ITTO GUIDELINES ON FIRE MANAGEMENT IN TROPICAL FORESTS

INTERNATIONAL TROPICAL TIMBER ORGANIZATION
ORGANISATION INTERNATIONALE DES BOIS TROPICAUX
ORGANIZACIÓN INTERNACIONAL DE LAS MADERAS TROPICALES

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FOREWORD

This is the sixth publication in the ITTO Policy Development Series which aims to provide practical assistance to member countries as they address issues and develop principles to ensure the protection and sustainable management of tropical forests.

As each year large areas of tropical forests are lost to fires resulting from both natural and man-induced causes, these Guidelines have been developed particularly for those countries which have decided to implement forest fire management programmes but have little experience in this area. The success of such efforts will be of benefit to the global community overall.

As a follow up to the ITTO-sponsored activities in the rehabilitation of forests destroyed by fires in East Kalimantan, Indonesia, the International Tropical Timber Council (ITTC) embarked upon the development of Guidelines for the protection of tropical forests against fire. Pursuant to a Decision of the Council, an Expert Panel comprising specialists from producer and consumer members was convened in Jakarta from 6-20 March 1995. Draft Guidelines, based on a background paper prepared by Dr. J.G Goldammer (Germany) and Prof. S. Manan (Indonesia), were formulated and subsequently presented at the Eighteenth Session of ITTC in Accra, Ghana.

At this stage, it was recognised that the Guidelines would need to incorporate a range of issues in addition to just the suppression of wildfires in tropical forests. To this end, the remit of the Guidelines was extended to include factors relevant also to fire management. This has undoubtedly increased the scope and application of the Guidelines. The finalised version results from the painstaking work of J. Sorenson (USA) and R. Soares (Brazil) who incorporated this revision into the draft. The Guidelines were approved by ITTC at its Twenty-first Session held in Yokohama, Japan in November 1996.

The resources required by a member country to implement the various recommended actions contained herein were not a consideration in the formulation of the Guidelines. An action deemed necessary to accomplish a goal is presented even if it might be beyond the current means of some countries. However, in making the recommendations contained in these Guidelines, it is our hope that they will generate enhanced levels of international cooperation and assistance to developing tropical countries.

The Guidelines on Fire Management in Tropical Forests is one more step by the ITTO to aid forest managers and national planners to overcome the problems they face in achieving the sustainable management of their forests. The challenge now lies in the incorporation of these Guidelines into national action plans and for their effective implementation. This set of Guidelines is yet another ITTO contribution to promote the management, conservation and sustainable development of tropical forests as enshrined in the International Tropical Timber Agreement of 1994.

Yokohama,Japan   B.C.Y. Freezailah
18 April 1997   Executive Director

ITTO GUIDELINES ON
FIRE MANAGEMENT IN TROPICAL FORESTS

1.   INTRODUCTION

The vast majority of today's global vegetation fires are human-caused, and take place in the tropics and subtropics. They are the result of the increasing human population pressure on these areas where fire is being used extensively as a land treatment tool, e.g., for conversion of forested lands into agricultural lands; for maintaining grazing lands; and for facilitating the utilization of non-wood forest products of the seasonal forests and savannas.

In the evolutionary history of the seasonal tropics, lightning fires have significantly contributed to shape savanna and forest ecosystems. In addition, fire influence through traditional burning practices over millennia has strongly favored and selected plant communities that are considered to be sustainable and long-term stable fire ecosystems. However, the contemporarily changing fire regimes, and the alteration of sustainable time-space-fire relationships in the wake of changing land-use practices are often associated with forest and site degradation.

Tropical rain forests can be severely affected by fire. Shortening of shifting cultivation cycles and the increasing occurrence of escaping land-use fires into tropical rain forests cause high ecological damage by reducing biodiversity.   Fire-induced loss of soil cover negatively affects hydrological regimes and soil properties, leading to severe erosion and loss of productive topsoil. High economic losses are caused by damaging valuable timber and non-timber resources, natural regeneration, and planted forests.

In addition, burning of forests and other vegetation of the tropics may exert impacts at different levels on local, regional, and global environments. Smoke from large scale tropical fires also reduces safety of air, land and coastal marine traffic; and may cause problems to human health. Fires in the interface of wildlands and residential areas often cause the loss of human lives, property, and other values at risk, e.g., forestry enterprises, sawmills, power lines, other infrastructures, and livelihoods.

On the other hand, fires play a central role in the maintenance of many natural ecosystems, as well as in the practice of agriculture and pastoralism. Tropical moist savannas in many regions are maintained by fire and would return to seasonal tropical forests if fire could be excluded. Some seasonal tropical forests regularly affected by fire produce valuable timber and non-wood forest products.

These ***ITTO Guidelines on Fire Management in Tropical Forests*** build on the previously published *ITTO Guidelines on Sustainable Management of Natural Tropical Forests*, the *Establishment and Sustainable Management of Planted Tropical Forests*, and the *Conservation of Biological Diversity in Tropical Production Forests*.

These fire management guidelines are designed to provide a base for policy makers and managers at various levels to develop programs and projects in which the specific national, socio-economic, and natural problems related to fire in tropical natural and planted forests will be addressed. The scope of the guidelines is to assist the ITTO producer and consumer countries to develop programs for reducing damage caused by fire; and to help tropical forest managers and rural residents to safely use and take advantage of the beneficial effects of fire in land-use systems. The Guidelines are in accordance with the UN Resolution 44/236 in which the 1990's were designated as the International Decade on Natural Disaster Reduction (IDNDR). One objective of IDNDR is to reduce damage, economic disruption, and loss of life caused by wildfires through concerted international actions, especially in developing countries.

The guidelines recognize that many forest fires originate in the agricultural and pastoral systems; and in degraded vegetation which is outside of forests. Therefore, fire management on former and degraded forest lands may help to re-establish productive forests and to safeguard the success of reforestation programs.

2.   POLICY AND LEGISLATION

Policy Development

Principle #1

The successful implementation of a policy to protect tropical forests against fire is highly dependent upon broad-based support from all sectors of society, particularly civic organizations and groups working with the responsible government authorities on a voluntary basis, and must be supported by appropriate legislation which is in harmony with laws concerning related issues.

Recommended Action #1

a.   Identify local communities, concession holders, timber companies, contractors, conservation non-governmental organizations (NGOs), women's groups, and other voluntary organizations to assess their interest and capacity to forge partnerships with government authorities in fire management programs. Where necessary, assistance will be provided by government authorities in the development of such organizations.

b.   A national fire policy forming an integral part of the national land use policy, and assuring sustainable forest management, should be formulated and accepted by all relevant parties, including government, local communities, and the private sector.

c.   Establish**,** and effectively staff and fund**,** a decentralized national agency, or strengthen an existing institution responsible for the establishment and implementation of an effective fire policy.

d.   Enact and/or revise national and local laws and regulations regarding the proper use of fire to ensure the effective implementation of fire management policies.

e.   Create a system of incentives and sanctions which will encourage responsible use of fire at all levels, including timber felling and sawmilling.

Principle #2

National parks, national forests, and equivalent reserves protect important and unique representative samples of tropical forest ecosystems as part of the world's natural heritage. These conservation units can be damaged by wildfires which are usually caused by the activities of rural populations.

Recommended Action #2

a.   In a national system for fire management, the protection of conservation areas should be considered a priority.

b.   Develop fire protection plans for forest lands with high conservation values.

3. STRATEGIES

Fire Management Planning

Principle #3

A fire management plan is an essential component for the prevention, suppression, and management of fire within forests and adjacent lands. Fire management plans must be part of an overall land-use (e.g. forestry) management plan. Planning should be on a cooperative basis on national, regional, provincial, and local levels as appropriate.

Recommended Action #3

a.   Provide adequate resources for fire management planning at different levels of fire activity.

b.   Develop fire management plans which include a clear statement of objectives; and incorporate information on land tenure, assets threatened, degree of fire risk, fire history, and fire management measures.

c.   Promote the active participation of concession holders, timber companies, contractors, local communities, and all other voluntary organizations, particularly non-governmental and women's groups. Their participation needs to be based on their abilities which could be enhanced through training in fire management; and on providing appropriate equipment and incentives whenever feasible.

Fire Management Options

Principle #4

The selection and application of fire management options depend upon the conditions and circumstances found at the national, provincial, and local levels which may include, inter alia:

· Forest types and management activities,
· Risk and sources of fire,
· Access and terrain,
· Fire management capabilities,
· Climatic conditions,
· Adjoining land uses, and
· Socio-economic factors.

Recommended Action #4

a.   Select and develop the appropriate fire management option which takes into account local circumstances and conditions.

b.   An integrated fire management program should be developed which may include some or all of the following fire management measures:

· Community participation in fire protection,
· Fire prevention (e.g. fire breaks, fuel breaks, and fuel management),
· Fire pre-suppression (e.g. collection of fire intelligence, weather and fire danger forecasts,

   detection and early warning and reporting systems, fuel assessment, equipment, communications,   water supplies, and training of fire fighters, etc.),

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· Prescribed burning (e.g. fuel reduction, slash burning, etc.),
· Fire suppression,
· Law enforcement and incentive systems,
· Training, extension and public awareness programs, and
· A compost processing policy for agricultural waste or residues from other operations carried out   near forest areas.

Principle #5

Fire detection and early warning systems are essential for the rapid and effective control of wildfires. A wide range of fire detection options exists, including look-out towers, surveillance aircraft, ground patrols, satellites, and information provided by the general public.

Recommended Action #5

a.   Explore and seek access to all potential sources of information and communication of early fire detection.

b.   Develop a system of early and rapid dispatch to fires, including assessment of likely routes of travel to determine impediments.

Fire Suppression

Principle #6

Typical fire situations in many tropical vegetation types can be successfully controlled and managed by experienced ground crews of fire-fighters. The success of ground crews depends upon local fire organization, on the availability of adequately designed hand tools, and the provision of basic training in fire suppression and fire fighter's safety. Fire fighting equipment is available in developed countries and may be adaptable to tropical forest conditions.

Recommended Action #6

a.   Encourage the formation of volunteer fire fighting brigades from local communities and forest users.

b.   Provide local brigades with well-constructed fire fighting tools and basic equipment.

c.   Provide training on fire fighting techniques and tactics to brigade leaders and fire crews; introducing technologies to enable fire organizations to combat forest fires. Such provisions may be possible through support from forest management organizations.

Principle #7

National level emergencies can occur involving numerous large fires due to changing climatic conditions, which exceed local and provincial capabilities. Disasters may be avoided if sufficient action is taken at an early stage.

Recommended Action #7

a.   A national fire fighting contingency plan which involves relevant government agencies, other organizations, and local communities should be set up to deal with large scale emergencies. This plan should outline the responsibilities of the various parties involved to prevent duplication of efforts and to optimize human and financial resources. Consideration should be given to the

recruitment of international support where appropriate. Arrangements on financial components must be agreed to well before emergencies arise.

Role of Communities in Fire Protection

Principle #8

The majority of tropical forest fires and other wildland fires are caused by the activities of the rural population. An efficient fire prevention strategy therefore requires an initial understanding of the cultural and socio-economic background of the tropical fire scene. The fire prevention program relies heavily on a positive relationship between the rural community and the forest-fire manager. Mutual confidence and public support can be created by participatory approaches.

Recommended Action #8

a.   Employ or encourage participation of rural residents in fire prevention work, such as establishment and maintenance of fire breaks and other fuel treatments.

b.   Encourage integration of agriculture and grazing land-use into fuel break systems through incentive mechanisms (e.g. through cost-free leasing of fuel break lands). Where burning is used as a form of pasture health management, incorporate techniques to minimize risk of escaped fires.

c.   Stimulate community cooperation in fire prevention through various incentive measures such as provision of funding popular initiatives for villages which have succeeded in preventing the spread of wildfires into adjoining forest lands. For example, systems to supply potable water are often lacking in some remote areas; and installation priorities are often uncertain. A community which demonstrates major reduction in harmful fires could be rewarded by having its system installed more quickly.

4.   **MONITORING AND RESEARCH**

Monitoring

Principle#9

Assessment, prediction, and monitoring of fire risk, as well as a means of quantification of forest fires and other rural fires are prerequisites for fire management planning purposes. Statistical data sets can also be used to gain the attention of authorities, policy makers, and the general public. In the tropics such information is difficult to gather by ground based-methods. Airborne and spaceborne sensors offer possibilities to monitor less accessible and sparsely populated land areas with inadequate ground-based infrastructures.

Recommended Action #9

a.   Seek access to meteorological information from ground stations, and space borne systems; using this information for fire intelligence (fire risk assessment).

b.   Use existing orbital remote sensing systems for fire detection and prediction to obtain real-time information on the geographic location of fires.

c.   ITTO member countries should join others in supporting the development of international mechanisms, (early warning systems), to predict wildfires. Such a system would not predict occurrence, but rather would report the development of conditions which can be counted on to

result in serious fires. It would have to gather and interpret information from a number of sources, including satellites, and land-based stations.

Research

Principle #10

Basic scientific and applied research are the fundamental sources of information needed for tropical forest fire management. Research on fire behavior and its impact on ecosystems, biogeochemical cycles, atmospheric quality, and local and global climate, as well as evaluation of damages and losses, will help to establish indicators on how to manage fire in various tropical forest ecosystems.

Recommended Action #10

a.   Support universities and research institutions, in cooperation with international partners, to undertake research on tropical forest ecosystems including the following main areas of interest:

· Compilation and explanation of the state of the art of fire knowledge on past and present fires (occurrence, and ecological impacts)
· Fuel inventory and modeling,
· Fire behavior models,
· Fire risk indicators,
· Fire risk mapping,
· Fire-weather prediction,
· Environmental impact models,
· Impacts of gaseous and particle emissions of fires on biogeochemical cycles, atmosphere and climate,
· Socio-economic aspects of forest fire, and
· Rehabilitation of forests damaged by fire.

b.   Study the dynamics of swidden lands and secondary forests, as well as timber and non-timber products, which are used by the local communities and are likely to contribute to the cause of fires.

c.   Establish demonstration modules for non-traditional harvesting of secondary forests with a view to offsetting the pressure exerted by agricultural burning practices.

d.   Establish demonstration practices to offer alternatives for the preparation of agricultural lands other than the burning of felled trees.

Principle #11

Knowledge of forest fires and fire management must be exchanged among forestry and research personnel throughout the world to enhance the coordination and cooperation in forest fire prevention and suppression.

Recommended Action #11

a.   Select and conduct training courses on information exchange methods, such as Internet and other relevant electronic communication systems.
b.   Promote periodical international seminars on forest fire management.

5.   INSTITUTIONAL FRAMEWORK AND CAPACITY DEVELOPMENT

Institutional Development

Principle #12

Institutional development and strengthening are highly critical, and attention should be given to human resource development. Fire management must be implemented under the jurisdiction and responsibilities of all land owners involved, i.e. on lands managed by national and provincial governments, local communities, concession holders, timber companies, contractors, and private forestry enterprises. However, an institutional framework must ensure that the national fire policy will be implemented.

Fire management actions affect various sectors of the society, and fall within the responsibilities of a variety of government agencies and land users. Therefore, a national interagency structure must coordinate the various responsible agencies involved in order to maximize efficiency and to share fire management resources. Assistance through bilateral and international programs should be encouraged in order to enable the transfer of existing knowledge and advanced technologies where needed.

Recommended Action #12

a.   Establish or strengthen structures at the national level which are responsible for preparing and implementing national fire policies. Additional governmental infrastructure should be established or strengthened to build up fire management capabilities at the provincial and local levels.

b.   Develop or strengthen suitable mechanisms and structures at national, provincial, and local levels to provide for the establishment and coordination of rural fire brigade organizations, including volunteer fire brigades.

c.   Develop operational plans in which the role of voluntary organizations, particularly non-governmental and women's organizations, are defined and exercises conducted at intervals to strengthen procedures, and enhance preparedness.

d.   The institutions responsible for fire management should promote cooperative agreements between rural communities, NGO's, forest companies, and the relevant public institutions, as well as political authorities.

e.   Nations and organizations with fire management expertise should offer advice in building institutional frameworks and capacities; to provide for technical assistance, materials, and support to countries lacking adequate infrastructure.

Principle #13

Fires may affect resources on the territories of neighboring countries; or may have transboundary effects, e.g., smoke pollution. Cooperative agreements between neighboring countries may help to solve transboundary fire problems; and allow for sharing of resources at regional scale.

Recommended Action #13

a.   Establish bilateral and multilateral agreements on cooperation, and mutual assistance in fire management.

b.   ITTO member countries should have mobile rural fire brigades in order to provide fire management support in situations that go beyond the capacity of the affected country. These brigades would, at the invitation of the affected country, enter that country and augment its fire fighting forces until the crisis passes.

Funding and Implementation.

Principle #14

Large fires in the tropics may adversely affect global economies, environment, and biodiversity. Timber which is destroyed or degraded lowers the supply of available forest resources, and affects prices worldwide. Cost of management of these fires should logically be borne locally, nationally, and when appropriate, internationally. To prevent and combat these fires, appropriate institutional infrastructures and mechanisms should be supported from national resources and, if necessary, international cooperation and assistance could be considered.

Recommended Action #14

a.   Implementation of a program to protect the forest against fires requires forest authorities to establish special units responsible for such a program at national, provincial, and local levels with adequate, financing, staff, skills, equipment, and operational procedures.

b.   Cooperation and active involvement of local communities, the private sector, non-governmental organizations, and the mass media must be promoted to ensure the implementation of an effective program.

c.   To ensure preparedness, coordination, adequacy, and effectiveness of operational procedures, workshops, and exercises at various levels, should be organized at regular intervals involving all affected parties, including neighboring countries, as appropriate.

d.   Relevant international and regional organizations should promote cooperative efforts to prevent and combat forest fires.

e.   Donor countries should accord high priority in their development assistance programs to help developing tropical countries establish programs to protect forests against fires through financial assistance, provision of expertise, transfer of technology, and assistance in training.

f.   Development banks should favorably consider providing assistance to developing tropical countries to protect forests against fires through the provision of grants or loans at concessionaire rates.

g.   Multilateral facilities such as the GEF (Global Environmental Facility), UNDP (United Nations Development Program), the Common Fund for Commodities, and other relevant arrangements should create 'windows' to support activities related to the protection of tropical forests against fires.

h.   International organizations such as the ITTO, FAO (United Nations Food and Agriculture Organization), UNEP (United Nations Environmental Program), UNDRO (United Nations Disaster Relief Organization), UNESCO (United Nations Educational, Scientific and Cultural Organization) and other relevant organizations, activities (e.g. IDNDR), and international initiatives and conventions should strengthen programs related to protection of the forests against fires. ITTO member countries should join others in supporting the development of international mechanisms to obtain prompt assistance to mitigate the consequences of wildfire disasters, upon request.

i.	The CSD (United Nations Commission on Sustainable Development) should ensure that in the implementation of Agenda 21 for forests, due attention is given to forest fires in relation to arrangements that may be developed to harmonize and promote international efforts to protect the world's forests. A UN-sponsored Global Fire Research and Management Facility, which includes a Global Vegetation Fire Information System, and the capabilities to provide support on request to any nation in fire management, should be considered by the CSD.

j.	Donor countries and lending institutions should ensure that their project appraisal procedures include fire risk assessment; and where appropriate, adequate resources should be included in the project budget for fire protection.

k.	Seek the cooperation of NGOs, women's groups, and other voluntary organizations, to raise funds in support of programs to protect tropical forests against fire.

l.	Projects and activities related to the protection of tropical forests against fire should merit support from the Bali Partnership Fund to be established under the ITTA (International Tropical Timber Agreement) of 1994.

## 6.	SOCIO-ECONOMIC CONSIDERATIONS

Economic Implications

Principle #15

Damage to forest cover and the wasteful burning of biomass cause significant loss of productive resources. Forest fires also negatively affect the environment, e.g. soil and water resources, and atmospheric qualities. This has direct and indirect cost implications to the country. At the same time, programs to protect forests from wildfires are complex and costly. Many sectors of the economy, including the forestry, agriculture, fisheries, transportation, and health sectors, stand to benefit from effective fire management; and should be prepared to contribute equitably towards the costs.

Recommended Action #15

a.	Estimate the potential direct and indirect costs to the national economy brought about by wildfires. The costs of various options of preventing and controlling wildfires should also be estimated to ensure that fire management policies and programs are viable.

b.	The agency responsible for fire protection should undertake a cost/benefit analysis of proposed fire management programs under a variety of scenarios. It should design programs which are cost effective and within its budgetary means. National and provincial governments should be prepared to provide adequate financial support to the forestry agencies should it be necessary for them to meet costs.

Principle #16

Preventing wildfires is much more cost-effective than suppressing them and bearing the resulting losses. The causes of forest fires, and the underlying reasons for them, need to be determined before effective prevention plans can be made. The general public can be an important cause of wildfire. One reason for this is a lack of understanding on the importance and value of forests. In many tropical countries, uncontrolled shifting cultivation (slash-and-burn, swidden system) is a

source of wildfires, as is the use of fire to dispose of crop residue and woody vegetation during land conversion.

Recommended Action #16

a.   Promote improved agricultural and agrosilvopastoral systems as alternatives to shifting cultivation.

b.   Establish model demonstration areas for specific farming and agrosilvopastoral practices, combining them with other components of a fire management system (e.g. integrating farming and grazing activities to modify fuel loads or fuel break systems).

c.   Develop suitable incentive programs to reward communities and individuals which use appropriate land-use practices, resulting in reduced fire damage.   In the case of individuals, it is often effective to simply make formal recognition , in the presence of peers, that the individual has done something special.

d.   Develop and promote an environmental awareness program on the relation between social, economic, and environmental benefits derived from forests, and the negative impacts associated with wildfires.

e.   Establish a program to investigate the causes of wildfires, and the underlying reasons. This should form the basis for formulating a wildfire prevention, education, and extension program.

f.   Develop and implement programs following the principles of regenerative agriculture to promote nutrient cycling so that biomass is utilized to enhance soil fertility.   These programs should consider sustainable agricultural practices promoted and disseminated by organizations such as the IIRR (International Institute for Rural Reconstruction), CATIE (Center for Research and Training in Tropical Agriculture), and grassroots level NGOs.

g.   Demonstrate a variety of land treatment and soil preparation practices which apply viable and inexpensive soil and water conservation techniques. Consider establishing demonstration plots where fire is not utilized as a tool in site preparation or land clearing.

Community Consultation

Principle #17

There may be competing or conflicting land resource uses between rural inhabitants and other land use classifications such as forest concessions, timber companies, contractors, and conservation units. These conflicts can lead to the setting of wildfires. People need to be able to benefit directly from forest uses in order to value and protect these resources. Local people use fire for economic, religious, agricultural, and cultural reasons; and they will continue to do so in the future. Experiences gained from traditional fire management practices may be of benefit within a wider national context. Some tropical countries have experience with fire management involving local communities, with varying degrees of success. Lessons from these experiences may be beneficial to other countries.

Recommended Action #17

a.   Provision should be made for consultations with people within communities in an open and transparent way to resolve conflicts on rights of forest land use and the obligation of fire protection.

b.   Local people should be trained in techniques to manage and control fire so as to prevent destruction of the forest cover; taking into account their traditions and skills.

c.   Local governments and citizens should be involved in decisions on how fire will be managed in areas under their purview. Communities may also need financial assistance to carry out fire prevention measures and respond to wildfires. Community organization and training must be done following participatory methodologies in order for them to be effective and sustainable.

d.   Provide opportunities for exchange of information and experiences in fire management involving local communities through forums supported by international organizations such as ITTO, FAO, CIFOR (Center for International Forestry Research), and multi-lateral mechanisms.

Principle #18

In many rural societies, women play an extremely important role in agriculture, raising livestock, collecting fuelwood, and utilizing the forest to produce non-timber goods. Women are therefore more appreciative and caring for the natural environment although it is often difficult to integrate them into educational and extension programs, due to their other roles and responsibilities. Women's active participation in fire management programs can be effective in protecting tropical forest resources from wildfires. The same can be said of the other members of the whole family unit. Adults, children, and elders must all be included in the solution.

Recommended Action #18

a.   Include women as active participants in community based fire management activities; capitalizing on their knowledge and experience in the use of fire in agriculture, livestock production, and forest management.

b.   Develop an effective fire education component which is specifically directed towards women at the provincial and local levels. The transfer of fire management technologies, and the sharing of experiences may best be done through participatory programs and extension services in which women can play important roles.

7.   LAND RESOURCES MANAGEMENT AND UTILIZATION

Forest Management

Principle #19

Fire management is an integral part of sustainable forest management, which in turn should be based on appropriate land use planning, taking into account the views of all concerned parties.

Recommended Action #19

a.   Integrate fire management considerations into forest management planning. For example, when making forest inventories, it is important to include information on the quantities of fuel, (dead tree, branches, litter), with a view to assessing the danger of fire.

b.   Incorporate fire protection measures into forest concession contracts.

c.   Include provisions for protection of the forest against fire when implementing silvicultural management practices.

Principle #20

Fire risk may be reduced by practicing increased forest diversity, particularly in plantations, in terms of species, age, and structure; as well as through preventative silvicultural techniques. Reducing fire occurrence lowers the forest's vulnerability to degradation from insects and disease.

Recommended Action #20

a.   Consider the possibility of underplanting or intermixing the main canopy with suitable species of low flammability which are native to the area and already field tested.

b.   Give priority to rehabilitation measures of fire damaged forests.

Principle # 21

Savannas and grasslands are important tropical ecosystems, often interrelated with forest lands. Fire usually plays an important role in these ecosystems, and must be adequately managed in order to maintain the ecosystems and avoid damage to the nearby forests.

Recommended Action # 21

a.   Determine the appropriate fire regimes of the savannas and grasslands near forest areas, and develop fire management plans to address the requirements for sustaining those ecosystems.

b.   Consider using prescribed fire and/or other techniques to prevent damage from free propagating wildfires in those ecosystems.

c.   Instruct residents living within or near those ecosystems, which require periodic fire for their survival, on the proper use of fire, including adequate firing techniques.

Forest Utilization

Principle #22

Large forest areas are managed for timber production. Logging operations involve various activities including: the construction of infrastructure or facilities such as roads, camps, workshops, fuel storage, etc., the use of heavy equipment such as tractors, earth-moving equipment, skidders, trucks, vehicles, power saws, etc.. Workers have frequent access into forest areas, often throughout the year. These factors, combined with careless and poor equipment maintenance, or improper use, can increase fire risks.

Recommended Action #22

a.   Logging operations and the use of all equipment and machinery must be strictly controlled, and clearly specified in concession agreements to reduce fire risks. Spark arresters should be used to prevent fires starting from chainsaws and other machinery. The handling, use and storage of gasoline must be strictly controlled with clear instructions; and placed under the responsibility of a designated person.

b. Concession holders, timber companies, and contractors should be encouraged to conduct special campaigns at regular intervals on fire hazards to promote greater consciousness and more responsible attitudes.

c. Specific guidelines must be developed for implementation during periods of extreme dry weather or high fire risk. Such measures may include total or partial restrictions on logging. It may be necessary to restrict access to forest areas to that required for logging operations in accordance with management plans and harvesting activities; including transport of logs to processing plants.

d. Concession agreements should specify the role and responsibility of the concession holder in cases of fire outbreaks, including participation in suppression action, and sharing the costs of rehabilitation of fire-damaged forests.

e. Concession holders, timber companies, and contractors should provide appropriate training for their employees, and develop operational procedures in fire prevention and suppression to promptly handle fire outbreaks during logging operations.

f. Concession agreements should require that concessionaires' crews and equipment be available for use in fire control activities.

Principle #23

Logging operations may result in accumulation of biomass, invasion by weed species, and desiccation of organic soil matter, all of which can increase fire risks. The careless use of fire during timber harvesting operations has resulted in large wildfires. These fires cause significant economic losses to governments who are often left with the responsibility for rehabilitating fire damaged forests.

Recommended Action #23

a. Plan logging operations to avoid creating large openings, which result in the drying of the forest floor, and invasion of fire prone pioneer species. Allow for techniques, (such as climber cutting), which minimize damage to surrounding trees.

b. Logging wastes should be minimized through a system of incentives and penalties that apply to concession holders and contractors. Where appropriate, encourage the use of logging residues by local communities, so long as this activity does not increase the risk of fire starts.

c. Laws, regulations, or codes of practice that apply to forest operators should be formulated and enforced; and if necessary, contractual arrangements modified to promote responsible fire protection by concession holders and contractors.

d. Penalties should be levied against concessionaires to recover losses of forest values and recoup costs for rehabilitation of fire damaged forests due to negligence.

Other Forest Uses

Principle #24

Communities living in and around forest areas have long-established traditions to hunt, to fish, and to collect food, medicinal plants, and other products from forest areas. Conversion of forests for other land uses, and population pressures, have increased the intensity of such uses by these communities, resulting in greater fire risks. Also, fire risks are greatly increased in forest areas through recreational and sporting activities.

Recommended Action #24

a.   Concession holders, timber companies, and contractors should provide assistance to organize and provide support to local communities; encouraging their active participation in forest fire prevention programs.

b.   Some forest based activities of local communities involve the use of fire. Such activities should be regulated through measures which reduce the risk of wildfire starts from these activities.

c.   Conflicts and misunderstanding between local communities and forest concession workers must be avoided through regular dialogues, and respect for local traditions and sensitivities. The welfare and well-being of local communities must always be considered by concession holders, timber companies, and contractors for any employment opportunities or facilities which become available.

d.   Assist communities in their efforts to enhance respect for traditional values and customs which have historically preserved natural resources.

e.   During periods of extreme fire danger, access to forests for recreational pursuits should be strictly controlled. Camping should be restricted to certain sites where facilities such as stoves should be provided. Elsewhere, the use of fires for cooking should be prohibited.

f.   Patrols should be undertaken in areas frequented by people to ensure compliance with rules and regulations in force. Such patrols should be more intensive during periods of high fire risks or during holiday seasons.

8.   **TRAINING AND PUBLIC EDUCATION**

Training and Extension Programs

Principle #25

Managers at various levels need to acquire and maintain knowledge of all aspects of forest fire management, as well as their responsibilities to maintain the health and sustainability of the forests. These managers include officials from forestry and other related ministries, as well as timber companies, contractors, and forest concession operators.

Recommended Action #25

a.   Identify the information and training needs for relevant managers, and where necessary disseminate appropriate materials and conduct seminars, workshops**,** short courses, and field training sessions dealing with the principles and application of forest fire management, including fire prevention and suppression.

Principle #26

People living near forests are often unaware that their activities may cause forest fires, and in some cases, can result in the destruction of forest ecosystems. Members of these communities, if motivated, properly trained and equipped, can be important sources of assistance in the prevention, control, and management of fires.

Recommended Action #26

a. Prepare and conduct courses for forest authority officers, concession holders, and contractors' staff for the "training of trainers" that can provide extension to local communities.

b. Identify and recruit suitable members of the community to be trained in fire prevention measures and in the use of techniques and equipment, (including traditional tools), to suppress and manage fires.

c. Prepare and conduct basic education programs, and provide extension materials for communities near the forest to increase their awareness on the importance of the forest environment and the role of fire.

d. When required, provide caches of basic fire suppression tools, under strict control of responsible individuals, to be used in emergencies by people identified and trained in "b" above.

Principle #27

Communities living near the forest have traditional values which affect their attitude toward the forest as a living entity. Local people are influenced by community and spiritual leaders who are likely to be effective in extending information on fire protection.

Recommended Action #27

a. Seek the cooperation of the community and spiritual leaders in fire management programs.

Principle #28

Within their areas, the vigilance and influence of NGOs and women's groups can provide effective and prompt assistance in forest fire management programs.

Recommended Action #28

a. Develop and conduct courses as necessary for leaders of NGOs and women's groups on their roles in forest fire management programs, including the dissemination of information to the public on fire dangers to forest ecosystems; and the ways and means to reduce fire risks when enjoying the forest environment.

Public Education

Principle #29

Members of the public are affected by wildfires that result in the loss of wealth and livelihood and threaten forest ecosystems. Most people, including recreationists, are unaware of the causes of fires**,** and their economic and ecological impacts.

The public's understanding of, and attitudes toward, the role and use of fire and forest management practices can best be improved through the education of children and youth.

Recommended Action #29

a.   Establish or enhance cooperation between forest authorities and education departments to allow for the design of suitable curriculums, and the conduct of education programs for elementary and secondary schools on forest and fire management. Explore ways to include non-traditional allies in the education campaign against fire.

b.   Use mass communication to provide information to the general public on the causes, impacts, and management of forest fires. The success of such public awareness campaigns will rely upon the selection of appropriate symbols and slogans which help stimulate the general public to identify themselves with the message. Seek cooperation and involvement of religious organizations, civic groups, and NGOs in public awareness campaign.

c.   Provide recreationists with information (e.g. pamphlets, leaflets), on the benefits that fire steals from them, and on their responsibilities for the prevention of fires starting from campfires and other recreational pursuits.

d.   Provide education on environmental issues, forest and natural resource management, and the impacts from wildfires at primary and secondary school levels.

Appendix 1

FIRE MANAGEMENT OPTIONS

Fire Management incorporates all activities required for the protection of forest and human values from fire, and the use of fire to meet land management goals and objectives.

The basic fire management options that can be considered for application within tropical forests include:

Fire Exclusion - applicable in those forest types where any fire effect would be undesirable and unproductive to the resource management and conservation objectives (e.g. tropical moist forests; fire intolerant plantation-type forests).

No Fire Management Measures Taken - applicable where occurrence of uncontrolled fire may be tolerated as long as no additional degradation factors interfere, such as excessive grazing. Also applied where no alternatives exist because of lack of active fire control capabilities.

The Fire Exclusion and No Fire Management approaches should only be considered where it is known that forest fuels will not build up and result in extreme wildfire behavior and damage to human values and forest ecosystems.

Integrated Fire Management - applicable where there is a good understanding of the impacts of fire on the specific forest types involved; where there is capability to actively manage all fire situations (e.g. to prevent and suppress all undesirable fire); and where the use of prescribed fire will promote resource management and other conservation goals. The application of the Integrated Fire Management option should be given primary consideration where wildfires have the potential to threaten human life or property and other assets identified in management plans for protection.

Integrated fire management measures include the following aspects:

· Fire Prevention,
· Fire Pre-suppression,
· Fire Suppression,
· Training and Education,
· Law Enforcement and the Use of Incentives, and
· Prescribed Burning for Specific Purposes.

FIRE PREVENTION MEASURES

The prevention of forest fires and other wildland fires embraces a wide range of measures that modify fuels and modify human behavior around or within the fire-threatened resources so that the initiation, spread, and intensity of fires are reduced to such an extent that they can be controlled by the technical means available.

In order to minimize any adverse impacts, some of the proposed measures outlined here may need to be modified when being applied to high conservation value areas---particularly reserves.

HUMAN BEHAVIOR MODIFICATION.

A major component of forest fire prevention is managing the human element, which is the main cause of forest fires. People start most fires in the tropical forests of the world. Preventing fires started by humans most often involves: 1) education and informing those segments of the public that constitute the risk component of fire ignition; 2) training people in the proper use of fire in order to minimize the opportunity for fire to escape, and to reduce off-site damage; and 3) promoting more responsible behavior by those who often fail to control the fires they start, by ensuring that these people will actually benefit from fire prevention (e.g. by providing incentives/rewards for those whose behavior limits fire damage to forests).

FUELS MODIFICATION.

Fuel management involves the treatment of combustible surface fuels and the near-surface aerial fuels which allow fires to spread from the ground and into the forest canopy. The treatment of these fuels is concentrated within narrow buffer zones (e.g. fire break or fuel breaks); or is applied to broad areas inside or adjacent to the forest stands to be protected.

Fire Breaks.

The establishment and maintenance of mineral earth fire breaks along boundaries between the forest estate and other areas can be useful in the control of low intensity wildfires. However, since fires may easily cross fire breaks which are several meters wide, it is often extremely uneconomical to establish and to maintain such large unproductive strips of land. Furthermore, fire breaks can favor the establishment of undesirable species; and in steep terrain lead to soil erosion during the rainy season.

Fuel Breaks.

Fuel breaks differ from fire breaks, in that they are generally wide (20 m to 300 m) strips of land on which the native flammable vegetation has been maintained, altered, or replaced by introduced vegetation so that fires burning into them can be more readily controlled.

Fuel breaks can be maintained economically in the tropics by agricultural or agroforestry systems. The design of agricultural fuel breaks should be according to the suitability of sites for growing crops. The selection, treatment and harvest of crops should observe the seasonality of fire danger (e.g. removal of flammable residues before the onset of the high fire danger period).

Silvopastoral fuel breaks involve the integration of grazing within treeless strips, or under wide-spaced tree overstory (shaded fuel breaks). The grazing resource may either be native vegetation or

seeded grass species. Pastoral fuel breaks may include fire breaks, particularly in those areas where prescribed fire is applied for fuel break maintenance.

Shaded fuel breaks can often benefit both pasture and forest management, so long as the selection of tree and animal species is done carefully to ensure the compatibility of both uses (e.g. avoid damage caused by browsing animals, etc.).

Fuel breaks may also be established where they are not utilized for agricultural land uses, so long as slash from thinning and pruning operations is removed by hand or mechanical means (e.g. shredding or chipping to small particles).

Fuel Reduction Burning.

Fuel reduction burning is a form of prescribed burning involving the application of planned fire to wildland fuels in either their natural or modified state under specified environmental conditions which allow the fire to be confined to a predetermined area. The objective of fuel reduction burning is to decrease combustible materials so that wildfires can be more readily controlled.

Fuel reduction should be applied where it is safe and cost-effective; and where there is a potential of unwanted fire starts, a risk to human lives, and a significant damage potential. The frequency of burning is governed by the rate of fuel build-up, the known tolerance of the ecosystem to frequent fire, and the resources available to carry out the work.

It is necessary to have reliable information on weather, fuel conditions, and fire behavior. It is also desirable to have information on fire effects. These factors constitute the basic elements of a burn prescription. Other factors that should be considered include terrain, access, and conditions which affect the environment (e.g. smoke, soil erosion, etc.).

Prescribe burning is also conducted for other objectives such as:

· Site preparation for plantation establishment and natural regeneration;
· Land use changes (e.g. conversion from forest to agriculture land);
· Pest control (e.g. insects and diseases);
· Fire dependent ecosystem maintenance; and
· Wildfire control (e.g. back burning and fuel reduction).

As in fuel reduction burning, the use of fire for other fire management objectives requires planning, resources, and reliable information about fuel loads and weather conditions.

OTHER PREVENTION TOOLS.

Fire Access Roads.

In developing plans for rural, main, secondary and/or access roads, alternative routes should be considered to strategic locations, including the construction of heliports and water supply sources, and the provision of manual equipment for fire fighting.

Appendix 3

FIRE PRE-SUPPRESSION

Fire pre-suppression measures include those activities and systems that are required to enable fire protection organizations to cope with wildfires before they start. These measures include:

· Fire plans and intelligence systems,
· Detection systems,
· Organizational structures,
· Stand-by and response orders,
· Communications,
· Fire equipment provisions,
· Fire-weather and fire-danger forecasting,
· Maintenance of access and water sources, and
· Formation and training of fire-fighting crews.

These pre-suppression systems and measures must be developed and maintained prior to the onset of the high fire danger period. Many of these elements can be integrated through an information and decision support system for fire managers. An idealized scheme of the elements required for a complete fire intelligence and fire management decisions support system is given in Appendix 6.

Appendix 4. Ecological, economic and management aspects of integrated fire management options in various tropical and subtropical forest and sub-forest types

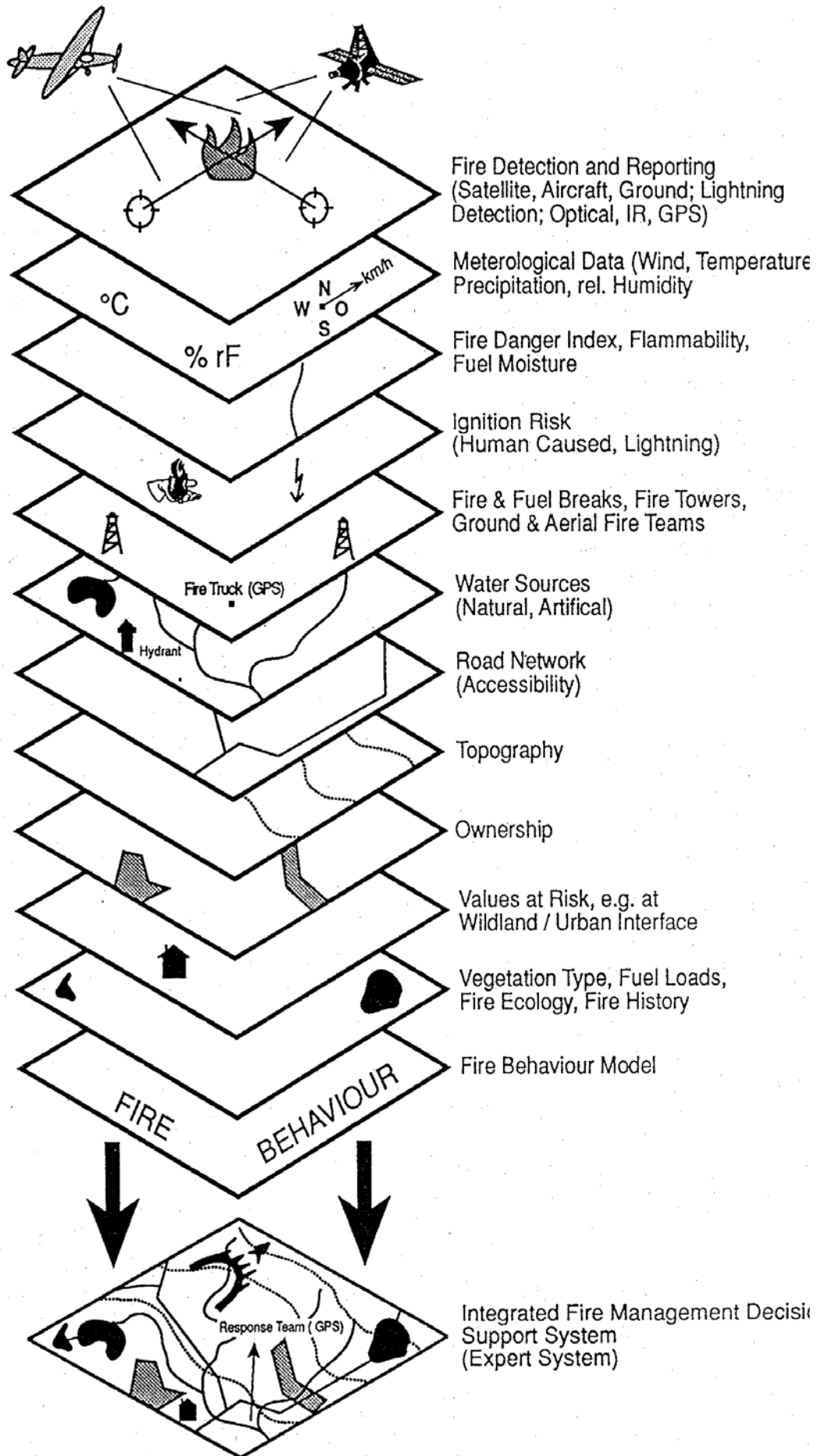|	Ecological and Economic Aspects of Fire	Tropical Moist Forest	Tropical Dry and Other Seasonal Forests (e.g. *Tectona grandis, Shorea robusta*)	Coniferous Forests (e.g. *Pinus* spp.)	Industrial Plantations (e.g. *Pinus* and *Eucalyptus* spp.)	Silvopastoral Systems (e.g. open pine forests with grazing)	Grass Savannas (e.g. extensively grazed wildlands)
Fire Exclusion	Ecological Impacts	High diversity of species, habitats and niches. High stability	High diversity of species, habitats and niches. High water retaining and soil protection capability.	Replacement of coniferous species by less fire tolerant broadleaved spezies. Pines only on dry shallow and disturbed sites. Overall increase of species diversity. High water retaining and soil protection capability.	High risk of uncontrolled high-intensity stand replacement fires.	Undesirable increase of species not suitable for grazing purposes. Replacement of grass stratum by succession.	Progressive successional development toward brush/tree savannas or forest. Promotion of less fire tolerant species.
	Economic and Management Implications	Heavy disturbances, e.g. clearcuts and skid trails must be avoided	Economic wood production difficult because of high diversity of species. Increase of non-wood forest products.	Economic wood production difficult because of high species diversity.	Wood production feasible. Extreme high risk of destruction of plantation by wildfire.	Only possible if intensively grazed and mechanically cleared.	Not feasible.
Un-controlled Wildfires	Ecological Impacts	Forest community destroyed or degraded. Pioneer Species favored	Selection of fire resistant/tolerant tree species. Opening of forest formation.	Retreat of fire sensitive species and favoring of fire resistant pines. Opening of forests. Stand replacement fires. Forest degradation.	Stand replacement fires.	Uncontrolled selective fire pressure. Maintenance of openness.	Maintenance of a wildfire climax. Uncontrolled selection of fire adapted plants.
	Economic and Management Implications	High losses involved (bio-diversity, site stability, economics)	Species composition and relevant management and marketing opportunities out of control.	Tendency of degradation and loss of productivity.	Management objectives jeopardized if no efficient fire prevention and control system available.	Possible long-term degradation and loss of productivity.	Productivity depends on savanna type and other degradation factors involved.
Prescribe Fire	Ecological Impacts	Not applicable (only on adjoining fire-prone vegetation)	Controlled selection of tree species. Advantageous for stimulation and harvest of selected non-wood forest products.	Controlled favoring of desired fire-tolerant species. Reduction of stand-replacement fire risk.	Maintenance of desired monostructure of plantations. Reduction of stand-replacement fire risk. Increase of vitality and water supply.	Controlled promotion (stimulation) of desired tree and fodder plant species.	Controlled promotion of desirable grass/herb layer and tree/brush regeneration.
	Economic and Management implications	Integrated Fire management System requires availability of relevant ecological background knowledge, trained personnel, and infrastructural facilities to prevent and control undesired wildfires and conducting safe prescribed burning operations					

based on Kutser and Goldammer 1993

Appendix 5. Potential objectives for the use of prescribed fire in management of plantations in the tropics

Objectives	Target	Desired effects	Undesired effects or potential hazards	Possible Substitution
Wildfire hazard reduction	Thinning or post-harvest slash, forest floor (raw humus), aerial fuels, rank understory	Reduce potential wildfire intensity, remove surface and ladder fuels, reduce understory stature	Stand/tree damage (crown, bole, or root)	Partial (mechanical treatment/removal by hand, shredding, piling and burning outside of stand, pruning)
Site preparation for natural regeneration or planting	Forest floor, post harvest slash, undesired vegetation	Expose mineral soil (improve germination), increase seedfall	Encroachment, sprouting, or germination of undesired plants	Partial (herbicides to kill undesired vegetation)
Improve accessibility	Thinning of post harvest slash, rank understory	Improve access for silbivultural operations, esthetics (recreation)	Reduction of understory stature	Partial (herbicides to kill understory)
Increase growth/yield	Raw humus layer (forest floor), understory plants	Enhance nutrient availability; reduce competition for moisture, sun and nutrients	Loss of nutrients (leaching), erosion	Fertilization and herbicides
Alter plant species composition	Weeds and other undesirable vegetation	Promote desired species	Increase in weed germination/production of undesirable seeds	Herbicides
Pest management	Pests and diseases and their habitats	Eliminate spores, eggs, individuals, and breeding material	Fire-induced tree stress, increased susceptibility to secondary pests	Pesticides
Silvopastoral land use	Slash; forest floor; mature, unpalatable growth; competing vegetation	Create/improve conditions for desired ground cover		Mechanical removal of dead fuels and vegetation
Improve fire protection	Surrounding buffer zone, fuel breaks and fire breaks	Reduce spread and intensity of wildfires (outside of stands)		

Appendix 6

(Unpublished Model of the Fire Ecology Research Group, Germany)

Fire Detection and Reporting
(Satellite, Aircraft, Ground; Lightning
Detection; Optical, IR, GPS)

Meterological Data (Wind, Temperature
Precipitation, rel. Humidity

Fire Danger Index, Flammability,
Fuel Moisture

Ignition Risk
(Human Caused, Lightning)

Fire & Fuel Breaks, Fire Towers,
Ground & Aerial Fire Teams

Water Sources
(Natural, Artifical)

Road Network
(Accessibility)

Topography

Ownership

Values at Risk, e.g. at
Wildland / Urban Interface

Vegetation Type, Fuel Loads,
Fire Ecology, Fire History

Fire Behaviour Model

Integrated Fire Management Decisi
Support System
(Expert System)

WILDLAND FIRE MANAGEMENT TERMINOLOGY

Selected important wildland fire management terms are given in this appendix. Some of these terms are taken from the United Nations Wildland Fire Management Terminology (FAO 1986) and may have been modified for this document.

Aerial Fuels

The standing and supported forest combustibles not in direct contact with the ground and consisting mainly of foliage, twigs, branches, stems, bark, lianas and other vines. In general they easily dry out and may carry surface fires into the canopy

Agrosilvopastoral Systems

Land use systems in which woody perennials are used on the same land as agricultural crops and animals, in some form of spatial arrangement or temporal sequence. In fire management, agrosilvopastoral systems are planned on fuelbreaks (particularly shaded fuelbreaks), to reduce fire risk by modifying understory vegetation and soil cover.

Backfire

A fire set along the inner edge of a control line to consume the fuel in the path of a forest fire and/or change the direction of force of the fire's convection column. Note: Doing this on a small scale and with closer control, in order to consume patches of unburned fuel and aid control line construction is distinguished as "burning out", "firing out", or "clean burning".

Broadcast Burning

Allowing a prescribed fire to bum over a designated area within well- defined boundaries for reduction of fuel hazard, as a silvicultural treatment, or both.

Center Firing

A method of broadcast burning in which fires are set in the center of the area to create a strong indraft; additional fires are then set progressively nearer the outer control lines as indraft builds up so as to draw them in toward the center.

Control a fire

To complete a control line around a fire, any spot fires there from, and any interior islands to be saved, and cool down all hot spots that are immediate threats to the control line, until the line can reasonably be expected to hold under foreseeable conditions.

Counter Fire

Fire set between main fire and backfire to hasten spread of backfire. Also called draft fire. The act of setting counter fires is sometimes called "front firing" or "strip firing".

Crown Fire

A fire that advances from top to top of trees or shrubs more or less independently of the surface fire.

Drip Torch

A hand-held apparatus for igniting prescribed fires and backfires by dripping flaming fuel on the materials to be burned. The device consists of a fuel fount, burner arm, and igniter. The fuel used is generally diesel or stove oil with gasoline added.

Early Burning

Prescribed burning early in the dry season before grass, tree leaves, and undergrowth are completely dry, or before the leaves are shed; as an insurance against more severe fire damage later on.

Firebreak

Any natural or constructed discontinuity in a fuelbed utilized to segregate, stop, and control the spread of fire; or to provide a control line from which to suppress a fire; characterized by complete lack of combustibles down to mineral soil, (as distinguished from fuelbreak).

Fire Danger Rating

A component of a fire management system that integrates the effects of selected fire danger factors into one or more qualitative or numerical indices of current protection needs.

Fire Hazard

A fuel complex, defined by volume, type, condition, arrangement, and location, that determines the degree both of ease of ignition and of fire suppression difficulty.

Fire Intelligence

All infrastructures, communication, base data, and other hard- and software that provide the inputs to an information and decision- support system in fire management.

Fire Management

All activities required for the protection of burnable forest values from fire; and the use of fire to meet land management goals and objectives.

Fire Prevention

All measures in fire management, forest management, forest utilization, concerning the land users and the general public which may result in the prevention of outbreak of fires, or the reduction of fire severity and spread.

Fire Retardant

Any substance except plain water that by chemical or physical action reduces the flammability of fuels or slows their rate of combustion, e.g., a liquid or slurry applied aerially or from the ground during a fire suppression operation.

Forest Residue

The accumulation in the forest of living or dead, mostly woody material, hat is added to and rearranged by human activities such as forest harvest, cultural operations, and land clearing.

Fuel

All combustible organic material in forests and other vegetation types, including agricultural residue.

Fuelbreak

Generally wide (20 - 300 meters) strips of land on which either less flammable native vegetation is maintained and integrated into fire management planning, or vegetation has been permanently modified so that fires burning into them can be more readily controlled (as distinguished from firebreak). some fuelbreaks contain narrow firebreaks which may be roads or narrower hand-constructed lines. During fires, these firebreaks can quickly be widened either with hand tools or by firing out. Fuelbreaks have the advantages of preventing erosion, offering a safe place for firefighters to work, low maintenance, and a pleasing appearance.

Ground Fire

A fire burning in organic terrain, e.g. dried tropical swamps and peat layers.

Ladder Fuels-

Fuels which provide vertical continuity between strata. Fire is able to carry from surface fuels into the crowns of trees or shrubs with relative ease and help assure initiation and continuation of crown fires.

Mass Fire

A fire resulting from many simultaneous ignitions. These fires generate high levels of energy output.

Preattack Planning

Fire planning within designated blocks of land, covering the following items: locations of fire lines, base camps, water sources, helispots, transportation systems, probable rates of travel, constraints of travel on various types of attack units, determining of construction of particular fire lines, the probable rate of line construction, topographic constraints on line construction, etc.

Prescribed Burning

Controlled application of fire to vegetation in either its natural or modified state, under specified environmental conditions which allow the fire to be confined to a predetermined area and at the same time to produce the intensity of heat and rate of spread required to attain planned resource management objectives.

Prescribed Fire

A fire burning within prescription. The fire may result from either planned or unplanned ignitions.

Pre-suppression Planning

All measures of fire intelligence and preparedness for fire suppression actions.

Seasonal Forest

A closed deciduous forest, or an open forest with continuous grass covet, distinguished from other tropical forests by distinct seasonality and low rainfall. Includes closed forests made up of deciduous hardwoods which shed their leaves during the dry season and woody/tree savannas.

Shaded Fuelbreak

Fuelbreaks built in forest areas where the trees on the break are thinned and pruned to reduce the fire potential yet retain enough crown canopy to make it possible to control surface fires more easily.

Silvopastoral Systems

see "Agrosilvopastoral Systems ".

Slash & Burn Agriculture

Farming, (usually small-scale), in which plots are prepared by cutting and burning off vegetative cover.

Smoke Management

The application of knowledge of fire behavior and meteorological processes to minimize air quality degradation during prescribed fires.

Surface Fire

Fire that burns only surface litter, other loose debris of the forest floor, and small vegetation.

Swidden

See "Slash & Burn Agriculture".

Tropical Moist Forest

Forest biome situated in areas receiving not less than 100 mm of rain in any month for two out of three years, with a mean annual temperature of 24°C or higher; mostly low-lying, and generally closed.

Values-at-Risk

Any or all of the natural resources or improvements which may be jeopardized if a fire occurs.

Wildfire

Any fire occurring on wildland except a fire under prescription.

Wildland /Residential Interface

That line, area, or zone where structures and other human development meets or intermingles with undeveloped wildland or vegetative fuels.

APPENDIX 8

FURTHER READING AND INFORMATION SOURCES

GENERAL BACKGROUND

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LITERATURE DATABASES AND PERIDOCIALS

A database containing some 40,000 references of publications on all aspects of fire management, including basic research, is compiled and continuously updated by the International Association of Wildland Fire (IAWF). IAWF provides members (institutions and individuals are eligible) with additional service, e.g. the scientific *Journal of Wildland Fire*, the magazine *Wildfire* and regular announcements of new publications . For further information contact:

International Association of
Wildland Fire
103 E. Main, P.O.Box 328
USA-Fairfield, WA 99012

The ITTO Information Network provides a literature search and retrieval service for individuals and organizations active in tropical forest research and management. This service is only available to people living and working in the tropics. For further information contact:

ITTO Information Network
International Organizations Center, 5th Floor,
Pacifico-Yokohama, 1-1-1 Minato-Mirai
Nishi-ku, Yokohama 220
JAPAN

The UN-ECE Trade Division, Timber Section publishes *International Forest Fire News* (IFFN). This newsletter covers fire management and fire research issues at global scale and intends, among others,

to build a bridge between fire researchers and fire managers. It contains also information on fire seminars, conferences and training courses. IFFN is distributed twice per year through the United Nations system. For further information contact:

Timber Section
UN-ECE Trade Division
Palais des Nations
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