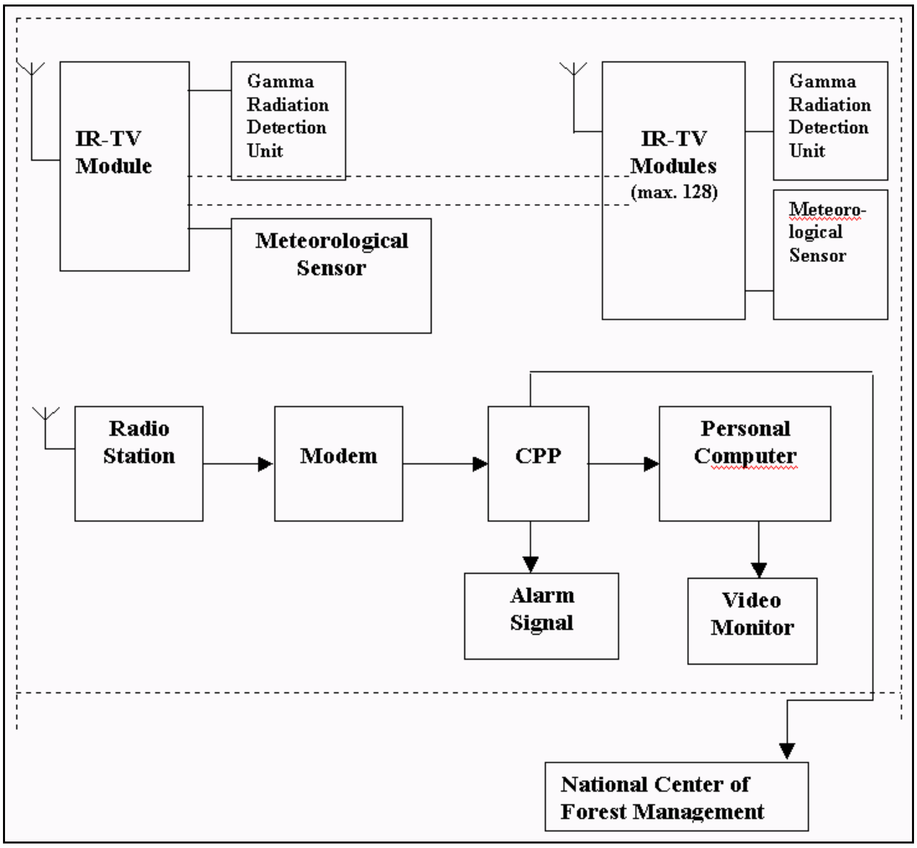

Fig. 1. System structure of the Automated Remote Infrared and Television System for Forest Fire and Ecological Monitoring

Fig.2. IR-TV detection module

Central Point for Information Processing (CPP)

The Central Point for Information Processing (CPP) receives data from the IR-TV modules and releases alarm after a fire has been identified. The CPP includes an IBM-compatible personal computer (with the Pentium processor and Windows), a radio station (Motorola GM-350), modem, antenna, power supply, and alarm system. The CPP performs the following:

* operation of the radio-network
* control and diagnostics of each of IR-TV-modules
* creation of an electronic map of the region monitored
* creation of images
* decision support
* other service functions

Technical specifications are given in Table 1. The CPP is located i. a. w. the requirements for a radio network location. The IR-TV detectors are mounted on watch towers that are strategically located.

System Functioning

Spectral separation and time-amplitude signal analysis is double checked by three rotations of the IR-TV-detector. The signal of the detected fire and its azimuth is registered in the memory of IR-TV-module and stored until information interchange with the CPP. Periodical inquiries at 5- to 10-minute intervals of the IR-TV-modules are realized from CPP. The bearings from the watch towers to the detected fires are indicated as red arrows on the electronic map, and the fire location is determined by the intersecting bearings (Fig.3). Upon request by the CPP the IR-TV-module transmits TV-pictures on the given azimuth. In addition maps of heat fields can be generated that show temperature profiles in colour images. These products are displayed on the CCP monitor. The IR-TV capabilities of the system are as follows:

IR-channel:

* detection of flames
* detection of heat ascending over a fire
* confirmation of signal identified by the IR-channel
* comparison of heat field maps received in different time periods

TV-channel

* fire detection by depicting fire smoke
* visual analysis from the interested direction

Figure 3 shows a the example of an electronic map on which the location of the detected fire is indicated.

Structural Features

All electronic and automated IR-TV system units are built in block technology and can be easily replaced if repair is necessary. Structural and functional characteristics of the automated systems for forest fire monitoring allows a connection to the National Forest Management System of Belarus that is currently being developed, and to other services.

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Tab.1. Main technical specifications of the Automated Remote Infrared and Television System for Forest Fire and Ecological Monitoring

Maximum temperature resolution of IR channel:	<0.5°C
Detection distance to fire (6 m^3):	at least 10 km
Spatial resolution:	175 m at 10 km distance
Full survey of area under control:	6 min
Detection time with confirmation (criteria analysis) of fire location:	30 sec
Area controlled by one IR module:	>300 km^2
Inquiry interval of single IR modules via radio:	5 to 10 min (programmable)
Angle of vision of TV channel:	6°
TV camera:	black-and-white or colour
TV channel resolution:	600 Tvl
Adjusting of CCD light of TV camera:	Automatic
Transmission time of TV image:	1.5 - 2 min
Information interchange:	via radio link at a single frequency (tunable between 137 and 174 MHz)
Electricity supply of IR modules and CPP:	220V $\pm$ 5% (50 Hz)
Power requirements:	radio stations (base and periphery) – 25 W, single IR-TV detection module – <150 W, CPP – 200 W
Operational limitations by temperature:	0°C - +50°C
Equipment durability:	dust-and water proof

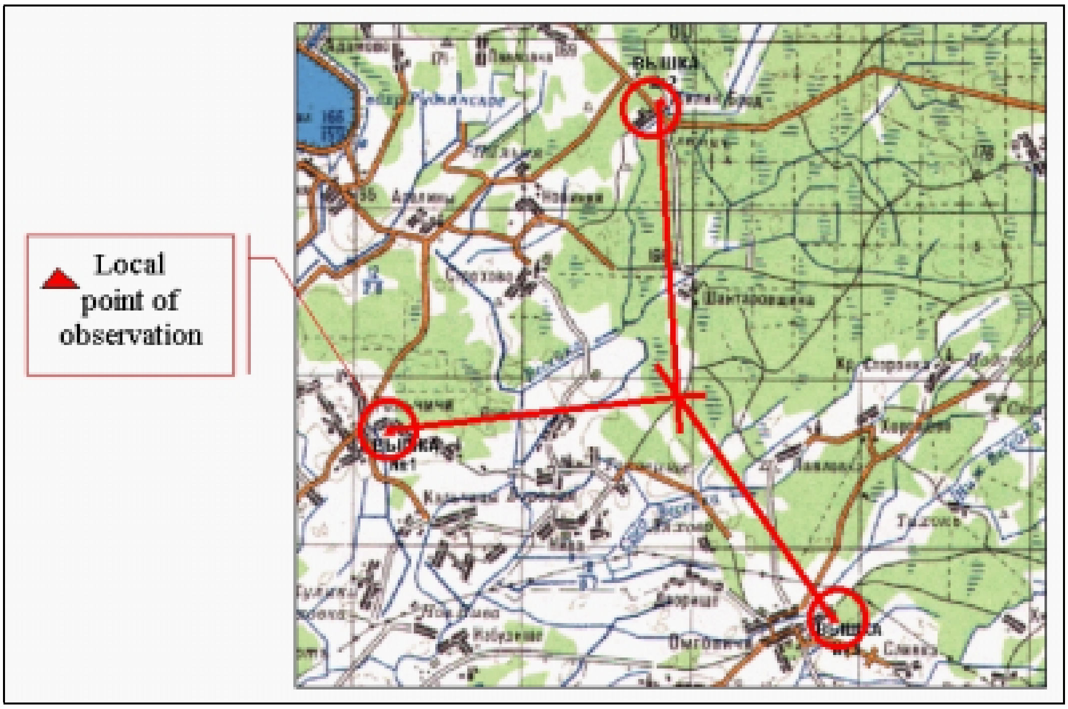

Fig.3. Example of an electronic map on which the location of the detected fire.

FRANCE

GAMMA-EC:
Gaming And MultiMedia Applications for Environmental Crisis Management Training

Introduction

Disasters do not happen every day. Therefore, disaster management will never be part of the daily routine of the fire brigade, police or health care units. In order to be prepared to these situations as good as possible, however, these organisations exercise regularly. These exercises are mostly limited to the own organisation, for, due to a lack of time, fire brigade, police and health care units do not often succeed in arranging multidisciplinary training programmes. This is due to the pressure of the daily operational process, and to the large amount of time and effort that is needed in order to prepare such an exercise. GAMMA-EC (Gaming And MultiMedia Applications for Environmental Crisis management training) is developed to reduce this amount of time and effort, and to promote education and training.

The GAMMA-EC Project

The goal of GAMMA-EC is to develop educational and training tools for disaster management. These tools consist of a multimedia application for the individual education of the public official within their own work field, and of an interactive game simulation for multidisciplinary team training. Within this project (1998-2000), the multimedia application and the interactive game simulation will be elaborated for two types of disasters: forest fires and chemical accidents. In the long term the intention is to extend the educational and training tools for other types of disaster, such as for example floods and nuclear accidents.

Multimedia

The multimedia application is intended to complete and freshen up the official's knowledge. In addition to this, the application can be used to apply the acquired knowledge in simple cases (Fig.1). These cases, or scenarios, are the core of the multimedia course. The purpose of the scenario is to let the trainee test its knowledge or browse the knowledge base by trying to solve the problems he faces as he goes through the scenario. Such a training tool enables the official to determine himself the place and moment he wants to get to work with this application. In this way the official is able to prepare well for this team training.

Interactive game simulation

The interactive game simulation supports the training management with the preparation of the exercise (such as making scenarios), as well as with the real performance of the multidisciplinary team training. The interactive game simulation supplies the necessary feedback with regard to the development of the disaster, taking into account the events set in advance (scenarios) and the players' actions and decisions. The actions and decisions will relate to evacuation, warning the population, combating the cause, etc. During the team training, the officials are in a room resembling the official's natural surroundings as much as possible (Fig.2). Via the usual lines of communication the report concerning the development of the (simulated) disaster reaches the official.

With this interactive game simulation, skills such as coordination, communication, decision-making under time pressure, and decision- making based on unreliable and incomplete information can be trained. Elements from the exercises can be reused through the generic intention of the game simulation, which considerably reduces the effort for making new exercises. During the game the simulation calculates the consequences of decisions for the further development of the disaster, which makes the output consistent. Because of this, it is expected that the training management required will be reduced with respect to the present exercise method.

An existing exercise can be used several times to train different teams. For example, the exercise developed during the project will be available for fire academies willing to have a training session.

The game simulation tools also facilitates the creation of new exercises: it includes an exercise definition module.

Both the multimedia application and the interactive game simulation are developed from an instructional viewpoint.

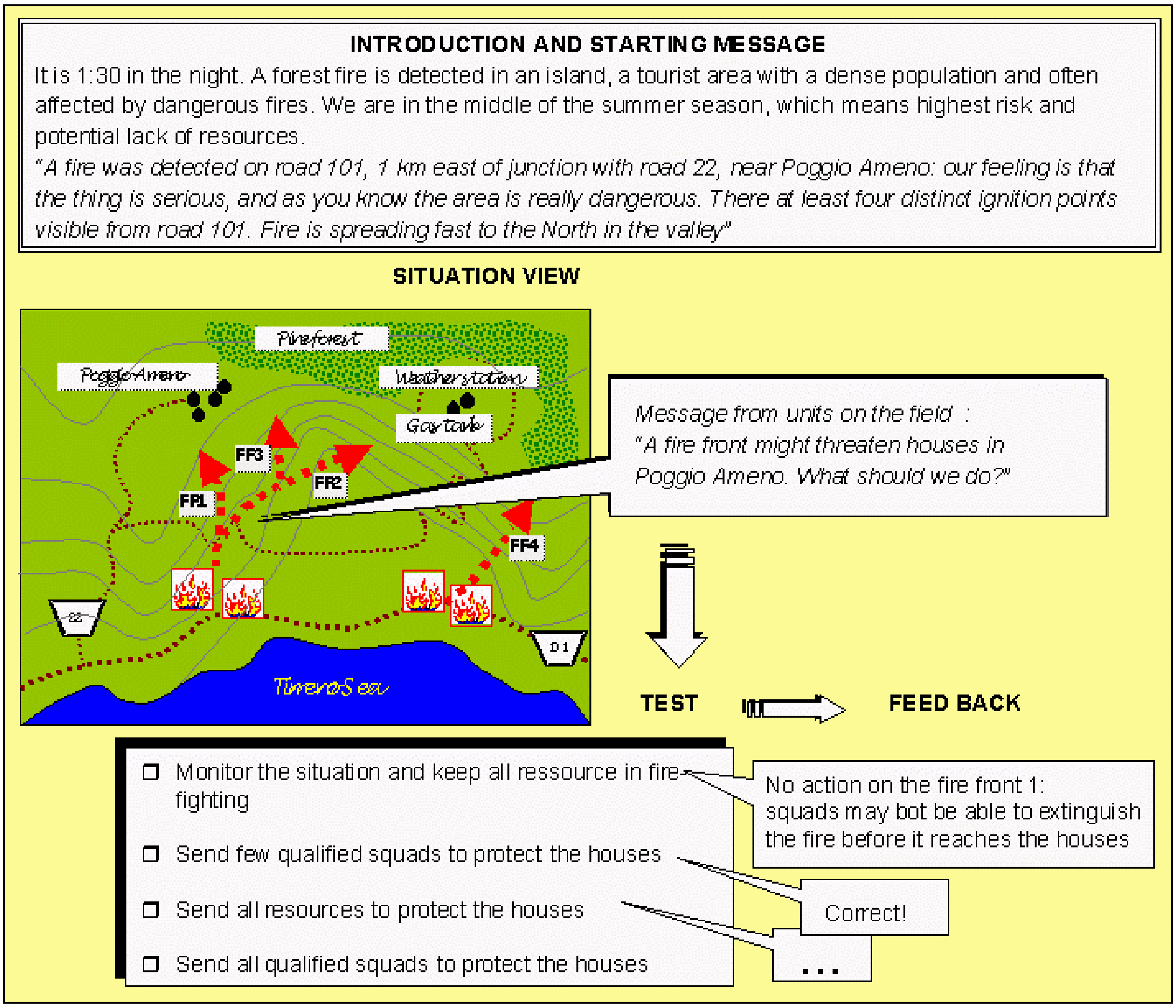

Fig.1. Example of interactive problem solving in the multimedia tool

The GAMMA-EC Consortium

Regarding forest fires, the work is carried out in collaboration with three fire brigade academies or fire research centres, from Spain, Italy and France. They take part in writing the multimedia scenarios and the exercise, according to the identified learning goals. NIBRA (Netherlands fire academy) plays the same role in the field of chemical accidents.

These fire academies play a key part in the project, as expert in the field of disaster management. They also represent the future users of the tools that are developed in GAMMA-EC.

The Consortium itself consists of research organisation from 4 countries :

* the Faculty of Education of the University of Barcelona has executed a target group analysis and an educational target analysis.
* Italsoft, an Italian software company develops the multimedia application (assisted by Mafrau) based on these analyses,
* TNO (Netherlands) develops the interactive game simulation.
* where forest fires are concerned, the project team makes use of the specific knowledge of MTDA, from France.

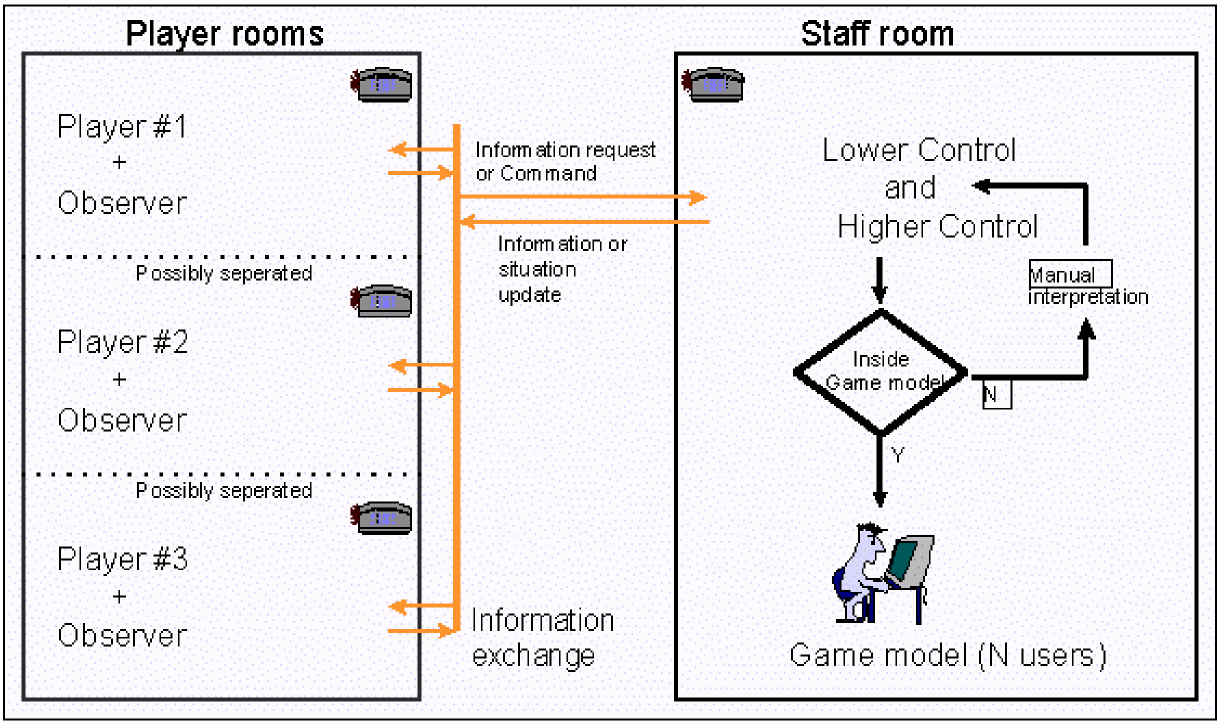

Fig.2. The game set up

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PORTUGAL

Project Eagle:
A Pilot Project on Forest Fire Detection in Central Portugal

Project Eagle is a pilot project coordinated by ADAI (Associacao para o Desenvolovimento da Aerodinamica Industrial) team of the University of Coimbra, with the financial support of the General Directorate of Forests of Portugal with the objective of demonstrating the feasibility of using advanced fire detection and decision support systems on fire control activities. The area of intervention of the project is the District of Coimbra, in Central Portugal, that is extensively covered by pine and eucalypt forests and has been subjected to a large number of fires in the past years.

This project started in January 2000 and has the duration of two years. Besides the Forest Service various other public and private institutions co-operate in the activities of the project. One of the aims of this initiative is the possibility of applying directly the results and products of research projects carried out with the support of national and EU research programs.

A group of manufactures of fire detection equipment were invited to participate in the project and accepted to install their equipment in a set of selected watch towers. During the past summer the following systems were operating at the designated sites:

WatchTower of S. Pedro Dias

The Bosque System installed on the lookout tower of S. Pedri Dias is provided by Faba-Basan (Spain) and includes a video and an infra-red camera (Fig.1).

Fig.1. The *Bosque System* sensors installed at the S. Pedro Dias site.

Fig.2. The BSDS System sensors installed in the Soutelo watch tower

Fig.3. Managing the various systems at the Operational Coordination Centre of Poiares

Watch Tower of Lousã

The Lousã watch tower is equipped with the IVCS System which is provided by Teletron (Italy) and incorporates a video camera.

The watch towers are currently manned by observers day and night during the fire season. The fire detection equipment that was installed supplemented their activity and was generally well accepted. All these systems transmitted their images and data to a control centre that was installed at the Operational Coordination Centre of Coimbra. This Centre is manned 24 hrs by the Fire Brigade during the entire year. The systems were controlled by personnel from the ADAI team that received a specific training with the operation of the various systems. The communication between the control centre and the remote towers was made by radio signals, with the exception of the IVCS system from Teletron that used GSM communication based on the network of Optimus telephone company.

One of the products that was being tested during this activity was the fire behaviour prediction system *Firestation* developed by ADAI team. This system uses the topographical data of the region and the vegetation maps of the study area of the project to compute the wind field and the fire propagation, as soon as the location of the fire is known. The system allows the simulation of fire fighting activities, to predict their effectiveness in controlling the fire.

Unfortunately the Summer of 2000 was extremely busy with fire activity in the entire Country, but specially in this part of Portugal. Between the beginning of July – when the systems started to operate – and the end of September, more than 400 fires were recorded in the area covered by the watch towers. From these around 80 were registered and monitored by the systems installed in the scope of the project. The two systems incorporating IR sensors have the capacity of detecting fire ignitions automatically. It was found that these systems operated with great reliability with an acceptable level of false alarms.

One feature that was very much appreciated by the personnel of the Coordination Centre was the ability of observing directly the development of the fires, without the need of an intermediate communication with a field observer. This possibility that was provided by the various systems helped the controllers to make their decisions to allocate the fire fighting resources according to the situation that they were observing directly. This was particularly effective during those critical days in which the number and extension of the fires in the area exceeded by large the available means.

The project provided the personnel of the operational institutions dealing with forest fire prevention and management in Portugal the possibility of observing and getting acquainted with the solutions that are offered by various manufacturers and research teams to help them in their activity. It is expected that the natural resistance to change and to incorporate new technologies, that exist currently, may be overcome and that the use of this type of solutions be more common.

We are currently analysing the possibility of extending the *Project Eagle* area of activity to other parts of the country.

Fig.4. Video and infra-red images from a fire near Moura Morta on 7 August 2000

Fig.5. Simulation of a forest fire at Moura Morta using *Firestation*

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GESTOSA 2000
Experimental Fires in Shrub Vegetation in Central Portugal

Under the coordination of the author, in the frame work of the EU funded INFLAME research project the GESTOSA 2000, shrubland experimental fires were carried out in Central Portugal on 19 and 20 May 2000. The experimental field of Gestosa was made available for the project by the Forestry Service of Portugal. It is situated in the Southern face of Serra da Lousã, near Castanheira de Pera, some 80 km from Coimbra.

During the two days of the experiments nine plots were burned under relatively severe conditions in a slope of around 60%. The plots had a width of around 80m and a length of 150m and were separated from each other by a fire break 6m wide. A survey of the vegetation carried out during several days prior to the experiments showed a dominance of the following species *Erica umbellata*, *Chamaespartium tridentatum* and *Erica australis*. The height of the vegetation was relatively uniform inside each plot and its average value varied in the range of 0.6 m and 1.4m between the various plots. Within the scope of INFLAME project the main purpose of these experiments was the collection of experimental data to validate models and sub-models required to predict fire behaviour.

Six plots were burned with linear fire fronts propagating upslope. Rates of spread up to 0.7m/s were recorded in these experiments. The other three plots were burned with point ignitions in order to analyse the joint effect of wind and slope on this type of fires, that is being studied by the INFLAME Consortium.

Data on the vegetation status, meteorological conditions, fire spread properties, smoke dispersion and retardant efficiency were collected during the experiments by the various research teams. Wind properties were monitored continuously during the experiments at seven automatic weather stations situated in the close vicinity of the test area. Video and infra-red images were taken during each experiment both from ground level and from an helicopter that was made available by the Portuguese Fire Brigade Service. These images are being processed in order to obtain a detailed analysis of fire spread in connection with data collected by other methods. Concentration of smoke particles were measured by specialised equipment placed at various locations during each test in order to assess the impact of the smoke plume on the personnel safety at the fire scene and on the air quality at farther distances.

The experiments had the participation of more than 40 scientists from Portugal, Spain, France and Switzerland and involved the participation of other 50 persons from various operational institutions that provided the safety conditions and other logistic services required for the experiments.

In 1998 and 1999 similar experiments were carried out in the area of Gestosa under INFLAME project with the same objectives. Reports of these experiments are available under request to the author.

INFLAME Project runs under Contract ENV4-CT98-0700. The project activities started in May fo 1998 and will end in October of this year. The project involves the participation of the following research teams:

Partner	Name	Leader	Acronym	Role	Country
1	ADAI	D. X. Viegas	ADAI	Coordinator	Pt
2	U. Alcalá	E. Chuvieco	UAH	Sub-coordinator	Sp
3	Algosystems	G. Eftichidis	ALGO	Sub-coordinator	Gr
4	U. Torino	G. Bovio	AGRO	Partner	It
5	U. Aveiro	C. Borrego	UAV	Partner	Pt
6	U. Aix-Marseille	A. Douguedroit	UAIX	Partner	Fr
7	U. Seville	A. Olero	AICIA	Partner	Sp
8	CEREN	C. Picard	CEREN	Partner	Fr
9	WSL/FNP	M. Conedera	WSL	Partner	Ch
10	U. Zurich	B. Allgöwer	GIUZ	Partner	Ch
11	U. Nancy	O. S. Guillaume	LEMTA	Sub-contractor	FR
12	U. A. Barcelona	E. Luque	CAOS	Sub-contractor	SP

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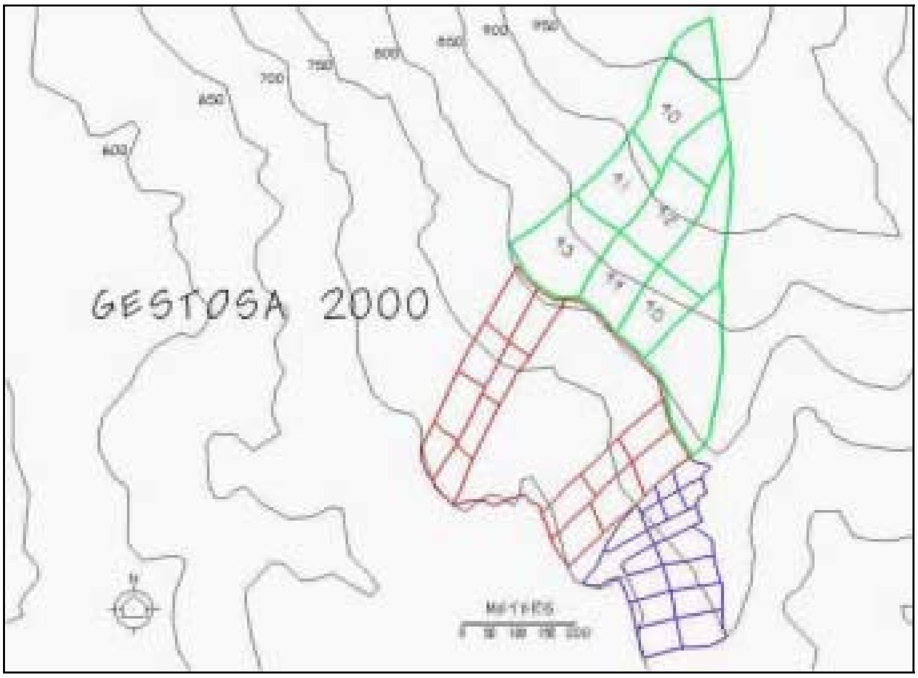

Fig.1. Schematic view of the test plots of Gestosa field experiment. The plots burned in 2000 are numbered from 40 to 45. The plots in the lower part of the figure were burned in 1998 and the plots in the centre of the figure were used in the tests of in 1999.

Fig.2. Burn of plot 43, ignited along its bottom.

Fig.3. Burn of plot 45a, ignited at a single point.

SOUTH AFRICA

Firehawk™
Electronic Forest Fire Detection and Management System

Introduction

In 1994 *Digital Imaging Systems* – a South African Technology Company – identified the need to replace traditional manned lookout towers with a reliable electronic fire detection system. In October of the same year the concept of computerised *Rapid Fire Detection* was born.

Technology plays a vital role in all spheres of forestry today, ranging from silviculture to harvesting. Basic things like the chainsaw, advanced computerized mechanized harvesting machines, the GIS and computerized data base containing large memory banks. Forest fires, are one of natures most destructive forces, yet nothing has ever been done to improve detection methods which have remained the same for hundreds of years.

Forestry companies have sophisticated methods to combat fires, including well-trained ground crews, sophisticated foam and retardant, all backed by aerial support from air tankers, spotter planes and helicopters. In certain countries smokejumpers are still used with success. With all these systems in place thousands of valuable hectares of forestry are still lost to fire each year. The major contributing factor for this is the late detection of fires. Ground crews and aerial support teams are only able to do something about a fire effectively if they reach them at the very early stage. They have no or very little effect once the fire has reached a certain size.

Manned lookout towers are as old as forestry itself. The human element associated with these lookout towers is the problem. More often than not, lookout towers are late in reporting fires. Guards have to work long hours under difficult circumstances with only short breaks in concentration. It is also very difficult for these staff members to pin point the actual location of any fire and to provide the best access details to the forester. Yet this antiquated method is still used in many parts of the world. Millions of dollars are spent annually in the combat of fires but nothing is done about their early detection.

Digital Imaging Systems has developed a system trademarked and patented in South Africa called **Firehawk** whereby rotating digital cameras covering large forestry areas transmit information to a base station where the Firehawk software differentiates between fire, smoke and glow and automatically raises an alarm

Firehawk™ - The System

Firehawk™ is a computer aided forest risk management system that is controlled by a human operator. The Firehawk™ system consists of the following elements (see also Fig.1):

- Cameras with zoom lenses
- Pan tilt head, which allows for the movement of cameras
- Masts (typically the camera assembly and transmission equipment is mounted on masts of either 30 to 72 meters in height depending on the surrounding topography)
- Microwave transmitters and receivers (used for the transmission of video from remote sites to the central control base)
- Radio telemetry links (the actual movement of cameras, i.e. pan, tilt and zoom, are controlled via these links, from the central base)
- Firehawk™ processor and software
- Monitors (to display individual camera visuals at the control base)
- Time-lapse video recorders (For the 24-hour video recording of events from the different camera installations)

Firehawk's capabilities are as follows:

- Multi-tower capabilities. Up to eight (8) remote camera installations can be connected to a single Firehawk™ processor. A base station can have many processors.
- Cameras scan a full 360 degrees in less than four minutes.
- Detection of smoke, fire and glow 24 hours a day.
- Manual manipulation of any camera in the system without affecting any other camera in the system.
- Multiple alarm reporting capabilities. Alarms are reported by the system without affecting any camera scanning its designated area.
- Geographical information on any camera and sector position by a simple one touch button operation. This provides valuable information to forestry personal, such as fire location and best access details.
- User friendly software, using the latest software platforms and operating systems.
- Multiple time zones setup capabilities. (day night and twilight).
- Unwanted image alarms are filtered out.
- The system can be used for Management check ups and controlling fire fighting operations.

General

Firehawk™ has been designed to be installed in remote areas where cameras can cover a radius of 6 to 8 km from the point of installation. Although the capability of cameras is far beyond the 6 to 8 km radius, weather conditions do not always allow detection of fires beyond this safe margin.

Real time video images can be transmitted up to 30 km. without repeating being required. These video images are fed to a central command base where they are processed and filter out unwanted image alarms and reporting only those required.

During the past six years the system has been installed and tested in various forestry areas throughout South Africa. The first installation was in the Richmond area of Kwa Zulu Natal. This area was chosen for various reasons. Topographically it is very mountainous, extreme temperature changes occur, hot summers and very cold winters with snow on high ground often occurring. This ensured that the system was tested developed to not only work under severe weather conditions, but also be accurate enough to guide foresters to the source of a fire in the shortest possible time once detected.

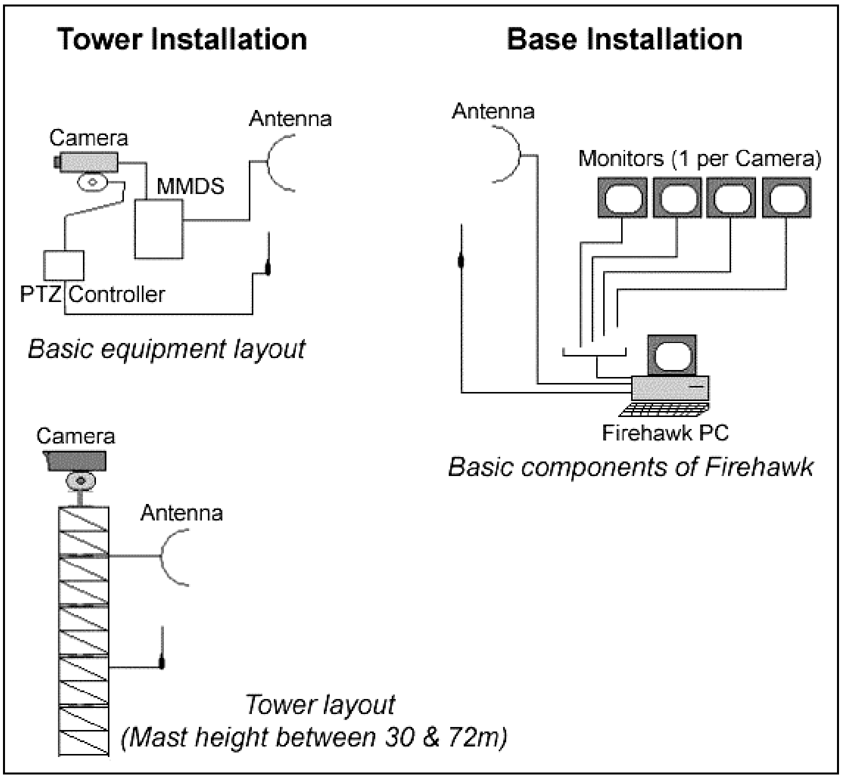

Fig.1. Elements of the Firehawk™ system

Presently Firehawk™ is installed in four regions of South Africa, and is continuously being expanded. Forestry companies (Mondi, Sappi and Masonite), Private growers and Government Agencies have committed themselves to the Firehawk™ system as being the preferred system for the detection of forest fires.

Results

In Northern Kwa-Zulu Natal during the 2000 fire season a total of 153 fires were detected. Of these 87 fires were detected at night. Results at the end of the season showed a burnt area rate of less than one hectare per fire (0.7 ha per fire), whereas during the 1998 fire season, before the Firehawk system was installed the burnt area rate was 5.68 ha per fire. This proved that by having the capability to detect fires more rapidly, ground crews and aerial support are able to get to the source of fires much faster, thereby limiting damage drastically.

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RUSSIAN FEDERATION

TV Systems for Early Detection of Forest Fires in Leningrad Region, Russian Federation

Introduction

Leningrad region is located in the Northwest of Russia. Its territory covers about 90 000 km^2. Federal forests occupy about half of the area, i.e. 45 000 km^2 which are managed by 27 forestry enterprises under the supervision of the Leningrad Region Forestry Committee, St. Petersburg. Almost 1 000 forest fires occur annually in the forests of Leningrad Region. They are caused by human activities, some of them by arson. The average area burned annually makes up 1 000 to 1 200 ha.

Until recently the detection of forest fires basically has been carried out by one of the divisions of the Russian Aerial Forest Fire Protection Association (*Avialesookhrana*) and by the ground services of the forestry enterprises. Since 1996 priority in forest fire detection was given to develop and install ground-based TV means for early detection of forest fires. At the end of 2000 the territory of Leningrad Region is covered by a network of 50 observation towers and masts that are 35 to 45 m high and equipped with colour video cameras for circular survey. Each of these lookout point surveys an area covering an observation radius of 15-20 km through the whole fire season (May to September). In order to cover the whole territory of Leningrad Region a total of ca. 110 of such TV installations are needed.

The extreme dry summer of 1999 experienced an increase of the area burned (11 000 ha). The districts which had not yet been equipped with TV fire detection systems sustained the heaviest losses. The wet summer of 2000 was rather quiet. However, the only large-scale forest fire (ca. 400 ha) originated early in summer in the south of the region where there are still no video systems for forest fire detection.

System Design and Functioning

Each TV lookout point for forest fire detection comprises:

* observation tower (35-45 m high)
* video camera on a rotary unit with azimuth indicator
* operator’s place with remote control of the video camera, colour TV monitor (the current azimuth is indicated on the screen against the background of the surveyed territory)
* telephone and UHF radio communication means for the information transfer on the fire detection, for dispatch and coordination of fire fighters, and for communication with the neighbouring TV lookout points
* fire-plotting map with the indication of location and geographical coordinates of an observation tower and an azimuth circle at the boundary of the video camera survey radius

Three types of observation towers are used:

* stationary, 35-45 m high, built on a concrete foundation
* collapsible, 32-36m high, made of prefabricated elements which can be assembled right on the ground during one working day, together with the video system
* mobile, 22-35m.high, with a hydraulic telescopic elevator that which is located on the chassis of a heavy off-road capability truck

Stationary and collapsible towers are set up not more than 250 m away from the operator’s building. Mobile towers can be freely moved around the territory under survey, considering local conditions of fire danger; they are self-contained and provide the operator’s place in a sheltered trailer.

In the forestry enterprises of Leningrad Region specialized forest fire video systems Klen (Velikiy Novgorod) and Baltika (St. Petersburg) are used. Improved methods for fire detection were elaborated in the St. Petersburg Forestry Research Institute and approved by the State programme in 1995. The improvements include:

- Video system power supply is 220V 50Hz
- The accuracy of fire bearings are +/- 3.0° (*Klen*) and +/- 0.5° (*Baltika*)
- A 120-mm lens provides 15x magnification
- The video camera is remotely controlled by means of an additional pair of wires (*Klen*) or through the video cable (*Baltika*)
- Ten functions are carried out from the control desk including remote orientation of video camera

The greatest effect from the use of forest fire video systems is achieved by a network of lookout points located at spacing distance of 12 to 20 km, depending on the relief. Each video system operator controls an area of 70 000 to 80 000 ha. The integration of network data allows the determination of fire locations by cross bearing. A stable smoke column appearing above the crown layer is confidently recognized from a starting fire with the area of 10 to 30 m^2. Such early detection allows initial attack and fire suppression before the burning area exceeds 50 to 100 m^2. Problems are faced only by multiple simultaneous ignitions and a lack of firefighting resources. Altogether the introduction of early fire detection devices considerably reduced the area burned.

In the recent four years several forestry enterprises of the Committee invested own funding (ca. $US400 000) into the development of forest fire radio communication and television-based fire detection systems without financial aid from federal authorities.

Considerably damages to the forest fire video systems are caused by atmospheric discharges. Even when switched off from power supply video cameras are hit through the cable line. Direct lightning blows were not registered. Almost ten percent of all running video systems have been affected by thunderstorms. The latest video system model Baltika-3 is already provided with lightning protection. Other problems have been caused by birds that have damaged the video system by pecking plastic gaskets of video cameras, resulting in penetration of water into the system. Rubber gaskets are not touched by the birds.

Mobile video systems face problems of properly determining the distance to the detected fire spot. The late model Baltika-3 provides an accuracy of locating a fire of +/- 500-700 m within its range of 10-14 km. Since Russian forests are divided into square compartments of 1x1 km size (planning quarters) the accuracy of fire detection within a certain quarter is considered to be sufficient.

Conclusions

The creation of the completed network consisting of 110 TV installations for forest fire detection on the territory of Leningrad Region will lead to a considerable reduction in losses caused by forest fires due to rapid intervention. In addition the number and time of expensive flights of patrol aircraft and helicopters can be reduced. Early detection of forest fires by means of television, supported by active fire suppression from the air will increase the efficiency of forest fire control. Aerial fire suppression still is not yet being used widely in the north-west of Russia. However, advanced technologies exist and have been tested, such as helicopter equipment for pressurized discharge of liquid fire suppressants (up to 15 m^3) using a foam generator, as well as infrared sighting device which considerably reduces the number of misses of the spot and at the same time provides automatic discharge of fire suppressants from airtankers. Since the fire season in the north-western part of Russia lasts for 4-5 months per year there seems to be a possibility for transferring forest fire video systems together with collapsible and mobile masts to the southern parts of Russia or even to the Southern hemisphere where fire seasons occur during Russia's winter time. Setting up of several dozens of such lookout points in a short period of time is much more lucrative compared to the construction of stationary towers and will let to use already available forest fire video systems in a best way.

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CONFERENCE ANNOUNCEMENT

Fourth International Conference "Forest and Steppe Fires: Initiation, Spread, Suppression and Ecological Impacts"

25-29 September 2001, Irkutsk, Russian Federation

The conference is organized by Tomsk State University, Center of Education and Research on Reactive Media Mechanics and Ecology; the Eastern-Siberian Institute of the Ministry of Internal Affairs of the Russian Federation; Siberian Branch of the Council on Combustion and Explosion of the Russian Academy of Sciences, Novosibirsk.

Aims and tasks of the conference: Discussion of the result of scientific investigating the problems of the forest and steppe fires in the 20th century and new methods of preventing and fighting them. Forest and steppe fires and technogenic catastrophes (taking into account their mutual influence, their prediction and evaluation of ecological impacts). At the conference the problems of applying methods of physics, probability theory and multiphase reactive media mechanics will be considered to investigate forest fires and technogenic catastrophes caused by these fires. An example of a complex fire was the escaped prescribed fire at the interface between the wildlands and the Los Alamos National Laboratory (USA) in early 2000. It is supposed to discuss setting up and solutions of new conjugate problems of reactive media mechanics, which allow to make mathematical modelling of the forest fires, database for this model and its application to calculating ecological impacts of these fires will be considered. Limiting conditions of the forest fire initiation and spread and new methods of fighting them will be discussed. The measures of preventing forest fires, possibilities of aerial and spaceborne detection and monitoring of forest fires will be covered. Computer programmes on will be demonstrated as well as experiments on suppressing forest fires by means of relatively small energetic effects on the fire front.

The Organizing Committee welcomes additional co-organizers and co-sponsors. Co-organizers or co-sponsors are expected to provide material or financial support to the organizing committee.

The working languages of the conference will be English and Russian. Publication will be in English.

Registration and abstracts are due on 15 August 2001. For details of application for participation (pre-registration form, requirements for abstract submission, etc.) please contact the Organizing Committee:

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IN MEMORIAM

Rudolph A. Wendelin, 90, a former USDA Forest Service artist credited for creating the look of Smokey Bear, died August 31 in Falls Church, Virginia. A graduate of the University of Kansas, Wendelin joined the USDA Forest Service in Milwaukee, Wisconsin, in 1933 and transferred to Washington, DC, in 1937. Following World War II, he resumed his USDA Forest Service career as the man in charge of Smokey Bear. The USDA Forest Service had invented Smokey in 1944 to be its “spokesperson” on the prevention of forest fires. Under Wendelin, Smokey changed from a baby bear to a full grown animal with fangs and claws, and then again to his more familiar, human-like form. By the 1950s, Smokey was outfitted with a ranger's hat, belted blue jeans, and a shovel he carried to protect America's forests from fire. Wendelin supervised Smokey's activities until he retired from the USDA Forest Service in 1973. During his retirement, however, Wendelin continued to draw Smokey for calendars and books featuring the bear. For his efforts on behalf of the Smokey campaign, Wendelin received numerous awards from the government and a host of patriotic organizations.

From: The Forestry Source, Society of American Foresters.