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NOTE

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

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→ 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 56 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

Inside International Forest Fire News

Beginning with the October 1998 issue of International Forest Fire News (IFFN) the UN-FAO/ECE/ILO Team of Specialists and the Global Fire Monitoring Center (GFMC), both responsible for the preparation and editing of IFFN, have been faced with two entirely different ways of transporting information to the international readership. IFFN is produced bi-annually by the leader of the UN Fire Team which works under a UN-ECE agreement on a honourary base, a voluntary contribution to the Joint FAO/ECE/ILO Committee on Forest Technology, Management and Training. The US Bureau of Land Management is a financial sponsor of the IFFN.

The technical production of IFFN, now in its 12th year, is rather simple. After producing a home-made camera-ready copy on a PC we mail the materials to Geneva where it is put patiently in the queue of materials to be processed in the printing workshop of the United Nations. It happens regularly that, for instance, a July issue is delivered to Geneva in August or September, printed in October or November, and finally reaches the readers by December. This procedure shows that technically we cannot compete with commercial or publicly funded journals or newsletters.

However, personally I believe in both, the value of printed media even if they are "slow". I know that out of the more than one thousand subscribers of IFFN many institutions and individuals maintain a collection of this journal. IFFN becomes much more frequently cited in the international literature, referring to statistical data, country reports, special analyses and using international contacts. IFFN still is the only fire news service which simultaneously offers information for three important groups, the wildland fire science community, fire managers, and policy makers.

To meet the growing demands of quick dissemination of information we can now serve the readers much faster by the Internet version of IFFN. A handful days after the camera-ready manuscript is mailed to Geneva the whole issue can be read on the homepage of the GFMC. The Internet version of IFFN is even much more illustrative and attractive by displaying colour and high-resolution graphs, photos, maps or imageries. Unfortunately we cannot afford this in the printed version. The Internet version of IFFN is can be read in the vicinity of near-real time reports on fires from all over the world, provided by the daily global fire situation update on the GFMC website. These reports are compiled by a systematic evaluation of a large number of satellite imageries, national or regional fire reports, weather reports and weather forecasts. New products are daily global, regional and national fire weather predictions for the current and next day, the next week and the next month. The GFMC also displays near-real time satellite-observed and modeled fire emissions such as aerosols or carbon monoxide. Readers systematically checking the GFMC website will find a comprehensive archive of past daily update reports, including a large number of satellite imageries, in the archive which has been built up beginning with the daily operations.

The GFMC and the UN Fire Team are now entering a critical phase. Increasing amounts of daily interpreted fire information from a large number of sources from all over the world requires more professional staff. There is no way to continue this work on a honourary base. Starting in 1998 the German Foreign Office provided kick-off funds for the GFMC as a contribution to the UN International Decade for Natural Hazard Reduction (IDNDR). The Decade ends by December 1999 as the funding does - and the follow-up arrangements are not yet fully established.

Recognizing the importance of providing a sustainable base for GFMC operations we have been supported morally and technically by several UN agencies and programmes. A new alliance is being developed currently with the World Conservation Union (IUCN), the World Bank and the European Council. The IUCN is a new co-sponsor of the GFMC and the IFFN. Through the IUCN involvement we envisage to build an efficient coalition, especially with the NGO community and governments which are members of the IUCN.

I hope that the next issue of IFFN will be delivered to the readers more timely. And hopefully with good news on secured funding of GFMC operations.

Freiburg - Geneva, 15 October 1999 Johann G. Goldammer

AFRICA FIRE SPECIAL

Guest Editorial

Ghana With the Wind

by Stephen J. Pyne

The fires rise and fall with the winds. The northerly monsoonal flow off the Atlantic retreats and the harmattan, parched as its Saharan source, advances south. The rains stop, the fires begin. At first they creep and smoulder, grasping at early-cured grasses and forbs. As the vegetation dries out in larger patches, the flames swell and burn more fiercely. Before the rains return, almost all that can be burned is burned.

The causes are endless, as inevitable as the dry season, as necessary as the sunshine. A register of fire is a litany of rural life. Pastoralists burn to sweep away encroaching brush, cleanse a site of ticks, inhibit snakes, and to shock dormant grasses back to life. Their flocks crowd onto the fresh green fodder, more palatable and more nutritious than the unburned stalks. Farmers burn to clean fields of rice and millet stubble, maize stalks, and sugar cane, or more broadly, the longer cycle bush-fallow of shrubs and trees. For a while they clear away competing plants, release nutrients, fumigate fungi, and drive off microfaunal pests and weeds. For a year, perhaps two or three, crops flourish. Local languages encode the best time for burning into their names for the seasons. Twi calls February Ogyefuo, literally meaning "fire farm"; Akwapin calls it Apambere, "time of collecting smouldering stems"; and Ewe, Dzove, which means simply "burn." Farmers in Bawku will ridicule neighbours as "untidy" and slovenly who have not burned before the first rains. Hunters set fires to smoke rats out of holes and to both drive and draw game. Their flames strip away cover for snakes and flush out mice and grasscutters, sometimes into gauntlets of guns, sometimes into the collapsing circles of communal hunts; later, after the rains, the duikers and bushpigs and antelope, along with the livestock, return to the succulent green pick that luxuriates on the burn. Typically a hunting field burns as a quilt of smaller patches, moving game as one might herds of cattle. The pattern of burning also helps shield inhabited sites from cobras, ticks, mosquitoes, lions, any predator that prefers tall grass and thick scrub for cover. Others burn to gather honey, using smoke to drive bees before tossing the torch to the grass. They set fires under the dawadawa trees to promote fruiting, under kapok and mango to protect from hotter, late-season fires, and around other flora to stimulate medicines. They burn out daily the holes drilled into uprooted palms for the tapping of palm wine. They fire off the Accra Plains to eliminate the grassy dew into which mosquitoes lay eggs. They burn woodlands to kill trees for later use as fuelwood or burn them again to make charcoal. They fell snags by firing around the base. Villagers burn their trash; farmers, their refuse; school kids, tufts of grasses around their playgrounds. Travellers - hunters, fishermen, migrants, sojourners - abandon campfires that escape into the bush, toss cigarettes that kindle savannas, leave a trail of fires like roadside litter. Residents carry firesticks or vats of coals from place to place, while embers blow from cracked pots into a fire-eager bush. Fires escape from pito brewing at funerals. Prudent forest guards early-underburn through teak plantations to remove excess fuels. Wardens in Mole National Park early-burn to hold the reserve's fabled wildlife within the bounds of its unfenced domain. Add to the mix of careless burners the malicious ones, the arsonists and warriors. Add, too, those who burn for fire festivals. In northern Ghana this consists of tossing torches high into selected trees. So extensively is the landscape firing that protective burning - burning under controlled conditions to vaccinate against wild bushfires - clears off what fuels remain. Villagers burn around their grass-roofed houses; farmers around still-unharvested crops; rice fields, and cocoa plantations; priests around sacred groves; and even foresters around gazetted reserves, all early in the season, each with a mind to erect a black, then green incombustible barrier that will last through the harmattan. All these fire causes are not unique to Ghana, but their cumulative effect - the sheer, indefatigable, unsparing penetration by fire into every biotic nook and cranny, its deep symbiosis with everything human - is that West Africa, between the desert sand and the salt sea, has the highest proportion of annual fire in the world. The scene is visible from space, imaged through satellites by day in infrared and by night in visible light, a vast spangled constellation of fires, like a Milky Way of burning, winding across the Earth's dark matter.

Virtually everything people do in the Ghanaian bush involves fire. Remove those enabling flames and human life would collapse. Few things are as fundamental to Ghana's national identity, and appropriately its flag records this environmental saga. Three bands of colour fill the field, with a black star in the center. The bands rise from bottom to top, one leading to another in mimicry of a year's climatic cycle - green, the season of

rains; yellow, the time of dormancy; red, the fires that follow; the black star, the ash and char that remain at the core of Ghanaian life and its ambiguous future.

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No one can doubt that fire pervades Ghana. But must it? Is fire in some way "natural," and therefore necessary? Or is it the product of human contrivance, and therefore, at least in principle, expungable? Is it like the sun, about which one can do nothing save seek shade, or is it more like malaria, for which one can invent vaccines or hope, someday, for outright eradication, or is it rather like the corruption that frequently infests regional politics, for which extinction is an ideal, worthy if unattainable? It is all of the above, and so inextinguishable.

Ghanaian fire flourishes because both nature and culture favour it. Bushfire's environmental basis resides in West Africa's ancient patterns of wet and dry weather. There has to be enough moisture to grow fuels and enough aridity to prepare them to burn. Ghana's seasonal rhythms - with well-defined wet and dry seasons, two such seasons along the coast, one longer swell in the north - are ideal. That pattern follows the Intertropical Convergence Zone (ICZ) as it writhes across Africa, gathering winds from the north and the south and mixing them until they boil up into daily thunderstorms. When the ICZ pushes inland, winds with a fetch across the whole south Atlantic bring rain. When the ICZ slides toward the coast, those moist winds recede and arid winds from the Sahara - the harmattan - rush across Ghana. The land dries, the burning begins.

A weave of wet and dry stretches across the countryside as well as across the seasons. The far southwest is consistently wet, the northeast only seasonally so. A gradient of moisture marches between them such that rainfall decreases, trees shrivel, and soils shallow as one moves inland. An evergreen forest grades into a seasonally wet forest which thins into the wooded Guinea savanna which further opens into the edge of the Sahelian savanna. The more closed forests resist fire even in the face of drought unless their canopy cracks open and more fire-prone species invade. Elsewhere the fuel fabric shows a tightly wrought woof and warp of fine-stranded combustibles, fluffed with expansive grasses, forbs, and other fallow-thriving species. Agricultural practices loosely follow these trends. There is more herding to the north, more tree-crop cultivation (such as cocoa and palm oil) to the south.

This geographic gradient is elastic. Other, longer rhythms compound the annual cycle of the rains. The Intertropical Convergence Zone is not a geodetically measured boundary but a churning riptide of air masses that wiggles and swings around the globe. How far inland it moves in any particular year and when and for how long are not mechanically prescribed. Droughts are common and sometimes profound. In normal years, fire burns in tight patches, only where the dead grasses are thick and the woods felled and cured; the surrounding vegetation remains too moist to carry fire. But droughts crush that difference out of the land, like presses squeezing sap out of cane. Then fires can burn nearly everywhere; they can even (under severe conditions) creep into closed forests. Ghana's geographic gradients become a climatic accordion, alternately pulled and pushed, scrunched between the sea and the sand. In one critical decade great droughts struck in 1972-73, 1976-77, and 1982-83. The harmattan blew like a furnace fan. Ghana burned inextinguishably.

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But fire exists not only, or even primarily, because natural conditions favour it. Fire flourishes because Ghanaians have put it there. Burning is as fundamental to Ghanaian society and economy as to its biota. Presently lightning accounts for less than 2% of ignitions. Almost certainly that number of starts would be higher under a purely natural regime. The explanation, however, is simple. Humans burn first. By the time lightning arrives with the onset of the rainy season, there is typically little left to combust. Thus whatever affects Ghana's people, affects its fire regimes.

In this way other cycles bonded to social life compound those of climate. There are demographic rhythms, historically tied to wet and dry periods such that regional population builds up during wet times and collapses during dry (with the surplus populations historically shipped off as slaves). There are economic rhythms, linked to the introduction to new foodstuffs and to the export of commodities beyond regional networks. Of the contemporary Ghanaian diet, only bushmeat, snails, millet, and yams are indigenous. The rest - plantains, coconuts, maize, cassava, rice, beef, pork, goat, cocoyams, groundnuts, sweet potatoes, and the rest - were

invented elsewhere and brought into Ghana through trade or migration. Moreover as long as external markets have encouraged them, its farmers grew for export as well as domestic consumption such crops as cotton, copra, and kola, to palm oil and especially cocoa. All this subjected Ghana's fire-flushed landscape to the uncertain economic winds of trade and capital. Balance of payments shortfalls proved as significant as moisture deficits; global depressions as vital as drought. These distant markets for capital could prove as influential as the Atlantic and Saharan sources of its seasonal winds.

Because in Ghana, as elsewhere, fire follows fuel, the rhythms of cropping and fallowing became the rhythms of bush combustibles. Some patterns remained cyclic, tied to the rains. But new crops, iron tools, fresh livestock (where the tsetse fly permitted), new markets for cultivated commodities, all imposed longer wave patterns, not unlike the ancient ebb and flow of decadal drought. Land given to one use changed to others. In particular, eager farmers cracked open forests to plant crops, while foresters added to the sprawl by culling hardwoods, often in association with cocoa plantations, occasionally to replace the wild woods with teak or palm oil plantations, but always, it seemed, allowing pyrophytic weeds and scrub to invade the now sun-spangled sites. And to these one should add the minerals that dazzled early-voyaging Europeans who long called it the Gold Coast. One after another commodity markets rose, then collapsed. They left behind, however, a different landscape, unable to return to the status quo. These were secular changes, equivalent to the south-encroaching Sahara. Together they squeezed and released the gradients of the cultivated landscape in ways that variously clashed, compounded, and cancelled out.

Perhaps the most visible reforms were political, for these gave shape to national borders - defined for a cosmopolitan audience the national identity - and have profoundly influenced the last century of Ghanaian life and land. Abundant slaves and gold had dotted the coast with trading posts (forts, really, so tenuous was Europeans' hold on the interior) from Portugal, Holland, Denmark, Sweden, and Britain. The strangulation of the export slave trade, beginning in 1807, rocked the economic foundations of the indigenous powers. Instead they began to redirect their enslaved throngs to colonize the surrounding countryside in weird mimicry of the plantations erected with slave labour in the Americas. By the 19th century only Holland and Britain remained, and after the final suppression of the trans-Atlantic slave trade, the Dutch withdrew in 1872. A year later British troops smashed the dominant political force inland, the Ashanti Confederacy, centred in Kumasi and declared the Gold Coast a crown colony in 1874. Europe's unseemly scramble for Africa quickly fleshed out borders, duties, and rights. Twenty-six years later British troops had to return to complete the military conquest. In 1902 the British Crown formally annexed Ashanti as a protectorate to its coastal colony.

The British practised cost-saving indirect rule. At the height of its colonial presence probably no more than 4000 Britons oversaw the country. Moreover, endemic diseases and uncertain markets for goods other than minerals, and later cocoa, stalled development. But a new capital, Accra, arose; roads and even some railroads punched through the bush; fresh export crops were introduced; the standard institutions of colonial governance appeared, from forest reserves to a college, a civil service, and a branch of the Royal Society; and both trade and peoples began to move along the great gradients from the interior to the coast. These were fundamental, evolutionary reforms, not readily reversed. Then in 1957 Ghana became the first of Europe's sub-Saharan colonies to achieve independence.

Expectations were high as Prime Minister Kwame Nkrumah became the black star of African liberation. Such circumstances made the subsequent political and economic crash all the more damning. Nkrumah's administration of excess and indifference ended in wild inflation and monetary riot followed by a coup. A downward spiral of political and economic recovery and collapse continued until 1982. By then the average Ghanaian was far poorer than at independence. Virtually every economic index had plummeted. Twenty-five years of autonomy - an era during which South Korea, beginning with the same per capita income, had quadrupled its income level - had in Ghana destroyed wealth. Yet so long as the various rhythms cancelled one another out or came in syncopation the system could muddle along with an episodic coup or default or exchange rate scandal. Then came 1982-83. The cycles compounded. Ghana crashed and burned.

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A new long wave of drought settled over the Sahel beginning in 1968. By 1972-73 its depredations had alarmed the international community. Conditions abated, then worsened in 1976-77, then waned again before returning with massive effect in 1982-83. The drought spread out of the Sahel like stiff molasses. It shoved against the leisurely swells of Ghana's geographic gradients until the desert seemingly pressed against the sea.

The drought worsened beyond the scope of written records. Even Lake Volta dried up. The landscape's traditional mosaic broke apart as its normally wet grout dried and cracked. Fires spread like swarms of locusts. Smoke crowded out even the perpetual dust of the harmattan haze. Bushfires incinerated 35% of Ghana's cereal crops; they invaded fire-sensitive cocoa plantations; they swept over bush-fallow and pasture like flame through kleenex. They burned villages. They even probed and seared the closed forests. They complicated a vast refugee tide spilling into Ghana from the Sahel and Nigeria, which was forcibly repatriating a million Ghanaians. And they shattered the provisional political reforms of Flt. Lt. Jerry Rawlings' "second coming."

Rawlings had led a coup in 1979 that deposed and summarily executed the corrupt Gen. I.K. Acheampong and several of his cronies. Incredibly, Rawlings had then retired in favour of president-elect Hilla Limann. But conditions - social, economic, climatic - continued to deteriorate. On the last day of December 1981 Rawlings removed Limann and installed himself as head of a Provisional National Defense Council (PNDC). A year later the PNDC announced a 4-year economic plan. But the Soviet bloc informed him that it would give nothing, and drought continued to strangle the countryside. Money and rain blew away on the desert winds. With Wagnerian sweep, the fires ended Ghana's political opera in a flaming coda. Rawlings turned to the IMF for advice, and the country began to rebuild its economy along more transparent and market-friendly lines until, a decade later, it had again become the economic black star of Africa.

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Its association with Ghana's Götterdämmerung made the reform of Ghanaian fire seem a natural part of reforming Ghanaian society overall. As the new government sought to integrate Ghana into the global economy through the advice of the International Monetary Fund (IMF), so it also sought technical help for coping with bushfires. The U.S. Forest Service sent advisors in 1985. In 1998 the International Tropical Timber Organization (ITTO) launched a 3-year program to stabilize fire threats along the cordon of fraying forest reserves that separate the high forest from the savanna. Other international donors, including the Netherlands, proposed projects to improve bushfire protection. But exchange rate mechanisms proved easier to reform than fire practices.

Free-burning fire thrives for different reasons in different parts of the world. The world's major firepowers - the United States, Canada, Australia, and Russia - experience wildland fire because they have reserved vast domains of wildlands. That was a legacy of their colonial history; disease and force swept the natives aside and left open, for a time, immense sweeps of virtually vacant land. These were reserved as public domain before new settlement could claim them. The greater fraction of the world, however - including the most extensive of burned lands, like Africa's savannas and Brazil's cerrado; including almost all of Ghana - knows fire through agriculture. Herding and farming shape fuels, and the needs of crop and herd dictate patterns of burning. Virtually every facet of rural life in some way relies on fire. As long as Ghana's rural economy thrives, so will its bushfires.

Ghana is not unique in its fire saturation. Begin with the observation that, until very recently, almost all agriculture depended on fire for both its creation and sustenance. The nature of agriculture is to cultivate plants and animals in an environment for which they are not native. To succeed the land must be changed: it must be readied to receive exotic cultivars and livestock. Fire does this, and the need for recurring fire is an explanation of the need for fallow. An agricultural system that requires fuels must grow them.

The fire-fallow process is relatively easy to understand for swidden, or slash-and-burn. But it applies no less to field rotations. In the former, the farm cycles through the landscape, catalyzed by fire; in the latter, the landscape (as it were) cycles through a fixed farm plot, again jolted by fire. In temperate Europe, for example, fire had almost no natural presence, yet agriculture utterly depended on it. Even garden plots intensively spaded and manured relied on routinely burned outfields for the pasture that fed those dung-yielding cattle. The assertion that pre-industrial agriculture does not require fire is wrong.

But some places have more of it than others. In sites for which fire does not exist naturally, only constant human tending keeps it on the land. Remove that kindling hand, and you remove the flame. In places that are naturally fire-prone, however, fire tends to occur more abundantly and more readily escapes. The problem is not to create fire so much as to control it. Fire seems less a servant than a collaborator: the opportunities to reduce or redirect it are fewer. Where wholesale migrations are occurring, then fire displays both the shock

and swirl of those movements. Fire is no more fixed than the landscapes it burns. All this is true for Ghana.

Yet there are parts of the world for which open burning has become expendable. Why? The simplest answer is that they industrialized. They no longer have an economy that depends on agriculture, or they possess an agriculture that no longer depends on fire. They broke out of - transcended, really - the endless cycle of growing and fallowing by tapping fossil biomass, which serves as a kind of fossil fallow. They still reach beyond the growing field for fuels; they still combust them. But they burn or distil coal and oil, and they do so by indirect means - by tractor-drawn plows and harrows, by artificial fertilizers, by pesticides and herbicides. So they no longer fallow, and no longer openly burn that rank growth. In such places, rural fire has faded away.

That is the simplest explanation of how countries moved beyond a rural fire regime. The problem of promiscuous rural burning was never really solved in any technical sense except in those places for which fire existed only through wilful application. So long as a rural economy flourished, so long as a rural population committed to fire-fallow agriculture resided on the land, so did fire. Something had to move the farmers and herders off the landscape. Industrialization did that, in part, by reducing the number of agricultural labourers needed and in part by creating jobs in cities. Often, however, the rural population was forcibly removed through enclosure or collectivization, or in colonial situations by disease, war, and eviction. All were violent processes; socially violent, ecologically violent, or both. None offer suitable models for today's developing countries.

The point is that rural fire control occurred at a local level or not at all. There has been no successful "high modernist" strategy for coping with rural burning at the level of a national or even provincial government. Historically, the solution to excessive burning was, locally, to regulate it better and, nationally, to evolve beyond an economy based on fire-fallow agriculture. Rural fire thus mirrors the better known demographic transition that accompanies industrialization. The United States, for example, experienced horrific fires during settlement in the latter quarter of the 19th century. Its officials - even the creators of conservation as a political philosophy - proved unable to solve the problem in any systematic way. The prevailing belief was that the fires would vanish as settlement matured, that forest fires would disappear as forests became farms. The cycle of abusive burning continued, in fact, for over 60 years and ceased only after the rural landscape was exhausted and more or less abandoned. Instead, America's successful "firefight" occurred on reserved public lands - precisely those landscapes not subject to the pressures of a rural economy.

There is no easy solution to Ghana's rural fire economy. If history and analogy are useful as guides, Ghana will not control bushfire through legislation or force or persuasion. The current fire regimes will persist until Ghana evolves out of them. The critical issue is how to pass through that fiery metamorphosis without savaging the landscape beyond redemption. In particular, it is an open, but vital, question whether Ghana's forests can survive a prolonged transition.

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The burden of answering that query has fallen to the Forest Department. This being Ghana, whatever might threaten the forest will somehow involve fire, and will likely do so on such a scale that the control of fire will appear as an end in itself instead of a means. An exercise in fire exclusion would seem quixotic except that, incredibly, fire-free forests do exist. Unsurprisingly they have become objects of intense scrutiny for what they say about the politics and ecology of fire protection and thus for what they might promise for the future of the Ghanaian forest. The best known are sacred groves. They are not many, and they are not large, either individually or collectively. But they demonstrate that it is possible to shield woods from fire if the local community wishes to do so. Some human access is allowed with priestly oversight, and some harvesting of special plants may occur (and may provide one of the unpublicized reasons for protection). The rationale behind fire exclusion is special, however. The primary purpose is religious, or more broadly, the identification of a particular site with a people's identity; usually these are sites that commemorate the burial of a group's founder or its ancestors or in some other way lays a claim to social memory. For this reason, the preserved woods are themselves a relic, the biotic equivalent to the symbol-charged stools that distil the tribal story and define political legitimacy.

It may be that similar principles can apply to more extensive forests. The problem of course is that protection relies on belief as well as practice, or rather on beliefs and values that sanction certain practices and ban others. It is not obvious what would serve a similar function at the regional or national level. In the United States nature reserves such as national parks and wilderness areas serve an analogous purpose. They testify to the founding conditions of colonization; they are preserved ultimately because they express larger values and share in a national creation story. It is not clear that Ghana offers an equivalent rationale. The parks of South Africa, for example, actually stress rather than reinforce nationalism. Probably the sacred groves will endure as local monuments, but are unlikely to expand.

A second fire-free zone occurs around the Nandom district in far northwest Ghana, specifically the villages around Gozrii. Here the local chief, after suitable consultation with his council of elders, banned burning. One site of several hectares has now escaped fire for 13 years. The understory has roughened, the woods have thickened. Fire critics have advertized the Gozrii experiment as a model for what might be achieved elsewhere, or even across all of Ghana. Yet its success seems to depend on special ecological and political circumstances.

Unlike conditions in wetter regions, the grasses of Nandom's savannas can perpetuate themselves in the absence of burning and, further, they can serve as fodder for livestock which thrive in this tsetse-free sanctuary. Elsewhere, particularly to the south, the grasses are palatable only when fresh - during early growth - which is a major incentive to burn them prior to the rains. Besides, that livestock eat the grass means that there is less to burn. These circumstances are not generally typical of Ghana. Moreover, while hoeing residual fallow into the field (green manuring) is practised, it is clear that overall productivity depends overwhelmingly on rainfall. And it is not certain what deleterious effects might eventually result from fire's exclusion rather than from a shift in its regime.

The political context, nonetheless, is both sharper and more broadly applicable. The state has proved relatively ineffective; even the Forest Department and Ghana Fire Service appear as blunt instruments. Instead control resides within the village, through the power of the local chief, or through the larger collectivity, the paramountcy. The village thus practices prevention, patrols, sanctions violators, and fights fire. The lesson is that fire can be excluded, at least for a number of years, and that the local community is the only means by which to do so. The apparent success of one village has, in turn, inspired neighbours. The moral is as clear as crystal: only a program that rallies the local community can successfully alter fire's local regime.

That leaves Ghana's secular groves, its reserved forests under the direction of the Ghana Forest Department. The reasons for fire's removal are again both environmental and political. The reserves dapple a region that promotes high, often closed forests for which fire is not a natural presence and that, in fact, repel bush fires which strike along their dark border. The woods thus enjoy a certain intrinsic immunity from burning. That they exist outside the matrix of Ghanaian agriculture also excludes many ignitions. The political explanation is that they are overseen by an agency of the national government committed to fire protection. For most of the 20th century these two processes have collaborated to shield the reserves from routine fire. In all, the reserves legally protect about 20% of what were once Ghana's high forests and are all that remain outside of parks.

More recently, both the ecological and the institutional shields have frayed badly. The Forest Department is evolving into the Ghana Forest Service, which is committed both to a strategy of collaborative forest management and to a program of self-financing its operations. The outcome is ambiguous; at a minimum, the authority as well as the bureaucratic presence behind state fire protection have receded. It is not obvious that these institutions will survive, or if they do that they will exist as more than paper bureaucracies. Still, the reserves could probably endure these political strains were they not also stressed simultaneously by environmental factors. Forest reserves now exist as islands in a sea of agricultural fire, and climatic storms (like those of 1982-83) are rapidly eroding the exposed biotic coastlines. Most of the reserves have suffered from logging, agricultural encroachment, weed infestations, and fire; some have degraded significantly. The shock is particularly acute along the so-called transitional zone between the savanna and the high forest. Whatever their legal status, the reserves nonetheless hold most of what endures of Ghana's high forest in a form that approximates a coherent biotic system.

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It is small comfort to thoughtful Ghanaians to know that their problems are again not unique. The creation of forest reserves was a colonial practice of the last century, continued for a few decades into the 20th century. Ghana's were among the last established by Britain, but for that reason they represented a degree of acquired wisdom and for the Gold Coast, a compromise with local politics. Several false dawns appeared between 1907 and 1912, rudely based on the Indian model and assisted by an indefatigable forest officer, H. N. Thompson, loaned by Nigeria. The process collapsed under the pressures of the Great War and local protests and the office of Conservator of Forests was abolished in 1917. An acceptable new policy emerged in 1919; officials gazetted reserves; and in 1929 a revised forest ordinance accelerated the movement, which more or less achieved equilibrium in 1939. Yet ultimately the reserves remained an imperial institution: they expressed outside ideals and existed because of the power of the colonial authorities to install them.

Their origins, however, do not invalidate the reasons for their creation. In part, they existed to rationalize the timber trade. Experience repeatedly showed that local institutions collapsed when suddenly confronted with a heavily capitalized global market. Typically concessionaires scalped timber and left. Foresters promised to regulate those practices and to repair the damage done; the reserves were models to demonstrate how to accomplish this. They were a means by which the state could interpose itself between local and global processes, to protect the former and promote the latter.

Equally, reserves existed to promote larger, national values, as secular equivalents to sacred groves. It was believed that protected woods could ameliorate climate, help regulate navigable rivers, even provide a degree of solace for harassed urbanites. They spoke to national, even imperial values - the needs of a larger world - that local communities could not understand and would not support. Control thus had to reside outside the hands of tradition-bound peasants, transient hunters, and transhumant herders. In brief, reserves prevented economic monopoly, retarded the ruin of natural resources, and promoted transcendent goals. And, it is important to note, they often worked more or less as planned. Without its legacy of reserves it is probable that Ghana would today have no standing high forests of any consequence or coherence.

Nature reservations, most expansively forest reserves, appeared throughout Greater Europe's imperium. They were most successful where European settlers displaced the indigens, less so where Europe ruled over local peoples. In the former case, the reserves were often uninhabited. They were created at a time when the indigens were gone but European settlers had not arrived in force. The lands were, in a profound sense, vacant, and they remained the property of the crown, province, or state. Where peoples persisted in or around the reserves, administration was complicated and compromised. In a few instances colonial foresters administered the reserves on behalf of local rulers. This was the case with Ghana and with American Indian tribes. The outcome is probably the least politically stable of all such arrangements.

Europe's recession from empire left forest reserves along with other institutions in its wake. They have survived best where the national government remained strong, the reserves uninhabited, and their perception as a colonial hangover weak. The oldest reserves (those in India) have endured for less than 150 years; the youngest, like those in Ghana, for about half as long. Many exist only on paper. Most are undergoing some degree of review and reconstitution. New Zealand, for example, has disestablished its Forest Department and privatized most of its holdings, including all of its extensive Monterey pine plantations. British Columbia and Australia are renegotiating land claims from native groups, some of which will likely result in a transfer of usufruct (if not title) from public lands. This process of adjustment will almost certainly continue. It is doing so today in Ghana. In fact, Ghana's reserves exist for several announced purposes and reveal a spectrum of usage and degradation.

So it is not obvious how to protect them. They cannot be reserved without being used, cannot be used without introducing fire, cannot be burned without changing. While bushfire is neither the source nor a driver of such change, it is a necessary catalyst, and unless it can be controlled, the reserves will erode away into weed lots and bush fallow. Without fire protection legal protection is meaningless. With respect to its forest reserves, as with the rest of its land, Ghana's relationship is one mediated by fire.

Bushfires have entered the reserves proper because logging has cracked open their multi-layered forest canopy and then allowed pyrophytic weeds to invade. For those reserves dedicated to production forestry, logging has started a conversion that has replaced native woods with commercially valuable exotics. But whether the old forest is allowed to recover, or a new one replaces it, fires are now an inextricable part of the system. It has

entered most reserves and established residence. So long as logging continues, so will fires. Logging prescriptions must now factor in fire protection, and timber harvesting must accept those expenses as part of its cost of production even as the relative value of timber among Ghana's export commodities slides downward. A complicating factor is that the new Ghana Forest Service is expected to pay for itself through commercial logging and as the local stools receive a greater fraction of the accrued revenue both the incentives for logging and the dangers from bushfire will ratchet upward.

Outside the reserves the problem is one of fire-fallow agriculture. So long as rural life dominates Ghana's economy, so long will fire scour and polish the land. Inevitably some of those fires will crash into the reserve border, and splash across. Yet neighbouring villagers are also the only means for bushfire control. They alone can prevent fires, fight fires, and rehabilitate after fires. They offer the only reliable source of staffing for bushfire fighting, though they have had little incentive to support the Forest Department and many reasons to resent what they consider the appropriation of "their" lands by an alien bureaucracy. The redirection of forest policy into collaborative management - obviously modeled on community-based natural resource management programs developed for wildlife elsewhere in Africa - offers a partial solution. It is conceivable that villagers will do for the Forest Department what it cannot do for itself, provided sufficient incentives are offered. The political field, however, promises to become as complex and intricate as Ghana's polycropped farmlands.

The strains are greatest along the border. The reserves are (to put it kindly) weirdly constructed, or gerrymandered outright. Most reserves have a very long perimeter relative to their bulk, which makes them even tougher to defend. At least along the transitional zone, most borders are not well demarcated. They exist as an occasional sign and a cutlass-slashed swath through the annual flush of grass and scrub. They offer nothing to halt trespass or fire. They rely, ultimately, on the good will and discipline of the surrounding villages. The decay of their boundaries - like those at Afram and Pamu-Berekum - into fields of elephant grass and acheampong dissolve even that presumption. Without a border the reserves have no identity. Yet the Forest Department lacks the resources to defend those boundaries, and villagers, the incentive to assist them in the task.

The proposed solution - ingenious, really - is to construct a system of "green firebreaks" around the threatened perimeters. "Green" because they consist of incombustible crops; "firebreaks" because, at 40 meters width, they should halt a spreading surface fire; "ingenious" because they can enlist villagers to do the work in return for new cropland. Since the planting includes fast-growing, sun-blocking species, it is assumed that after 3-4 years the trees will overtop the abandoned fields and the fuelbreak will become sufficiently shaded and self-sustaining to both halt fires and waive the need for future maintenance. In principle, a program of such fuelbreaks could staunch the further fire-haemorrhaging of the reserves. It would leave the reformed Ghana Forest Service with administrative control and the villagers with practical access. The Netherlands has proposed a 10-year project around just such a conception.

Fuelbreaks are rarely more than a partial solution, however. They tend to serve only as an enabling device. They work best when they are built into the design of a site, not retrofitted. They help move a land from one status to another. Their assets are that they assist in the control of surface fires and that they are supremely legible to observers, whether critics or advocates. They are an obvious expression of an administrative presence. There are instances where they have succeeded - in taming prairie fires, in replanting burned forests, in protecting pine plantations. Yet they often look better than they perform. Their liabilities are formidable. They are expensive to install, especially when imposed on a landscape originally fashioned for other ends. They are even more expensive to maintain. Since they consist of plants, they grow, change, evolve, and require tending; most fall into disrepair when their informing crisis has passed. They fail during extreme fire behaviour which is precisely when the need for protection is greatest. Spot fires soar over them with complete disregard for the labour and ingenuity invested. And perhaps most tellingly, they tend not to be permanent features. They are transitional, and they suffer when the larger goals are inappropriate or unreachable. All these concerns apply to Ghana.

They apply especially to concepts imported from the outside such as the Netherlands proposal. Like the fuelbreaks it advocates, this scheme must be cobbled onto the existing landscape and so becomes awkward and transient. Behind the transfer of engineering, however, stands a transfer of culturally coded values. Would the proposal have the same punch if those "green firebreaks" were called cassava corridors or plantain patches? Would the scheme have the same political panache if it were not premised on the vision of "desertification,"

on the perspective that forests converted to grasslands are outliers of the Sahara? Is not the vision behind those protected reserves one of a biotic seawall to hold back the rising savanna? Are not the Dutch imagining the shallowing forests of Ghana as they have their own shallowing seas, such that the firebreaks will act as a system of dikes with which to drain fire from the landscape? Whatever other difficulties may be embedded in the scheme, the critical one is that fire does not behave like water. Savanna is not heath. Seasons in Ghana follow the ebb and flow of rain, not temperature. The firebreaks scheme could, at most, assist Ghana over its transformation into an industrial state. It can, at best, stay the fiery flood until the compounding waves begin to disaggregate and the spring tide of rural life subsides.

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The core problem remains political. If fuelbreaks work best as transitional devices, then what is the end result and how long will it take? The critical transitions are several. There is, first, the forest itself. Assuming the scheme does exclude fire, at what point has it succeeded? Particularly if logging continues, as it must to finance the Ghana Forest Service, then the fuelbreaks must remain more or less permanently, which will create serious difficulties with maintenance.

The scheme is, secondly, transitional within the evolution of the Ghana Forest Service. The institutional arrangements will be redefining themselves for many years to come, perhaps over decades. The role of the Forest Service as a viable agency will depend on the definition - the perceived value - of the reserves it oversees. Without those reserves, there is little justification for a forest bureaucracy within a state bloated by civil service patronage. But as the reserves are progressively used, so their purposes have multiplied.

The tradeoffs are tricky. The reserves' diversity of purposes dissipates as well as concentrates a political rationale. If the reserves serve only one purpose, they will lose constituencies. If they serve too many, they risk a loss of definition, and even as the agency attracts some constituencies, it alienates others because, at particular moments, it must choose one or another. The Ghana Forest Service may simply absorb the conflicts within itself in perhaps bureaucratically painful ways. One solution is to subsume the reserve system under an umbrella organization but subdivide the various functions among separate bureaus. The Forest Service, for example, might have special interest in commercial logging and plantations. This seems to be a direction toward which the institutional momentum is headed. It may be that such definitions, like the proposed fuelbreaks, are a provisional device.

The most powerful transition is of course that of Ghana from a developing, rural nation to an industrial one. This is not something the Forest Department can create, though it will be profoundly affected by the outcome. When the rural economy subsides, so will fire pressures on the reserves. Any scheme of protection must see the forests through that phase which, barring major setbacks, will likely last for 40-50 years. A scheme should also provide protection under the worst fire conditions, such as the return of a season like that of 1982-83. One or two equivalent outbreaks - a likely outcome over the next half century - and the highly exposed reserves may simply burn away, save those in the most remote and damp locales. Climate and culture, both unpredictable and both outside the control of the Ghana Forest Service - how they mix or mash will determine the timing of large fires, and the outbreaks of those fires the success of forest protection.

Paradoxically perhaps the multiplication of purposes behind the reserves may not, by itself, add up to a compelling argument. If the forests are valued primarily for timber, then the state may seek to privatize them and international donor nations may lose interest in subsidizing them. The values that may be gained are too ephemeral and those values threatened with loss too remote. Environmentalism behaves as though on a green mission to civilize Africa that has replaced for many affluent nations the anti-slavery campaigns of old. Remove that incentive, and the public appeal will fail. If the reserves exist to promote biodiversity or eco-tourism, then a parks or wildlife agency may be the most suitable instrument. If the reserves belong to the surrounding stools, and those peoples want to determine for themselves what should be done with land, then the Forest Department becomes a bureaucratic barrier, one that is politically inexpedient. The reasons for allowing the reserves, which are after all a colonial relic, to fall away are many.

Yet a compelling logic exists for holding them more or less intact. It resides not in any one purpose or use but in the simple fact that the reserves help keep Ghana's environmental options open. If the reserves collapse, then so will Ghana's relic high forests. They will disappear into stumpfields and farms, and once gone they

will not be restored. They were the creation of a unique period of Ghanaian history. When Ghana emerges through its industrial adolescence, it will wish it had those reserves, for purposes it cannot today define. And the only way to ensure that those woods survive as biological landscapes, not simply as hollow legal entities, is to protect them from fire. The alternative is for the country to find that the winds unfurling its symbol-laden flag have scattered its woods, that its forests have gone with the flames riding the surge of the harmattan.

How bushfire protection will happen is hard to predict. The uncertainties are too great; the complex tables of programmatic elements, detailed strategic plans, and elegant policies and declarations that appeal to international donors and IMF advisors are almost certain to be frustrated. Most likely the Ghana Forest Service and its sister agencies will muddle through, though in a vigorous and creative way. They will improvise. They will find ways to tend the necessary fires and contain the damaging ones. They will cross this period as one might hop from log to floating log across a pond, not stopping long enough to tumble over. With pluck and luck, they may carry most of the reserves along with them. A century from now Ghana will be glad they succeeded.

Acknowledgements *This essay grew out of a visit to Ghana at the invitation of the U.S. Forest Service to participate in an ITTO program on bushfire protection. It stands outside my official report and represents my own thoughts, not those of the sponsoring agencies. I would like to thank Mark Buccowich and Mark Beighley of the Forest Service, respectively, for the invitation and for companionship. And I wish to convey my sincere thanks to the many Ghanaians of the Forest Department and Forest Research Institute of Ghana who made the tour possible, notably Dr. Kwesi Orgle, Dr. Victor Agyeman, Alex Asare, Kennedy Owusu-Afriyie, Godfred Ohene-Gyan, and Lucy Amissah.*

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Wildfire in the Southern African Development Community Conference as part of the

Wood for Africa Conference 1999

The **Wood for Africa Conference** was held in Pietermaritzburg, 10 June 1999, with as focus group middle and upper level management in the Southern Africa Development Community (SADC) and abroad. It was a one-day focused conference that coincided with the Woodfor Africa Exhibition held on the same site, from 10 to 13 June 1999.

Background

In his opening speech the conference chairman C. de Ronde - author of this conference report - underscored that Southern Africa has a very important fire history in its natural environment, and the role of fire in maintaining biodiversity in the region cannot be over-emphasised. Whether in the magnificent fynbos plant kingdom, high altitude montane grassland or sub-tropical savanna, moist and dry vegetation communities need fire some time during their growth cycle, and this fact just cannot be ignored.

During the 20th century, accelerated population growth and significant changes in land use in the rural, agricultural and forestry sectors, have created new challenges in fire management. In some cases a steady accumulation of fuel biomass has caused a marked increase in fire hazard. Subsequently the occurrence of

wildfires in the region increased dramatically. More forest plantations were burned during wildfires in recent years than during any other time in our history, and the sustainability of the forestry industry is at present being threatened by wildfire in certain regions, with (for the first time) a significant number of tragic human deaths reported and millions of Rands lost in the form of private dwellings burned out in the process.

However, the forestry industry also experienced some remarkable success stories in their fight against wildfire with a new integrated approach to fire protection being implemented in some forest regions. Fire hazard and subsequent wildfire losses were reduced significantly, and we should take note of these events, and vigorously seek expanded implementation of these measures and fuel management schemes at a regional scale. Increased use of regional buffer zoning, fuel appraisal and prescribed burning inside plantation stands played a significant role in these fire hazard improvements.

Technology in fire management also improved drastically, particularly in the field of fire detection and fire fighting. Our scientists and fire managers are still meeting the challenge of reducing fire hazard by implementing these important new tools in the forestry environment, and will also significantly contribute towards containment of wildfire damage. The recent introduction of the new ***Veld and Forest Fire Act*** has also contributed to a more acceptable wildfire occurrence, and will continue to do so as the Act is implemented.

Unfortunately much work still has to be done in numerous regions of Southern Africa, where wildfires are still causing unacceptable damage levels. For this reason it is even more important that we thrive towards a complete integrated approach to fire protection at a regional scale, and include our rural communities, nature conservation management bodies and agricultural sector, locally and beyond the South African borders. Education in this respect has to be improved, and we need to look critically at out levels of fire-related training at our technicons and universities, as well as fire-related research progress. I am afraid that the latter has been neglected seriously during recent years and needs urgent funding improvement if we want to stay abreast in the fast growing world of fire technology. Southern African scientists used to be leaders in the field of fire ecology, but fire researchers have now become extremely rare species. This situation needs to be reversed if we want to meet our wildfire challenges.

Keynote Address

Johann G. Goldammer, leader of the Fire Ecology and Biomass Research Group of the Max Planck Institute for Chemistry, Biogeochemistry Department, based at the University of Freiburg, Germany, presented a keynote address touching on Southern African fire issues in a global context. His presentation ***"Forestry and Land Management in the Subcontinent of Fire: Challenges for Southern Africa"***, covered the increasing demand of forest products and subsequent increased interest in carbon sequestration, and how this challenge must be met by plantation forestry.

He painted a picture of degraded natural ecosystems, a changed socio-economic and cultural environment and how the establishment of plantations have changed the role of fire and fire management in the region, as well as on a global scale. To illustrate this, J. Goldammer compared the situation in Southern Africa with that of wildlands in other regions, and how this ties up with regional and global programmes.

As leader of the FAO/ECE/ILO Team of Specialists on Forest Fire, editor of the UN ECE/FAO International Forest Fire News and recently Convener of the Working Group on Early Warning of Fire and other Environmental Hazards of the UN International Decade of Natural Disaster Reduction (IDNDR), J. Goldammer presented the global picture of wildfire occurrence, effects and control as well as recent developments to improve the situation on a worldwide scale. He also reported on the progress and outcome of various international projects, and how this will influence the status quo in Southern Africa.

Wildfire Management in the SADC Countries of Southern Africa

Chris Kromhout, Deputy Director, Conservation Forestry, Department of Water Affairs and Forestry, reported on the 1992 discussions between representatives of the Forestry Sector Technical Co-ordination Unit (FSTCU) and the USDA Forest Service, where the possibility of a SADC-wide regional forest fire management system was raised, and the subsequent terms of reference for and investigation and a review of the situation, drawn up during 1994. This was followed up by a meeting in Lusaka by representatives of the SADC countries and by the project team consisting of experts from the US and Canada. The review was

sponsored by the USDA and Canadian International Development Agency (CIDA). By 1996, recommendations and subsequent project proposals were submitted for approval, after which nothing was heard of this initiative.

The chairman reported that, as far as his knowledge goes, the proposals were not approved (he himself was involved in some of the recommendations) and that the US co-ordinator of the initiative, Mr. Mike Calvin, has subsequently applied for early retirement, and has applied for permanent residency in South Africa. He was, however, involved in getting fire management units off the ground in Botswana and Malawi.

Integrated Fire Protection Systems in Southern African Plantations

Neels de Ronde, forestry consultant, presented the mechanics of the new approach to fire protection, an integrated regional system for forest regions. The basis for this, fuel modelling, fire hazard rating and regional buffer zoning with full integration of nature conservation and riparian zone management were explained, and how successful the new ideas were implemented in some forest regions. Financial implications of the fire protection improvement, and further implementation elsewhere in Southern Africa was also presented.

The necessity to incorporate other disciplines, such as nature conservation and agriculture was stressed, while the importance of considering the urban interface and rural requirements was also emphasised. The formulation and application of this regional fire protection strategy was highly recommended.

The National Veld and Forest Fire Act

Lael Bethlehem, Director of the Department of Water Affairs and Forestry (DWAF) of South Africa, introduced the ***National Veld and Forest Fire Act No. 101 of 1998***. The Act will be the first of its kind to address the wildfire problem on a National scale. On 30 April 1999 a conference was held in Pretoria to discuss the implementation of the Act. The DWAF will be responsible for the provision and management of policies regarding forestry, and the administration of the Act.

Although DWAF will not play a direct fire fighting role or duplicate the work of fire management agencies, DWAF will put together the framework to support people working on the ground, and will play a role in the following four key areas:

* Helping to develop Fire Protection Associations (FPAs)
* Development of the Fire Danger Rating System
* Research and Statistics
* Assisting in the dissemination of information to the public

Latest Developments in the Field of Fire Detection, Suppression and Prevention

Additional presentations were given on several technical developments. Gavin Hough reported on "Fire Detection and Positioning" involving improved high-resolution digital video techniques. Another "Digital Early Fire Detection System" was introduced by Malcolm Warrack. Two papers were presented on "Health and Safety of Wildland Firefighters" (by Mark Anderson) and "Fire Insurance and Risk Management" (by Pierre Bekker).

In the field of fire fighting Hennie Engelbrecht reported about "Combined Cross Border Fire: The Usutu Pulp Fires of 1998". This presentation provided information about cross-border wildfire threats between the Mpumalanga Province of South Africa, and the Swaziland-based Usutu Company. He emphasised the importance of co-operative fire fighting across company and country boundaries and the importance of co-ordinated fire detection, initial ground attack and aerial support.

In his presentation on "The Urban Interface Zone" Stephen Barber discussed the changing role of the urban interface and its relative importance in Southern Africa today. It was stressed that the conflict between urban developments and the natural environment is not in such serious conflict as elsewhere in the world, such as in California, USA. However, it was generally agreed that some hotspots are presenting a serious fire hazard in some of the Cape regions, and that urgent steps are required to counteract these developments.

Jakes Oosthuizen concentrated his presentation on the prevention of veld and forest fires by means of the law, human relations, statistics and fire weather monitoring, as well as fire preparedness, early detection and attack. He also sketched the present fire hazard situation, the role of El Niño, La Niña and medium-term forecasts.

Summary

In his closing speech the chairman mentioned that this conference had been organised at just the right moment, and that we now need to consider how to take the momentum of this meeting further. A follow up conference, covering the whole of Southern Africa and including other affected disciplines such as Nature Conservation, Rural communities and Agriculture, was suggested. This meeting should also be used to invite international specialists as speakers, and in this way address most important concerns.

Johann Goldammer reported that a Round Table Conference will be held in Namibia first with some South African delegates attending. This should then be followed up by a similar conference in South Africa, with a broader regional strategy in mind with the aim of fire management improvement in the whole of Southern Africa, and eventually further north into the continent.

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Smoke from savanna fires in Southern Africa are a common picture since more than a million years, but become of increasing public concern in the context of increasing awareness on the role of "greenhouse gas" emissions.

The National Veld and Forest Fire Act
Act 101 of 1998 of the Republic of South Africa

Introduction

When the Forest Act of 1984 was revised in 1998, it was decided to extract the sections pertaining to fires and produce a separate act. This has elevated the importance of fires countrywide and has taken the issue to a much wider taarget audience than only the forest industry. The burden to control fires has now been put squarely on the shoulders of the landowner, which means that regulation by Government is limited to a minimum, but still enough to encourage economic and social progress. Through the Act, Government undertakes to provide a service by adopting the responsibility of developing a national fire danger rating, of collecting fire related statistics and of campaigning an awareness around the dangers of fires and of measures to limit losses caused by fires.

The Act is available on the Internet at the website of the Department of Water Affairs and Forestry < http://www-dwaf.pwv.gov.za > where legislation documents can be searched directly under

< http://www-dwaf.pwv.gov.za/Documents99 >

Regulations of the Act are presently being drafted. The most important provisions of the new Act are briefly highlighted:

Purpose

The purpose of the Act is to prevent and combat veld, forest and mountain fires throughout the country and thereby limit and reduce the damage and losses caused by fires to life, fixed property, infrastructure improvements, movable property, stock, crops, fauna and flora and veld in rural areas.

Fire Protection Associations

The intention of these associations is to decentralise governance of fire issues relating to prediction, prevention, managing and fighting to the lowest practical level for the landowner. The idea is that landowners organise themselves into logical geographical units and with backing of legislation, take charge of their own affairs. These associations have to apply for registration in order to obtain legal status. They deal with all aspects of veldfire prevention and fire fighting. The Act regulates the establishment, registration, duties and functioning of Fire Protection Associations.

Fire Protection Associations have the authority to make rules and enforce them. The Chief Executive Officer of a Fire Protection Association is officially registered as a Fire Protection Officer and has certain duties and powers (power to enter and search, to seize and to arrest) under the Act. The registration of a Fire Protection Association can be withdrawn if it becomes inoperative or ineffective.

Local Authority Fire Brigades

In terms of the Constitution, fire fighting is a Local Authority function, with Provinces and Central Government playing facilitating roles. Also, Local Authorities are expected to serve their districts, not only the cities, towns and villages, but all farms, communal areas and State land. Fire fighting services cannot accomplish the task without the assistance of landowners, who have to have their own capacity to deal with fires. The Act reflects this position in that the Chief Fire Officer of a municipality, where it is a member and has a service, will, in certain circumstances, be the Fire Protection Officer of the Fire Protection Association. The parties involved in this process of integration have to devise a way of dealing with a novel, dynamic situation without losing the competence there may be to deal with fires.

Fire Danger Rating

The Act obliges Government to prepare and maintain, on a continuous basis, a fire danger rating system for the country in consultation with the Weather Bureau and Fire Protection Associations. A process has been

started to establish the required system. Terms of reference for a project to be undertaken by a contractor have been drafted. The contractor has to evaluate alternative methods of calculating the indicators to rate the fire danger and recommend the model most suitable for South African conditions.

Firebreaks

The Act places a duty on landowners to prepare boundary firebreaks and maintain them in areas where fires occur, whether within or outside of an area of a Fire Protection Association. The preparation of firebelts, the timing thereof and their location depends upon the co-operation of landowners. The width and length of a firebelt is not prescribed by the Act, but must be such that it has a reasonable chance of preventing a fire.

Fire Fighting

There rests a duty on all owners to acquire equipment and have available personnel to fight fires. The degree to which this is done is either subject to prescription or it must be reasonable under the circumstances. Certain persons are given the power under certain conditions to enter land and fight fires or take control in fighting a fire in an emergency. The Act also provides for agreements to be entered into between the State and Fire Protection Associations or between such associations to assist each other in a case of fire.

Delegation and Assignment

The Act allows the Minister to delegate the exercise of any of his powers, apart from individuals in the State, to anybody who is not an organ of the State. This could open doors for handling some of the provisions at Provincial or Local Government level.

Presumption of Negligence

In cases of civil proceedings, negligence on the part of the defendant is presumed until the contrary is proved, unless the defendant is a member of a Fire Protection Association. This in itself is a big incentive for landowners to join such an association. However, the plaintiff must still prove that an act or an omission by the defendant was wrongful. This could become a complicated legal concept which would demand that each situation be considered in court on its merits.

Offences

The Act lists certain activities which make a landowner or any other person guilty of an offence. Negligence amounts to fault for purposes of an offence. In a court of law the reasonableness of any action under given circumstances will be under scrutiny.

Conclusion

The main principle within this act is that the landowner is the main player in controlling wildfires. The State is going to assist to a greater extent than in the past having taken upon itself to apply a system of fire danger rating. It must also devise, together with all the role players, an information system to raise the awareness level about wildfires among the public at large, especially among land owners.

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Integrated Fire Management in Southern Africa

1. Introduction

Most Southern African Biomes need fire to maintain biodiversity. This may range from an average rotation of fifteen years in the fynbos-covered mountains of the Cape regions and drier grassland communities, to as little as two to four years in the moister summer rainfall areas, but throughout Southern Africa, the important role of fire has never been questioned. As a result of changes in land-use, some biomes have changes significantly over the years, and the establishment of industrial plantations in the higher rainfall areas, demarcation of nature reserves, intensive agriculture and shifting grazing patterns in rural areas have no doubt changed biomass characteristics of the land, but the role of fire was maintained throughout the process, although in places in a somewhat revised form.

The inherited role of fire in forestry plantations was not recognised before the 1980's, by which time serious wildfires occurred at an increased rate, threatening the sustainability of timber supplies. The "total protection policy" applied in these plantations - completely excluding fire from planted areas - increased fire hazard steadily, as fuel accumulation ran out of control in many forest regions. It was only during the 1990's that fuel management was considered as a viable fuel level control technique, and that selective use of prescribed burning was accepted as an important long-term solution to combat the increased wildfire problem (de Ronde 1990, 1997, de Ronde et al. 1990).

On a regional scale, the mixture of natural ecosystems, agricultural land and forestry activities was never considered on a broader scale, and the fuel status/dynamics of these regions was before the early 1990's not appreciated either. This resulted in fragmented fire protection measures following (mainly) historical property boundaries, with a serious lack of continuous protective lines through the landscape. As a result the occurrence of large wildfires increased.

2. Methods

The "top-down" approach

Wrong placement and inadequate widths of fire breaks, and a lack of understanding of wildfire hazard at regional level had to be dealt with and to overcome these problems, fire protection improvement was scheduled in the following order:

* Regional appreciation phase
* Fire protection evaluation at plantation level
* Integrated fire protection application phase

Regional appreciation phase

Mapping fire history: Before considering fire protection measures, the perimeters of major wildfires experienced in the past were mapped on topographical maps at a 1:50,000 scale, in order to determine the main direction(s) and area(s) of wildfires that occurred in the past.

Classifying basic fire hazard categories: To make evaluation at a regional scale more meaningful, a typical basic fire hazard classification used to express external fire hazard has been presented below (Tab.1).

Placing the main buffer zones: A range of 800 - 1500m wide dynamic buffer zones were developed, placed diagonally against the direction of wildfire threat. As these zones would require too many hectares of naturally vegetated areas (montane grassland, savanna or fynbos) at the expense of planted areas, it was decided to include both yearly-burned vegetation such as grassland (where available), as well as existing mature *Acacia mearnsii* stands within these zones. The latter proved to be highly resistant against fire as a result of the lack of forest floor biomass/available fuel inside mature stands.

Tab.1. Regional fire hazard grading used

Hazard Class	Hazard Description	Qualifying Categories
A	Extremely high fire hazard	Montane grassland irregularly burned Non-managed Wattle jungle Rural settlements situated on the dangerous, wind-exposed side
B	High fire hazard	Irregularly burned wetlands Industrial sites, e.g. sawmills Plantations consisting mainly of *Eucalyptus*
C	Medium fire hazard	Yearly burned montane grassland Yearly burned wetlands Plantations consisting mainly of *Pinus* Rural settlements situated on the less dangerous leeside
D	Low fire hazard	Overgrazed tribal land Managed *Acacia* plantations Yearly cultivated (ploughed) lands Cultivated mealielands Mechanically-prepared and sown, static, grazing camps

Prescribed burning inside stands was also introduced as a fuel reduction measure inside zones, while yearly weed control was also used to restrict fuel development, in stands too young for prescribed burning to be applied. Yearly-maintained roads, rivers with evergreen riverine forests, mountain forests and steep rocky slopes were also incorporated in buffer zones to make up the total area required, provided available fuel levels were sufficiently reduced to bring a high intensity, crowning and spotting wildfire down to a low intensity, manageable, surface fire.

A set of unique fuel models was developed for each forest region, to be used as a basis for site-specific fuel classification systems that could be used as input for BEHAVE runs required for fire behaviour testing (Burgan and Rothermel 1984). The regional plan also included a disaster management plan and regulations regarding the co-ordinated use of aerial and ground attack in the case of serious wildfires.

Plantation fire protection evaluation phase

Fuel modelling and fuel classification: The fuel classification system developed with the assistance of site-specific fuel models, using BEHAVE (op. cit.), also made it possible to arrive at actual and predicted fire hazard ratings at plantation level, which provided the information needed to arrive at more realistic fire protection requirements, particularly with regard to fire belt routes and width.

Mapping fire hazard rating: Present and future predicted fire hazard ratings were mapped, illustrating both the existing fire hazard, as well as the predicted status of fire hazard in the future. These maps made it possible to identify hazardous areas, to quantify fire hazard and to determine any predicted major shift(s) of fire hazard over time.

Evaluating existing fire protection measures: During this process all the previous studies conducted were considered, and note was taken of calculated fire protection requirements. A preliminary plan of action was then drawn up.

Integrated fire protection application phase

This is the application phase when recommendations were considered, conducted after the regional and plantation-level evaluation processes were completed. All proposed measures now had to be integrated with the conservation programme, the plantation working plan and other disciplines. Nature conservation plans and riparian zone management requirements were also successfully integrated into the revised fire protection plans.

3. Results

Fire hazard reduction and improved fire break placement

The fuel modelling/fire hazard rating mapping, at regional and at plantation level, proved to be an effective way in which fire hazard could be evaluated and used to reduce areas at risk in case of a wildfire. This was particularly true for the Melmoth district in the Kwazulu-Natal Province, which had experienced three major wildfires over a period of four years (destroying 2000-5000 ha at a time) before the new system was implemented.

The most important outcome of the Melmoth, and also Mpumalanga Highveld and North East Cape regional fire protection evaluation exercises was that, for the first time, regional fire protection systems could be placed across property boundary lines for optimum results.

Stopping major runaway fires

The regional buffer zones created have already resulted in stopping some major wildfires from entering plantations, where standard fire break systems (such as yearly-burned grassland fire belts) failed to do so in the past. Internal fires were also significantly restricted, particularly in the Melmoth and Swaziland regions.

Reducing plantation areas at risk

Plantation areas at risk were significantly reduced by more effective internal belt placement in conjunction with major buffer zone systems, aiming at reducing exposed areas to 300-500 ha protection units. In the Sappi Forests Highveld District, foresters managed to reduce the area at risk inside plantations with an average 37%, while simultaneously reducing fire break preparation costs with 25% and reducing the external risk of wildfire significantly. Similar success was achieved in other forest regions.

Integration of the conservation burning programme

In most cases the optimum burning rotation recommended for e.g. ecologically-sensitive wetlands is two to three years, while grassland burning requirements for fire protection purposes is a yearly fire application. This gave rise to conflicting needs for forestry and nature conservation. By re-scheduling the conservation burning programme, by means of applying prescribed burning in a specific mosaic sequence that fitted into the fire protection burning schedule, it was possible to satisfy both the plantation burning requirements as well as the recommended conservation burning policy.

Plantation fuel management

The selective use of prescribed burning inside plantation stands not only proved to be a cost-effective management tool for fire protection purposes, but was also used to introduce fuel reduction programmes where previously only the use of slash burning after clearfelling could be considered to reduce fuels. Chains of prescribed burned plantations of fire resistant species such as *Pinus elliottii*, *Pinus pinaster* and *Pinus taeda* were used to strengthen buffer zone systems along hazardous boundaries in a cost-effective way, replacing less effective hand, or mechanically-prepared, fire belts. *Eucalyptus grandis*, *Pinus patula* and *Pinus radiata* stands were sometimes also used for this purpose, but because these trees are more susceptible to fire damage, they could only be incorporated at older age, restricting prescribed burning application potential. However, in *P.patula* stands, further burning experiments are now being conducted first to determine the possible use of prescribed burning.

Fig.1. Pine plantations embedded in fire-prone environments, such as the *fynbos* ecosystems, are subjected to extreme wildfire risk without proper fuel management. Photo: GFMC/IFFN

Fig.2. Fires occurring at the wildland-urban interface are a common problem in Southern Africa and involve a high risk of property losses. Photo: GFMC/IFFN

Riparian zone maintenance

Water is a scarce commodity in Africa. The new system has also been used to advantage to correct wrong fire belt placement, to benefit both maximum water flow and optimum fire protection. This has resulted in a better long-term approach to riparian zone maintenance, as well as fire protection improvement, in the Usutu Plantations (Swaziland), and on the Mpumalanga Highveld and in the North East Cape (South Africa).

4. Conclusions

Practical application of the new, flexible, methods to improve fire protection have resulted in a few exciting success stories in Southern Africa over the last four to five years. Use of the new regional approach, and the application of a fuel modelling base, are now also being considered in various other Southern African regions.

The basis for the success was to move away from rigid, ineffective, fire belt systems, towards dynamic, (better placed) buffer zones, the incorporation of selective use of prescribed fire inside natural biomes and forestry areas.

The direct and indirect financial implications of the new system are substantial, but training and applied fire-related research will also have to form an integral part of the application of the new techniques.

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Proposed Co-operative Fire Management in the SADC Countries of Southern Africa

The member states of the Southern African Development Community (SADC) now consist of Angola, Lesotho, Mauritius, Namibia, Swaziland, Zambia, Botswana, Malawi, Mozambique, Republic of Congo and Seychelles.

In 1992, during discussions between representatives of the Forestry Sector Technical Co-ordination Unit (FSTCU) of SADC and USDA Forest Service, the possibility of a SADC-wide regional forest fire management system was raised. This led to terms of reference in 1994 for an investigation or review of the situation in each country, a report on the findings and recommendations that were discussed at a meeting in Lusaka in November 1995, attended by representatives of 11 of the then 12 SADC countries and by the project team, consisting of experts from the United States and Canada. The review was sponsored by the United States Department of Agriculture Forest Service and the Canadian International Development Agency (CIDA).

A follow-up report was produced in February 1996. This report contains recommendations leading to project proposals which are presented in some detail. I quote here the recommendations contained in the follow-up report:

SADC-Wide Recommendations

Chapter 3 of the ***SADC Regional Forest Fire Management System Review*** report details the following recommendations:

1. All resource management agencies involved with a fire responsibility need to adopt a proactive attitude to fire management. As a first step, a position should be dedicated to fire management at the national level and preferably at the regional and project levels as well. The establishment of these positions will provide accountability for the fire management program.

Status: accepted in principle by member states attending a workshop in Lusaka, Zambia, 21-23 November 1995.

2. SADC members should commit to building cooperative fire management arrangements with each other in order to accomplish their fire management objectives, as opposed to "going it alone". These arrangements should include sharing of resources, operational understandings on common border zones, joint participation in training initiatives, research and technology, and information exchange.

Status: accepted in principle by member states attending the workshop in Lusaka, Zambia, November 1995, and further developed in Project Proposal No.1.

3. FSTCU should arrange for a team to visit Angola to gather information regarding their fire management situation which could be included in an updated version of this report.

Status: completed with FSTCU visit to Angola in August of 1995 and subsequent publication of "Addendum to the SADC Regional Forest Fire Management Systems Review Project" in November 1995.

4. FSTCU should convene a meeting of SADC country forestry, national park and wildlife representatives to review this report and to chart a course for implementation of the Project Proposals.

Status: completed through workshop held in Lusaka, Zambia, 21-23 November 1995, attended by 11 of the 12 SADC member states.

5. Following the meeting mentioned in above (No.4), SADC should consider the need to develop a strategic action plan for implementing a fire management program in Southern Africa.

Status: to be addressed; accepted in principle at Lusaka workshop.

6. In the absence of comprehensive data on fire occurrence and extent at the national level in most countries, a regional program should be developed to monitor and report vegetation loss to fire.

Status: accepted in principle at Lusaka workshop and further developed in Project Proposal No.1.

At the Lusaka workshop it was further agreed that a seventh recommendation should be added as follows:

7. With the recent installation of membership to the Republic of Mauritius, FSTCU should arrange for a team to visit Mauritius to gather information regarding wildfire management in that country.

Status: while attending the workshop, Mr Appanah, Deputy Conservator of Forests for Mauritius, wrote a summary of forest fire conditions in Mauritius, from his perspective. This summary will be included as a separate chapter in the final report. Notwithstanding this, a fact-finding mission to Mauritius, arranged by FSTCU, should proceed.

Against the backdrop of the above recommendations, the delegates to the workshop considered, prioritized, revised and further developed the SADC-wide Project Proposals (Chapter 4). This report details the direction provided at the workshop.

I also quote the list of SADC Regional Wildfire Management Project Proposals, contained in the follow-up report:

SADC Regional Wildfire Management Project Proposals

Incorporating the direction and prioritization provided by the delegates to the Lusaka workshop, four Project Proposals, each with several Modules, have been developed:

PROJECT PROPOSAL NO.1 Regional Wildfire Management Coordination

Modules:
1A Wildfire Management Coordinating Group
1B FSTCU Wildfire Management Specialist
1C Wildfire Monitoring and Assessment Information System
1D Equipment Development and Acquisition
1E International Wildfire Agreements
1F Wildfire Weather Data Network

PROJECT PROPOSAL NO.2 Wildfire Personnel Training

Modules:
2A Basic Wildfire Suppression Training
2B Forestry College Improvements
2C Mid-Career Internships

PROJECT PROPOSAL NO.3 Wildfire Prevention and Public Education

Modules:
3A Wildfire Prevention Information Materials
3B Extension Training - Wildfire Management

PROJECT PROPOSAL NO.4 Operational Wildfire Research and Technology Transfer

Modules:
4A Prescribed Burning - Miombo Woodlands
4B Operational Fire Management Research - Zambezi Teak Woodlands
4C Wildfire Management Demonstration Centres

The costs for each Module have been estimated in U.S. dollars

Two of the SADC-wide Project Proposals from the original report, one proposing a Centre of Excellence (Proposal No. 9) and the other involving a Fuels and Fire Behavior Photo Series (Proposal No. 14), were not accepted by the workshop participants. Also six of the original Project Proposals were combined into three of the present Modules: Project Proposals 6 and 7 have been combined into Module 3B; 12 and 13 were combined into Module 3A; and 17 and 18 are now Module 1D. Module 1C, Wildfire Monitoring and Assessment Information System, is new and results from the SADC-Wide Recommendations.

After 1996, no further news or progress reports were received from FSTCU. When I was requested to present the current wildfire management situation in the SADC countries at the Wood for Africa 1999 conference in Pietermaritzburg on 10 June 1999, I attempted to obtain a progress report from FSTCU but was not successful in attempts to communicate. At the conference, Dr. Johann G. Goldammer of the Fire Ecology and Biomass Burning Research Group requested me to report on the SADC Wildfire situation for the UN International Forest Fire News. For this purpose I succeeded in communicating by E-mail with P.E.S. Mwale, Head of FSTCU, and was informed that the proposal to USAID to fund the implementation of the wildfire management proposals was declined.

FSTCU is still seeking assistance in implementing the projects that have been identified. Although donors dislike funding that cannot be taken over by the budgets of recipients, to avoid dependency, some of the projects are not of a kind to cause dependency when funded by donors.

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Remarks by the Editor: Chris Kromhout retired several weeks after the South Africa Wildfire Conference of June 1999.

NAMIBIA

Reduction in Fire Incidents in East Caprivi

Background

A pilot area was established in 1996 in north-eastern Namibia to develop a Model for community based forest fire control. The pilot area consisted of 1.2 million ha of the best forests of Namibia and it belongs to the sub-tropical region. Despite that the area belongs to the Kalahari zone, the relatively high rainfall (700 mm) keeps the forests growing.

Prior to the involvement of the Government of Finland the forests in the pilot region burned at a rate of 850,000-950,000 ha each year. Around 99 % of all these fires were of anthropogenic origin.

Expansion of the community-based forest fire management model to other regions

The Model for community-based forest fire management (Integrated Forest Fire Management [IFFM]) was developed in East Caprivi. This Model proved to be very successful as it reduced the fires by 54%. Therefore, it was recommended to expand the project area to cover West Caprivi and Kavango. This means that forest fire control activities now will cover 7 million ha in the Northeast of Namibia.

Strategy

The project is still embarking on two different approaches to the fire problem:

* to support public relations and extension activities for forest fire prevention within the Government and the training and mobilizing of local communities into fire management units, and
* to run a massive fire awareness and public education campaign in schools and local organizations in the area, involving all stakeholders. This includes the production of written material, posters, bill boards, theatre plays, radio programmes and videos.

Thereby, at present moment, the activities are directed towards the source of fire, i.e. the local people. The strategy adopted, will teach people in local communities in how to use fire in a controlled manner and how to prevent wildfires.

Tab.1. Outputs of Integrated Forest Fire Management activities in East Caprivi between 1995 and 1998. Note: The programme by the Finnish Government to assist the Directorate of Forestry of Namibia to control forest fires began in April 1996.

Output Areas	**Conventional Government run Forest Fire Control**	**Development of Integrated Forest Fire Management**	**Development of Integrated Forest Fire Management**	**Development of Integrated Forest Fire Management**
	1995	**1996**	**1997**	**1998**
1. Total area burned in East Caprivi	838,000 ha	790,000 ha	558,000 ha	390,000 ha
2. Area of East Caprivi burned (%)	99 %	91 %	67 %	47 %
3. Reduction in burned area (%)	0.2 %	6.0 %	24 %	54 %
4. Area under forest fire management	10,000 ha	115,000 ha	396,000 ha	636,000 ha
5. Area covered by fire management (%)	2 %	14 %	48 %	76 %
6. Area protected from fire by D.o.F.	2000 ha	-	-	-
7. Area protected from fire by local communities	none	50,000 ha	202,000 ha	450,000 ha
8.Effectiveness of fire prevention in managed areas	20 %	44 %	51 %	71 %
9. Number of communities /stakeholders	none	7 + 2 DBC + 13	23 + 6 DBC + 42	28 + DBC + 24 + 64 [1]
10. Fire lines or fuel breaks built (cutline)	150 km	487 km	1217 km	1812 km
11. People involved in fire control activities	30	300	525	1000
12. Number of fires observed	10.000 +	6000-8000	4000-6000	3000-4000
13. People educated in forest fire control	none	7500	13,000	33,500
14. Total area burned **in Namibia** including prescribed burning in National Parks	3-5 million ha	3-5 million ha	2.1 million ha	2.0 million ha (estim.)

[1] Number of stakeholders involved in assisting the Directorate of Forestry (D.o.F.) in forest fire prevention activities during 1998 were: 28 local communities (16 contracted), 2 DBC camps (ex-combatants), 24 handicraft producer villages (under the Caprivi Arts and Cultural Association (CACA) and 64 schools.

Fig.1. Community women have collected grass for roofing. Each bundle sells at US45 cents. A fire-damaged deciduous forest can be seen in the background. Photo: Jerome Mukutolo, IFFM, Katima Mulilo

Fig.2. IFFM instructors teaching local villagers in the protection of their grass collecting areas. Stored grass (thatch) in the picture is worth ca. $US450. Photo: Jerome Mukutolo, IFFM, Katima Mulilo

As the above table indicates, the results of creating a model for controlling fires in communal lands in Caprivi are encouraging. Thus, by the end of 1998, the new Caprivian Model for Integrated Forest Fire Management (IFFM) has been extensively tested and found effective. However, what still remains to be done, is that a final assessment of the model be made before it is being transferred to other fire prone areas in northeastern Namibia.

Field survey among local communities

As Table 1 shows, tens of thousands of local people are involved in fire prevention. The result is that the annual area burned has been reduced by 54% in the Pilot Area. Also the number of fires has dropped by 70%. It was therefore decided to carry out a survey to ask the local population of how they experienced the efforts to control fires in the local communities. The survey gave the following results related to the control of fires in the communities:

* the effects of fire on the environment were widely recognized
* fire protection should be given to communities rather than to the government
* availability of grasses and thatch has increased
* increased income has been generated from sales of grass etc.
* availability of building material has increased
* plants and trees are healthier
* more food is available for people from the forest (fruits, nuts etc.)
* more food is available for livestock
* income from sales of animals has increased
* less diseases in livestock
* no livestock or agri-crops killed by fire in pilot villages
* increased wildlife in villages controlling fire

During the fire season (April-November) in 1999 it is estimated that 1500 villagers are engaged in controlling wildfires in north-eastern Namibia. In addition 1000 teachers and a total of 30,000 students have received basic fire education.

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Update on the Southern African Regional Science Initiative - SAFARI 2000

SAFARI 2000 continues to progress in its development. With the successful completion of the NASA EOS SAFARI 2000 workshop, regional and international participants gathered at the SAFARI 2000 Regional Implementation Workshop in Gaborone, Botswana, 26-30 July 1999. At the time of prepring this ssue of IFFN the results of the Gaborone Workshop are not yet available. Thus, the SAFARI 2000 Executive Summary reflects the state of preparation of mid 1999. Those interested in update information are kindly requested to visit the website:

< http://safari.gecp.virginia.edu >

The SAFARI 2000 Executive Summary as well as the NASA EOS SAFARI 2000 Workshop Summary are given below.

SAFARI 2000 Executive Summary

The Southern African Regional Science Initiative - SAFARI 2000 - is an international, collaborative science initiative aimed at developing an integrated understanding of selected aspects of the southern African earth-atmosphere-human system. The foundations of the study were laid during June and July 1998 at a series of stakeholder workshops involving scientists from southern Africa, the United States and Europe. The goal of SAFARI 2000 is to identify and understand the key linkages among the physical, chemical, biological and anthropogenic processes underpinning the functioning of the biogeophysical and biogeochemical systems of southern Africa.

This initiative will explore and study the linkages between land-atmosphere processes, principally the biogenic, pyrogenic and anthropogenic emissions occurring in the region, their transport and transformations in the atmosphere, their influence on regional climate and meteorology, and their eventual deposition and its effects on the functioning of the ecosystems of the region. To this end, SAFARI 2000 will

* exploit the synergy between remote sensing, modelling, airborne sampling and ground-based studies;
* use the semi-closed sub-continental anticyclonic circulation system as the mechanism linking the biological, physical and chemical components of the regional ecosystems; and,
* combine the expertise and knowledge base of regional and international scientists.

SAFARI 2000 follows on the success and builds upon the scientific legacy of the Southern African Fire-Atmosphere Research Initiative in 1992 (SAFARI-92). SAFARI-92 showed (a) that with a concerted effort it is feasible to quantify and validate regional emissions, and (b) that our understanding of the impacts of these various emissions needed further study. As a result, at the core of SAFARI 2000 is an experiment to quantify and validate these regional emissions, thereby providing the basis for the study of the impacts of those emissions on the biogeophysical system.

SAFARI 2000 is a coalition of related regional and global environmental change research efforts being undertaken or planned by the African, U.S. and European science communities for the period 1999 to 2001 in southern Africa. They include initiatives that are already funded and underway; planned initiatives for which funding is being sought; and some that are still being formulated. SAFARI 2000 encompasses the following science elements with contributions from both ground-based and airborne activities: land processes; land use and land cover change; terrestrial ecology; aerosols and trace-gas chemistry and transport; surface radiation; cloud characterization and radiative effects; and hydrology. The ground and airborne measurements will be complemented by remote sensing observations from the new generation of earth observation satellites, such as the NASA TERRA platform scheduled for launch in July 1999, Landsat 7 and TRMM. In turn, the earth and atmosphere based observations of SAFARI 2000 will help validate the remotely sensed satellite observations on a regional scale.

These linked, short and long term field campaigns will measure and model biological, soil, atmospheric and radiation processes, using the existing ground-based and upper air monitoring networks, as well as airborne and remote sensing activities, for additional leverage. The international regional science networks developed

within the region under the auspices of IGBP and START will participate in the initiative and will be the mechanism for broader African scientific involvement.

SAFARI 2000 will be conducted over a three-year period starting in 1999 with three intensive ground and flying field campaigns:

August-September 1999 dry season:

identify and quantify major dry-season sources of emissions including those from biomass burning, land use, and industry.

February-March 2000 wet season:

identify and quantify major wet season sources of emissions (e.g. CH4 from wetlands and NMHC from plants).

August-September 2000 dry season:

track the movement, transformations, and deposition of dry-season emissions from biomass burning and other sources.

Each successive campaign will increase the level of international collaboration. Ground-based efforts will be co-ordinated to maximize overlap in the observations and for maximum logistical efficiency. Intensive meteorological and remote sensing measurements will support the campaigns throughout.

The integrated and synthesized products of SAFARI 2000 will be available during 2001 and will contribute to improving the scientific basis of the International Panel on Climate Change (IPCC) assessments for the region. The results will also contribute to the development of improved policies and practices for the management of regional air quality. Regional scientists will benefit through heightened recognition, enhanced capacity, and the transfer of technology. This in turn should help in formulating appropriate policies and responses to manifestations of climate change and to international treaties relating to global environmental issues. The policy and societal relevance of the scientific results of SAFARI 2000 will be addressed through an ongoing series of workshops to be held in conjunction with various regional networks. One such workshop, the Policy Dialogue Workshop on Ecological Impacts of Trans-boundary Air Pollution in Southern Africa, organised by the ***Air Pollution Impacts Network for Africa*** (APINA), has already been held. Others will follow.

SAFARI 2000 has an internal and external data sharing policy. Information will be disseminated regionally and internationally via the internet as well as through the distribution of CD-ROMS. The results from SAFARI 2000 will also provide a knowledge base to support the assessment of global change on a regional scale.

Summary of NASA EOS SAFARI 2000 Workshop [2]

Overview

The Southern African Regional Science Initiative, SAFARI 2000, presents an opportunity to study global change issues on a regional scale in a comprehensive fashion. A level of excitement exists at the prospect of coordinating and leveraging off of existing inter-agency and international research activities in Southern Africa to successfully conduct SAFARI 2000. As part of the progression in the coordination and planning of this regional science initiative, North American and Southern African scientists came together to participate in the NASA EOS SAFARI 2000 workshop held during 12-14 May 1999 at the National Center for Atmospheric Research, in Boulder Colorado.

The purpose of the Workshop was to review the SAFARI 2000 science plan; identify specific measurement

[2] Contributors: Bob Swap (contact address at the end of paper), Tim Suttles, Michael King, Harold Annegarn, Bob Cook, Jim Drummond, Bill Emanuel, John Gille, Peter Hobbs, Chris Justice, Luanne Otter, Stuart Piketh, Steve Platnick, Jeff Privette, Lorraine Remer, Gary Shelton, and Hank Shugart

needs and critical gaps in that plan; define and coordinate aircraft platforms and activities; plan and coordinate US contributions to the **SAFARI 2000 Implementation Meeting** in Gaborone, Botswana, during 26-30 July 1999. Participants in the workshop numbered approximately 60 and were affiliated with various universities and national government agencies.

The Boulder Workshop was conducted over 2 1/2 days. Day 1 was devoted to a review of the evolving plans for the science initiative, the status and progress of funded and planned investigations, and keynote presentation on each of the core elements of the Science Plan. These reviews and presentations set the stage for activities on Day 2, which included Discipline Breakout Groups to address the strategy for core element activities and potential gaps and Airborne/Surface Measurement Breakout Groups to address the measurement requirements and capabilities. On the final day of the workshop, Implementation Breakout Groups met to define approaches for coordinating and integrating activities of the science steering committee, the airborne operations teams, and the ground-based measurement teams. Reports were presented on the breakout group deliberations and other discussions were held on coordination between US and in-region research activities; identification of potential collaborative partnerships; data policy and principles; and Memorandum of Understanding, Letter Agreements, and International Protocol needs. The final session concluded with writing assignments to key participants with the objective of converting the workshop results into a U.S. Implementation Plan for SAFARI 2000.

The vision of SAFARI 2000 was presented with the breadth of that vision having followed, in part, from the remaining unanswered questions from SAFARI-92. Those questions focus on: total emissions and magnitude of different emission sources; varying emission estimates and the validation of these estimates; temporal, spatial, chemical and optical characteristics of the regional atmosphere as related to these emissions; and impacts of these emissions on biogeochemistry, radiative forcing, air quality and rain production. The concept of a SAFARI 2000 Core Experiment to address many of these unanswered questions was presented (Fig.1). The Core Experiment aims to study aerosol and trace gas emissions, their transports and transformations, their deposition and their impacts in Southern African as determined by ground-based, and in-situ and remotely sensed airborne measurement campaigns. The SAFARI 2000 Core Experiment is comprised of the following core elements: Terrestrial Ecology; Land Cover and Land Use Change; Aerosols; Trace Gases; Clouds and Radiation; and Modelling. Research and EOS validation activities associated with each of the core elements were discussed by the discipline specific breakout groups.

There was some concern in the breakout groups, given the workshop attendees present at Boulder, about being able to address some of the objectives of the Science Plan to a sufficient level. The breakout groups identified the need to involve a broader community of scientists to discuss ways to achieve some of the objectives of the Science Plan. In particular, the groups identified the need to strengthen the modelling activities (e.g. interdisciplinary modelling, integrated modelling, transport modelling, and ecological modelling). Such issues should be addressed at the upcoming workshop in Gaborone.

A proposed Management Structure for US participation was presented and couched within the existing SAFARI 2000 management structure. This will be developed for review at the Gaborone workshop. Guidelines for participation in SAFARI 2000 were also presented. The need for interactions and negotiations between US and regional scientists to be facilitated by the regional and US SAFARI 2000 secretariats was also stressed. Adherence to established international protocols regarding Memorandums of Understanding, overflight permissions and mutually agreeable shipping procedures were also discussed. The US international agreements are to be worked by the NASA Office of External Relations and facilitated by the regional SAFARI 2000 secretariat.

Discipline Breakout Groups

Three discipline breakout groups, Land-Modelling And Data, Aerosol - Clouds and Radiation, and Trace Gases, were given the charge to evaluate the core experiment concept and to identify research areas deemed important and not yet sufficiently addressed by SAFARI 2000. These breakout groups discussed existing data sets, funded projects and proposed projects related to SAFARI 2000. The workshop participants generally reached consensus regarding the broad science goals, the core elements and associated activities, and the idea of a core experiment associated with SAFARI 2000, but it was concluded that questions remain concerning informational and personnel gaps in the initiative. The workshop participants stressed the importance for getting cooperation between measurements and modelling groups. While many of the research activities were

viewed as relatively straightforward in terms of the development of a research strategy, others that were perceived as having high science benefit required more discussion and input from researchers with a different complement of expertise than was present at the workshop.

There was general consensus on several cross-cutting needs:

* Need for an interdisciplinary modelling component examining interactions over several time and space scales;
* need for modest resources to support the integrating modelling activities associated with SAFARI 2000; and
* need to further strengthen research components that link surface emission processes of aerosols and trace gases to the atmospheric chemistry and transport of free troposphere via the planetary boundary layer.

Specific activities requiring additional attention and strengthening include:

* Flux tower measurements of trace gases (CO_2, O_3 and reactive nitrogen species) and aerosols at both the Mongu and Skukuza micrometeorological tower sites;
* deposition studies, especially those studies focusing on the dry deposition of aerosols; and
* atmospheric profiling of the boundary layer and troposphere via balloon studies, acoustic sounders and additional rawinsondes.

A number of proposals are currently under development to address some of these needs. The most likely funding sources appear to be the NASA Research and Analysis Program and the National Science Foundation. The South African Weather Bureau agreed to construct a proposal to submit to national, regional and international funding agencies for the procurement of additional rawinsondes to augment daily ascents performed routinely by regional meteorological services.

The Land/Modelling Breakout Group stressed the need for in-region field observations during the initial phase of the growing season. Flux tower and aerosol and trace gas deposition data, especially for carbon, nitrogen and sulfur for incorporation into site specific and regional models was stressed as a programmatic need. Involvement of the vegetation canopy lidar instrument team in SAFARI 2000 was highly desirable for the determination of canopy structure and fuel load. The need for climate data records, AVHRR archived data and hydrological data in terms of soil moisture and rainfall was also articulated. The involvement of the Tropical Rainfall Measurement Mission (TRMM) and their data products in SAFARI 2000 was seen as highly desirable. The possibility of using the gauged Vaal River catchment and the South African Weather Bureau's (SAWB) overlapping radar network to validate the TRMM products for the southern African sub-continent was identified has a possible project that could produce a significant test of our understanding of the hydrological cycle. There is a possible modelling comparison exercise that would make use of a benchmark data set collected along the Kalahari Transect that could provide an important regional-scale test of the current site of dynamic global vegetation models. A clearly defined source of funding to support the necessary integrative and interdisciplinary modelling exercises required by SAFARI 2000 is needed. Data issues focused on the use of the Oak Ridge National Laboratory Distributed Active Archive Center (ORNL DAAC) on the US side and a regional mirror data site, most likely to be located in Botswana to handle and disperse the data collected in SAFARI 2000. It is planned that the establishment of a mirror data center with meta-data links established by regional participants will be clarified at the Gaborone meeting.

The Aerosol-Cloud and Radiation Breakout Group discussed objectives centered around the physical and chemical characterization of aerosols and their radiative effects, linking aerosol characteristics to fire sources, and cloud-aerosol interaction in maritime clouds. The implementation strategy required to address those objectives was viewed as straightforward. In terms of objectives focusing on the evolution of physical, chemical and optical properties of aerosols, biogenic aerosol, and cloud-aerosol interaction in continental clouds, the implementation strategy is not yet clear, but discussion has commenced. Similarly linking aerosol and cloud studies to ecological modelling, requires further attention. This group also requested additional ancillary data in the form of rawinsondes and dropsondes as well as access to data sets from the NASA Data Assimilation Office (DAO) and the SAWB. Input from transport models is also required for mission planning and post -intensive data analyses. A suggestion was made that those researchers who have the expertise to tie aerosol transports and deposition to ecological modelling provide the leadership necessary to address this goal

of SAFARI 2000.

The Trace Gases Breakout Group was able to make significant advancement in meeting the charges given to them during the workshop. Through their extensive discussions and deliberations, they were able to produce a number of recommendations to the SAFARI 2000 steering committee. Chief among them were the following:

* Strong need for compilation and maximum utilization of existing databases that include a variety of forms of printed material, CD publications and electronically stored data;
* the formation of a measurement-modelling liaison working group to aid in the designing of in-situ flight plans and sampling strategies;

* need to measure dew composition and precipitation concentration to address issue of dry and wet aerosol sinks;

* the study of frequency and intensity of lightning as a measurement of opportunity to aid in determining the production of NO_x;

* need for inter-comparison of airborne and spaceborne systems;

* enhancement of existing meteorological infrastructure within the region - augmentation of upper air sondes and trajectory analysis support.

* the need to better constrain estimates of the contributions of biogenic emissions to the budgets of aerosol and trace gases in the region.

Additional points included the need to understand biogenic hydrocarbon production, especially during the critical time of vegetation leaf out. The Trace Gases working group also identified a number of questions and implementation strategies to address those questions in their group report.

The discipline groups, especially the Land-Modelling and Data group, expressed the need for involvement of regional scientists and their scientific input especially in the areas of identification of surface sites and processes of scientific interest to the SAFARI 2000 effort. There was also a feeling that those investigators new to the region should familiarize themselves with the science and data products of existing research efforts. Along these lines, it was suggested that those researchers in need of such information should contact the SAFARI 2000 webpage (http://safari.gecp.virginia.edu) and /or the regional coordination secretariat. The general feeling during the Boulder workshop was that the Gaborone meeting is an important vehicle to further interactions, discussions and negotiations involved with SAFARI 2000 collaborative research activities, especially in the area of strengthening the land components with the objective of being able to collaborate with local experts and further develop logistical arrangements.

Aircraft Breakout Groups

SAFARI 2000 intends to use the atmospheric gyre as a physically integrating mechanism. This is beneficial in that southern African climatologies exist that allow for the establishment of a relationship between information in the long-term satellite record and the local observation sites. Airborne measurements are essential to achieve the goals of the experiment. Aircraft platform availability and participation were discussed in detail. The platforms committed to involvement in SAFARI 2000 include the NASA ER-2; the University of Washington Convair 580; and the South African Weather Bureau Aerocommander 690s. The opportunity to have the Proteus, a newly-developed, high-altitude, high-endurance remote sensing platform received much interest by the workshop participants. Its availability to SAFARI 2000 is subject to the Proteus team's success in securing additional resources.

Consensus was achieved among key US and regional scientists to consolidate the scientific decision making processes related to airborne operations during August-September 2000 campaign at Pietersburg, RSA. Coordination, communications and planning associated with aircraft missions will be conducted through the SAFARI 2000 aircraft mission control center at Pietersburg. For aircraft planning at the control center, it is essential to have daily meteorological forecasting and access to Meteosat Satellite Imagery. To initially facilitate this project coordination and planning, the August - September 2000 flying campaign will begin with all of the aircraft involved with SAFARI 2000 based at Pietersburg for at least one week.

The In-Situ Aircraft Group focused on design of the SAFARI 2000 dry season airborne campaigns. The experiments requiring in situ observations include:

∗ Terra Underflights - radiometric calibration and data product validation for aerosol retrievals, smoke/cloud masking, and fire detection and characterization;

∗ Namibian stratus studies - cloud retrievals and indirect effects;

∗ Biomass burning studies - "box studies", fire emission factors, chemical, physical and optical evolution of emissions downwind of fires;

∗ Industrial source studies - flights of opportunity looking at possible direct and indirect forcing effects.

The types of proposed flight tracks to meet the above needs are as follows:

* Cross-section wall flight sampling of the gyre with multiple aircraft

* Probe investigation flights of the gyre, both Lagrangian and Eulerian, by single aircraft

* Biomass burning flights - fire detection and smoke/emission sampling flights

* Coordinated flights involving remote sensing observations platforms (satellite, ER-2, Proteus) and in-situ observational platforms (Convair 580, Aerocommander 690A's)

* Marine Stratus

* Overwater flights

The various logistical needs for these different flight missions were discussed. There was general agreement concerning the utility of convening an airborne planning simulation exercise to be held in the region early next year in preparation of the August-September 2000 intensive flying campaign.

Recommendations

Summary Recommendations were arrived at from the various discussions during the meeting:

* Need for the additional involvement and funding of interdisciplinary, integrative modelling activities linking land and atmosphere

* Need to strengthen links between ground observations and airborne observations

* Augmentation of regional rawinsonde network to profile the free troposphere

* Acoustic sounder and pilot balloon studies to describe the planetary boundary layer

* Instrumentation of existing towers for flux studies of heat, moisture, momentum and aerosols/trace gases to describe interactions between vegetation and boundary layer

* Aerosol and trace gas deposition studies to detail atmospheric contribution to vegetated systems

* Involvement of a TRMM validation activity within SAFARI 2000 was deemed highly desirable

* Coordination of all US-sponsored activities in SAFARI 2000 through the regional secretariat office and compliance with protocols and international agreements for in-country research

* Need for funding to support regional scientists, outside of South Africa to participate in SAFARI 2000

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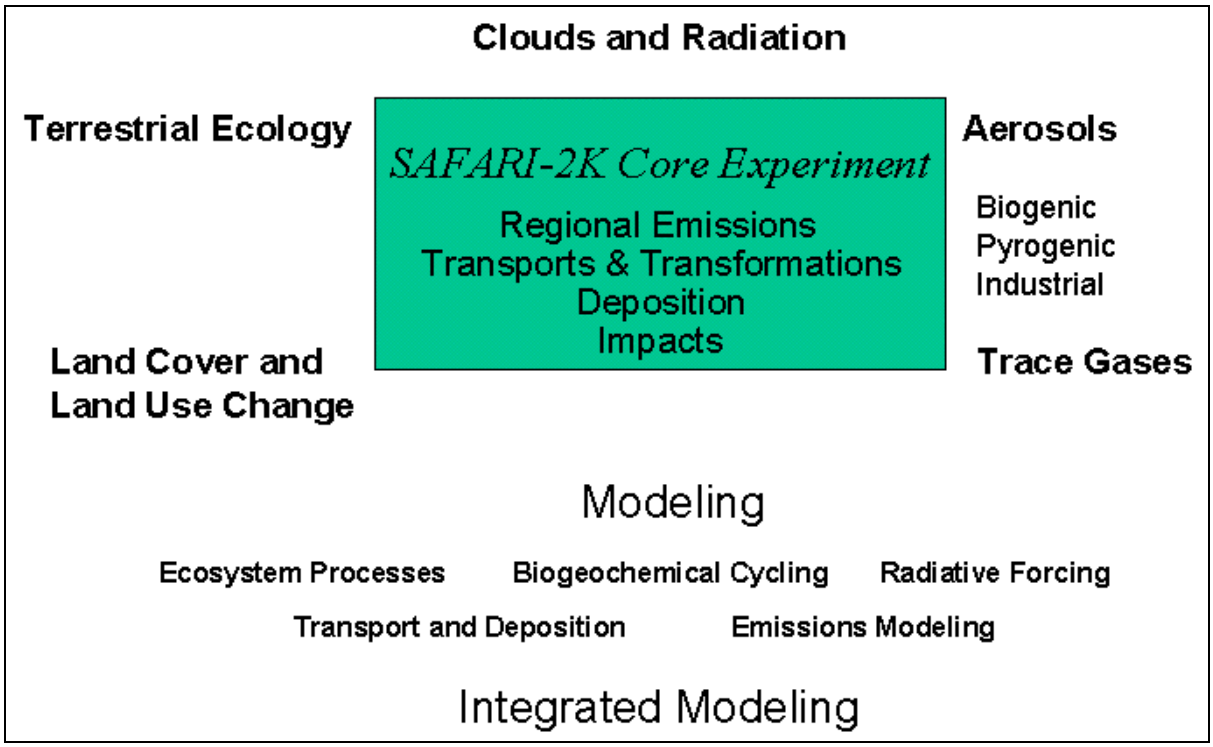

Fig.1. Schematic of SAFARI 2000 Core Experiment

COUNTRY NOTES

PEOPLE's REPUBLIC OF CHINA

Review of 1998 Forest Fire Season and the Spring 1999 Fire Situation in China

1998 Forest Fire Statistics

In 1998, the total number of forest fires occurred in China were 4,455, the total forested area damaged was 27,424 ha. There were 38 people killed and 78 wounds due to the fires. Compared to 1997, the number of the fire increased by 80.7%, but the damaged forest area decreased by 22.6%. Only one large fire occurred in Inner Mongolia in spring.

Serious Situation in 1999

From the beginning of the 1999, an unusual drought occurred throughout the major parts of South, Southwest, East and North China, and created conditions favourable for the ignition and spread of forest fires. According to preliminary (not yet completed) statistics, only in the period of January and February, 2,073 forest fires broke out, which damaged 12,191 ha of forested areas, and accounted for 3.7 times and 9.5 times increases in comparison with the same period in 1998. Remarkable casualties were reported from these fires. The fatalities and injuries were 33 and 198, while in the same period last year, it was just 1 and 32. It has been rarely experienced for most recent years in China that the fires come so rapidly and the damages resulted so seriously. By analyzing the reasons of the disastrous situation, the following characteristics are noted:

Unfavourable climate conditions: High temperatures and very low precipitation in most parts of China started in the winter of last year and continued to this spring. The day with strong winds increased. All these factors caused high and long-lasting fire hazard.

Forest fuel accumulation: From last summer, the temperature had kept high and sufficient rains had been down in most part of the country, some of where even flooded. These conditions promoted rich growth of grass and bush vegetation, which, particularly inside and around the forests, have contributed to the availability of dangerous fire fuels in the current fire season.

More human-caused fires: After the floods the needs for wood materials and number of people entering the forest increased, despite the fact that cutting limitations were issued in natural forests. Increased presence of people in the forest contributed to a high ignition risk which was difficult to control.

Forest fire control equipment shortage: Flooding occurred in most forest areas last year and had badly damaged the fire control facilities, e.g. roads, bridges, fire check spots, communication infrastructures etc.. These facilities could not be renewed in a short time and these circumstances have greatly reduced the capabilities in fire prevention and suppression.

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INDIA

Forest Fire and its Prevention by Generating Environmental Awareness in the Rural Masses

Introduction

Forest fires that are natural or man made play a significant role in ecosystem dynamics. Recurrent fire decreases the green cover through prevention of regeneration and leads to the slow death of the forest. It also increases erosion and alters the physical and chemical properties of the soil, converting organic ground cover to soluble ash and modifying the microclimate through the removal of overhead foliage. The soluble ash is washed away in the next rain. Fires can also make trees more susceptible to insect attack.

Fire is one of the early tools man used in his struggle to master Nature. But when a blaze is out of control it is dangerous. Forest fires cause a lot of damage to the ecosystem. Soil composition is affected, the quality of forest produce declines and wildlife is destroyed. "The incidence of forest fires in the country is high. Trees and fodder are destroyed on a large scale and natural regeneration is annihilated by such fires. Special precautions should be taken during the fire season. Improved and modern management practices should be adopted to deal with forest fires" says the National Forest Policy, 1988 in a special mention about forest fires. These fires cause irreparable loss to both tangible and intangible benefits from forests. Fire reduces the quality of forest produce, renders forests prone to diseases, degrades soil composition, decimates soil microbes, smothers regeneration and destroys wildlife.

A fire causing incalculable damage to the ecosystem as a whole can be termed as a forest fire. Such a fire is common in almost all types of our forests barring some wet evergreen patches. The fire season usually coincides with the hot summer which extends from January to April. The damage depends upon the frequency and intensity and the type of the forest, availability of fuel and the local climatic factors.

Forest fire and its management have long history in Indian Forestry. In 1954, the Chief Conservator of Forests of Madhya Pradesh Mr.C.E.Hewetson stated "*the conception of forest fire protection was one of the most creative and far reaching in its effects. Not only was it essential to allow the drier forest to regenerate, but it was and it is the most powerful single weapon in soil conservation. It was a tragedy that this idea of complete fire protection was gradually eroded away by the urge for economy in expenditure*." The most successful method of fires protection in the past used to be an elaborate network of fire lines, block-lines and guidelines, and their early clearing and burning. This system used to work very well and still does when population pressure on the forest is low. With increasing human population in and around forest areas, and their dependence for fodder, fuel wood and other non-timber forest produce, the traditional systems of fire control no longer works effectively. The human resources available with the forest department have not increased with increasing human pressure on the forest. On an average in India, nearly 500 ha of forest have to be patrolled by one guard and one watcher!

Background

Western Ghats in Southern part of India gives a salient fascinating features of the rich biological diversity of the Indian sub-continent. The forests of Western Ghats increasingly well documented and a place of attraction for biologists, tourists, environmentalist, painters for its exceptionally high level of biodiversity, endemic flora and fauna with beautiful landscape. Apart from biological values, the mountains are essential water catchments for large part of Tamil Nadu state for its agriculture, hydro-power and industrial needs.

Since independence in 1947, India has suffered a rapid depletion of forest resources. Some 75 million ha are officially classified as forest land, but according to the 1987 Forest Survey of India (Ministry of Environment and Forests 1987), the actual forest cover is 64.2 million ha. This is equivalent to only 19.5% of the total land area, whereas the National Forest Policy (MOEF 1988) set a goal of at least one-third (approximately 110 million ha) of total land area under forest cover for ecological stability. Moreover the existing resources are subjected to severe biotic pressure, owing to the fact that less than 2 percent of the forest area in the world, the country supports over 15 percent of the world's population and nearly 14 percent of the cattle (Saigal 1989)
In India, forest fires are the significant and increasing contributory factor in the degradation process, although

the extent of total damage is widely disputed. According to a study made during 1989, during the sixth Five Year Plan (1980-85) 17,852 fires were reported affecting an area of 5.7 million ha or an annual average of some 1.14 million ha (Saigal 1989). Even this range may be regarded as conservative. Data collected by the Forest Survey of India indicate that the forest area that is affected by annual fires may be as high as 37 million ha (Ministry of Environment & Forests 1987).

Local people have observed how the tropical forests have been destroyed from their area day by day. Pappammal, a 65 years _ old lady from Thekkampatty village who got the National award for growing trees in her land said fire is the only major factor for destruction of their forests. She said that local cattle graziers often set ablaze grazing areas in the hope of getting new shoots. The head load carriers destroyed vegetation to create pathways through the forests. Encroachers often set fire to forests in order to clear the land and for NTFP collection by the tribals and the villagers. The careless tourists could set off forest fires throwing away lighted matches or cigarette butts. It damages not only the trees and tiny herbs but also wild animals. Venkateswaran (57 years) an old man from the village Mangalapalayam expressed his experience: "*If the tree is cut, it can regenerate by means of coppice, if it is fired, it is dead - never grows…It was the terrible day of April 1992, when I was at Kodaikanal, throughout the night I observed the leaping flames of fire. My excellent 5 years old plantations within the forest was entirely ruined. I was helpless, just I could not stop the fire despite of the best effort with our staff*".

Rainfall has direct relation with occurrence of forest fire in the area. Every year we frequently come across fire in our forest during the months of February to May. Two years back in 1994, there was good rainfall. But this year as the rainfall was not enough, chance of getting fire in the forest was too high. But due to our community initiatives till now no fire incidence has been recorded from our forest" said the president of Thekkampatti Fire Protection Committee.

With the collaboration and joint initiative by the villagers and Forest department staff, an innovative forest fire protection movement was started in Coimbatore Forest Division (Fig.1) in 1995. There are 23 such committees protecting 69,347 ha of tropical forests. In the Government record from last 1991 to 1995 there were 119 fire incidences and 486.65 ha of forest area had been destroyed which was about 0.64 per cent of the total area.

The essence of fire prevention is nothing but breaking the fire triangle which is composed of fuel, air (and other climatic factors) and ignition source. A socio-cultural and psychological reorientation is necessary. The actual implementation of fire prevention measures, motives of the local people has to be understood deeply and to appreciate their problems. For this, apart from the knowledge in technical forestry, a sound understanding of the social system is important.

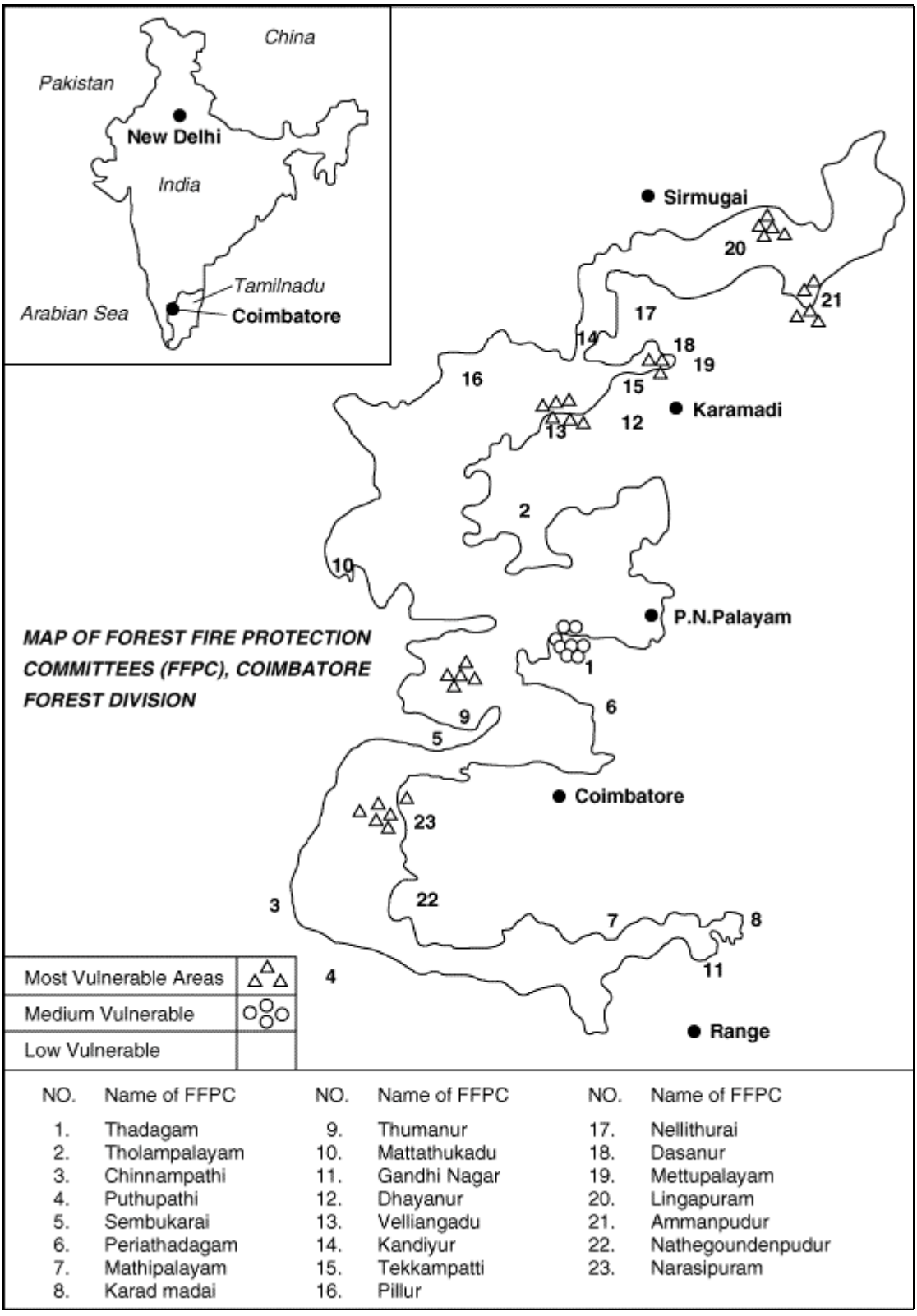
The present case study on participatory fire control strategies attempts to document the local initiatives in collaboration with the Forest department in prevention and management of forest fire which has been an important factor in the forest ecology.

The Site

* Land and People

The Irular, a tribal community, settled in the different pockets of forest areas of this region is entirely dependent on the forest and its products for their livelihood.

Ramaswamy, Headmaster of Sirumugai village and the president of Lingapuram forest fire protection committee, recalls how life, in this once-remote area has changed during the past two decades. Sandal trafficking, commercial logging,in-migration and the population pressure have influenced the area and resulted in deforestation, severe soil erosion, poverty among the villagers and fires which have rapidly destroyed the environmental stability and productivity of western Ghats. Many of the villagers still remember the year 1984 when bus service started in the area, they could get the first opportunity to visit district town. That was the beginning of their outside contact and modernization which they are not sure weather has done good or bad to the community, perhaps it has done both.



NO.	Name of FFPC	NO.	Name of FFPC	NO.	Name of FFPC
1.	Thadagam	9.	Thumanur	17.	Nellithurai
2.	Tholampalayam	10.	Mattathukadu	18.	Dasanur
3.	Chinnampathi	11.	Gandhi Nagar	19.	Mettupalayam
4.	Puthupathi	12.	Dhayanur	20.	Lingapuram
5.	Sembukarai	13.	Velliangadu	21.	Ammanpudur
6.	Periathadagam	14.	Kandiyur	22.	Nathegoundenpudur
7.	Mathipalayam	15.	Tekkampatti	23.	Narasipuram
8.	Karad madai	16.	Pillur		

Fig.1. Map of Forest Fire Protection Committees (FFPC), Coimbatore Forest Division

The area has never got high rainfall. The average rainfall is 750 mm along the plateau and at the foothills. The plains of Nilgiri hills are subjected to very hot and dry climate. In the villages the population has increased ten times over the past fifty years. Though the rainfall is scanty, significant improvement has taken place in agricultural productivity due to the Lower Bhavani river project. Though the rainfall has decreased as compared to early days, the changed land use pattern and the irrigation projects have resulted in better farm productivity.

*** Forests**

Historically the area is famous for its growth of teak, rosewood, Vengai, sandalwood and tamarind which were continued for a number of years as a main source for timber and other products, even after the British acquired possession of the forests. During early 19th century at the time of the construction of South Indian Railway, large number of timber trees were extracted for sleepers. In 1960, large scale coup felling was done in this area.

Local villagers were used to collect the entire range of non-wood forest products (NWFP) from this tropical forests. Tamarind used to be the most important forest produce.It accounts for nearly 25 per cent of total revenue from all NWFP's put together. The barks of Langal (*Cinnamomum zetlanicum*), Kolamavu (*Machilus macrantha*), Nellikai (*Emblica officinalis*), Mohwa (*Madhuca latifolia*) wild jacks, wild mangoes and a range of medicinal plants was the asset of the forest.

The forests of the area comprises of mixed deciduous species of small girth and medium height growth, which falls under:

a) The southern thorn forest - 6A/C1

b) The southern dry mixed deciduous forests - 5A/C3

c) The phoenix Savannah

d) The west coast semi evergreen forest - 2A/C2

e) The west coast tropical evergreen forests - 1A/C4
(Champion and Seth, 1964)

The tree species like Aya (*Holoptelea integrifolia*), Porusu (*Chloroxylon swietenia*), Pachala (*Dalbergia paniculata*), Thani (*Terminalia bellerica*), Lallangai (*Anogeissus latifolia*), Palai (*Wrightia tinctoria*), Vagai (*Albizia procera*), Rosewood (*Dalbergia latifolia*), Sandal (*Santalum album*), Konnai (*Cassia fistula*), Acha (*Hardwickia binata*), Poochakottai (*Sapindus emarginatus*), Tamarind (*Tamarindus indica*), Nellikai(*Emblica officinalis*) are dominated in the canopy of these forests. There are evidences of excellent teak (*Tectona grandis*) plantation in few areas.

Natural regeneration is insufficient. Local forest department is giving importance in the plantation of teak, sandal, tamarind and bamboo. Sandal a valuable timber tree of the area is being destroyed by the illicit wood cutters. In the last 30 years there is a significant reduction in the number of sandal trees. Large scale gang smuggling often reported. Human interference consists of felling, lopping, hacking, setting fire and grazing caused havoc. The damage caused by browsing, trampling down seedling and hardening of soil surface by repeated treading is common. Recently the population of wild elephant has increased in this forest and in small/big herds, they often raid the adjoining field crops.

Fire - Ecological Perspectives

Fires in the forests are regular annual feature in the area which occurs usually in the month of February to May. About one per cent area of forest is disturbed by forest fire every year. It causes extensive damage to sandal, bamboo, timber and non-wood forest produce yielding trees.

There are reports of conversion of tropical mixed deciduous dry forests in the slopes to Savannah type with

more and more coarse grass by repeated fires. Fire has a tremendous negative impact in growth of trees. The regeneration of tree species is halted in occurrence of fire. There is a quantum loss in the bio-diversity. No study has been done how much loss is occurring in the micro-organism but this is apparent that the microbial ecology is disturbed that is again related with the decomposition of litters and regeneration from seeds. In the process of succession the burnt forest area may take many years to function normally.

Many times fire give a positive results in the production and regeneration of grasses. Probably the influx of nutrient helps villagers to have more fodder in the rainy season. Uncontrolled fires affect forest resources in a variety of ways. Regeneration is killed or dies back thereby delaying the establishment of a new crop and extending the rotation. When newly planted teak plantations are burnt, it is standard practice to cut the young trees down to ground level: this stimulates new vigorous shoot from the base, but at least one year's growth is lost. Young eucalyptus plantations frequently require replanting and coppice regeneration dies back for (or must be cut back) after fire. Studies indicate that the volume increment of various species of Eucalyptus is reduced after fires and that the effect persists for several years. The cumulative loss of annual increment depends on the severity of the fire, but generally lies in the range of one to three years growth.

No research appears to have been done so far on the potentially far giver intangible effects of forest fires in India. Not only do uncontrolled fires burn down the vegetation, but also the organic matter is adversely lowered, increasing the frequency of flooding and causing soil erosion. In addition, wildlife patterns and habitat may be disrupted. The situation is exacerbated by a lack of fire protection planning knowledge and incentives.

In addition to the weather(temperature relative humidity, rainfall, wind velocity, etc.) the topography, build up of litter on ground, duff/fuel moisture percentage etc also strongly influence the possibilities of forest fires. Besides the short term improvement of forest land for improvement of grazing value through forest fire local people often use fire to facilitate hunting, honey collection travel and shifting cultivation.

Many time people put fire due to non-timber forest product collection like for clearing of the forest floor prior to the collection of flowers, fruits, seeds and in stimulating flush of leaf crop such as tendu (*Diospyros melanoxylon*), for flowers of Mahua (*Maduca indica*) in March and April and sal (*Shorea robusta*) in May for sal seeds.

Rodgers (1986) suggested that the non-burning of sal forest in Dudhwa U.P. since national park status in 1974 has allowed a dense undergrowth of unpalatable shrubs to develop. This prevents swamp deer making movements to drier grasslands in the monsoon, reduces chital forage availability and has prevented much sal seedling regeneration. A programme of occasional controlled burning in the sal was suggested on an experimental basis. Conserving marshes, swampy area and water catchments are essential for forest fire prevention. Forest fire reduces the wild food for the animals as well as for the forest dwelling people. Through their immediate effects on vegetation, fires have a further effect on animals-change in cover and food, on soils loss of litter, deposition of ash hardening of surfaces; and on water-changed permeability, increased surface flow. Many effects are related and interacting, fire ecology is thus both complex to understand and difficult to evaluate.

Emergence and Functioning of Forest Fire Protection Committees (FFPC)

"The forests belonging to us", this was the answer given by Shri Velliangiri (54) of Narasapuram village when he asked the question "*Whose forest is this?*". Now no one seeds the forests as exclusive property of the government or forest department. When Shri Subbiah (65) of Thekkampatti village encountered the questions: "*How much do you directly depend on forests for your livelihood ?", his answer was "less now a days because of diversification of income sources*". The next question asked was "*then why do you want to protect forest?*". He readily replied that the forests are absolutely necessary to maintain the ecological balance which is basic for sustaining the life support systems on earth". The same man said that his perception about forests has changed after he became the member of the local forest fire protection committee. Many localities have shared the view of Shri Subbiah.

Smt.Rangammal (70) of the same village remarked "when we have started growing trees in our farmlands (agro-forestry), how can we allow the trees to be cut in the natural forests?" She firmly opined that fire was

the single most important cause for destruction of forests in that region. Many endorsed her view in not only Thekkampatti village, but also other villages where forest fire protection committees were formed. This strong perception was the reason why people have readily cooperated to join hands with the forest department to check the wild fire by forming protection committees.

The President of the FFPC of the village Mangalapalayam recalled their last battle against a major fire in their neighbouring forest four years back. "…it was a big fire. We spotted it in the morning and informed the forest guard. As he was alone, we about 10-12 people went along with him to put off the fire. Only when we approached the spot we could realize how big the fire was. Flame was leaping 50-100m high. We could not go closer than 500 ft. from the fire. We struggled unsuccessfully from 11 a.m. to 4 p.m. with our limited means to put off the fire. We could only succeed to draw a fire line to prevent further spread of fire. It was burning throughout the night and naturally put off in the early morning. It was the horrible site to see the spot after the fire. It was just like a battle field after the war. At that I was wondering why the nature was curse to itself. How many decades it would have taken for nature to grow a tree and why does it destroy itself in few hours by fire. Later on when I joined in the forest fire protection committee only realized that natural occurrence of forests fire are rare and most of the fire are human made. I had owed to prevent its occurrence. We are planning to build up a task force to check to prevent forest fire through our village committee". Within a year of their formation, the committees have considerably succeeded in their missions. "Fire in the forests were regular occurrences and frequent in every summer. But in the summer season just after the formation of the committee. There were few or no incidence of forest fires". This was the observation of the people in almost all the villages.

Every one recalled the mass meetings held by the forest department in the year 1995 at Alanthurai, Thadagam and Lingapuram village functions to create awareness about the destructions caused by the forest fire, around 6000 people attended the meeting. The indirect but the heavy damage caused to their crop fields was highlighted in these meetings. Demonstrations and videos shows on how to control forest fire were also conducted after the meetings. These meetings in fact created a lasting impression on the minds of local people. Particularly the strange fact that forest department has conducted the public meeting (never in their memory such thing happened in the past) itself had attracted their attention. They cannot just resist the invitation to participate in forest protection by the forest department which has so far functioned in isolation, away from the people. In many images people have controlled themselves as the members of the protection committee just after the meeting.

Best thing to happen was the immediate follow-up by both the forest department and the villagers ("opinion leaders") after the meeting. Frequent group meetings were held in the villages to motivate and enrol other villagers in the forest protection committees. These meetings served as crucial look between the opinion leaders and other villagers and in turn the opinion leaders acted as the link between the forest department and the local people. The role of opinion leaders was to convince the other villagers and enrol as many members as possible. Definitely initial impetus was given by the forest department, but credit goes to these local leaders who had taken initiatives to diffuse the message deep into the community and expand the membership of the FFPC.

Though the villagers were not directly involved in protection or management of forests in the past, there has been an inherent concern among the community about the decline in forest cover. As the Range officer, Boluvampatti has rightly pointed out their concern about forests has been well reflected by the enthusiasm shown by the villagers of Narasapuram and Mangalapalayam during the initial meeting. "All we have done is to appeal to this concern and evoke their favourable response. The support we have been receiving from the community is something beyond our exception", he said. He further remarked "…now realize that so far by keeping the local people away from forest protection and management. We (forest department) have lost more than we gained. We have failed to utilize the potentials of local people. They would in fact multiply and expand our conservation efforts very effectively with almost no cost".

In all the villages, wherever we spoke to the villagers they expressed their tremendous concern over the fast declining of forest cover. Particularly elders, over the age of 65 years, could recall the existence of dense, impenetrable forests with lot of wild life movements before 50 years in their neighborhood. Now, they say that they can easily walk deep in the so called without any difficulty as they do in village paths hardly encountering any remarkable wild life activity. Almost all the village elders were unanimous in their opinion that the degradation forests was accelerated in mid 70s when commercial felling through contract system was allowed

by the forest department. When commercial felling was stopped, the degradation has also slowed down and now it has stabilized. The general opinion of all generations in the villages is that from the mid 1980s, due to massive social and farm forestry programmes, there is a perceptible increase in forest cover which has to be sustained. This is the precise reason they want to take voluntary measures to protect forests.

Everyone - all sections - are in agreement that forest fire is the single most important destructive factor in forests of this region. Forest fires are regular features in summer. Then why did they not take any measure prevent forest fire so far ? and why there is a sudden resurgence to protect forests from fire?. This question was asked in all villages. This response was common in all the villages. Though there were frequent incidence of forest fires in the past, they were all thought to be natural occurrences and nothing could be sure about it. Of course they were also aware of the deliberate attempt to put fire in forests. But they were perceived to be far less frequent. Moreover, they were not organised earlier. Lonely fights against the grand forest fires were impossible. They helplessly watched the fire destroying the forests. It was thought that it was the responsibility of the forest department to put off the fire. Community action to protect the forests was never in the mind of the people. Earlier the department was also functioning in isolation, distancing itself from the people. It was the unique appeal from the forest department calling for community action, community organization to protect the forests, particularly check forest fires. It was basically appeal to their inherent desire to protect forest which has now been channelised though community forests fire protection committees. Now all the members of the committee,after proper appraisal by the forest department realise that all the forest fire with rare exceptions occur due to human interventions, either intentionally and unintentionally and they are preventable.

They have also realised that through organised efforts, forest fires can be not only prevented, but also checked or put off if detected. They all have been adequately briefed, demonstrated and to some extent trained to check/put off forest fire by the department staff. Most importantly, they have understood that apart form "physical efforts" to prevent/check forest fire there are other effective "social Measures" like community education, social auditing, social and economical sanctions/fines, rewards/incentives etc. which can be adopted by them successfully. All the village committees adopt such measures in varying degrees and forms depending upon local conditions. The result is that there is almost no fire incidence in the summer season preceded by the formation of the sometimes which shows the year wise incidence of fires and extent of damage.

There are six forest ranges covering an area of 64,347 ha in Coimbatore district. As indicated in the map, this area is classified based on the fire occurrence into three categories viz., most vulnerable, medium vulnerable and low vulnerable. So far 23 village fire protection committees have been formed in all these three classified areas. This classification in any way does not undermine the importance of the fire protection committees formed in the low vulnerable areas. In fact though the fire occurrences are comparatively lesser in these areas, it is likely to become medium or highly vulnerable if adequate preventive measures are taken. In that sense, the protection committees in these areas also have equally important role to play.

The table indicates name of all the 23 fire protection committees and corresponding number of members in each committee, from this data, it can be inferred that the average membership of each committee is 14 and implies that only a fraction of village population are the members of the committee. However, the interaction with the villagers revealed that most of them were aware of the activities of the committee. This means that diffusion of information, which is the primary responsibility of the committee, properly takes place within the village social system. At present, the membership of the committee is by and large confined to the well informed few in the village. It is growing as the others in village also take active interest in the activities of the committee.The members of the committee function as opinion leaders to the rest of the community. They in fact multiply the effort of forest department by disseminating information and motivating the other people - young and old - to actively participate in forest fire protection activities.

The primary responsibility of the fire protection committee is to identify and check factors responsible for forest fire. As they now are able to precisely locate the human activities that cause fire in the forests, the committees could work out the strategies also to check such activities along with the forest department. As the first step, they have jointly organised educational campaigns targeting the groups which are likely to cause fire - the graziers, fire wood cutters, NTFP collectors, contract labourers, tribals, casual visitors to the forests etc. Frequent campaigns and meetings are being conducted to make these groups aware of the devastating effects the fire has on forests. The forest department has been supporting such efforts by supplying educational materials like leaflets, posters, video films and sometimes conduct demonstrations. The staff - Range officers and others participate in all the meetings/discussion and offer expert advice. However, the effective method to

persuade the offenders seems to be the personal influence by the members. Each member of the protection committee has taken responsibility to personally influence the likely forest fire setters and in few committees even targets have been fixed to each member for this task.

So far, the committee's educational efforts have been successful among the unintentional fire setters to leave their potentially dangerous habits like smoking inside the forests. They are yet mark their success among the intentional fire setters. Systematic efforts are necessary in this direction. The committees are regularly meeting to frame their strategies, proceedings of every meeting are recorded. The secretary of the committee takes the responsibility to conduct the meeting and record its proceedings. The committee is headed by the president. In many committees the office bearers of protection committee and the village panchayat are common and hence relationship between the tow bodies is almost cordial.Though so far no formal election of office bearers of the committee is held, their functioning is regulated through democratic procedures. Decisions are made in a democratic way in consultation with the forest department. In some committees, the Range officer is also a ex-officio convener. Otherwise, he is invited to the meetings as the special invitee.

At present, the committee just informs the forest department staff immediately if the fire is detected in the forest. Though the members are shown demonstrations by the department how to check and put off the fire, they are not well trained. They, of course accompany the staff to fight against the fire. Now, many committees are planning to build up a well trained special fire fighting squad comprising of village youth. The committees are also in the process of evolving more stringent punishment system comprising monetary fines, social sanctioning, *shramdhan* (hard physical labour), social boycott etc to enforce on the offenders. Many members opined that the present system of just catching the offenders and handling over them to the forest department is not very effective. Though they appreciate the punishment provisions of the department, say that the legal and administrative systems takes long time to settle the cases and creates less impact on the offenders. Foresters also agree to this point and say that locally evolved legal provisions would effectively supplement their efforts if properly coordinated.

When the point of women involvement was debated with the members, it was pointed out that since the committees were first started as the fire protection committees, and Women were perceived to have no role in fighting against fire their inclusion was not considered so important. Incidentally women also ask "What role do we play in controlling fire? It is men's job. This kind of misconception also seems to exist among the staff of the forest department. Range officer of the Bolampatti forest range agrees " Yes we, do miss women in the committee and I realise the lacuna. In fact they are crucial link to reach the whole community. We should take effort to involve them in committee's activities". He is true, especially when the committee's are enlarging their activities from just preventing forest fire to protection and conservation the whole forest resources under the fold of Joint Forest Management. If a community of other group is strongly against setting forest fire, the individuals in the group or community are effectively restrained from such action than by any law.

Role of Forest Department in Implementing the Programme

The institutionalization of the conceptual shift in Forest management from purely state sponsored to Joint Management with people's involvement has been gradual among the various levels in the Forest department. This has brought a change in their role from mere conservation to development i.e development through participation. Efforts are going on at the national level to reorient the foresters at all levels to the new task. Forest department is no more alienated from the people. They are increasingly accepted by the people as agents of change and are being offered assistance and co-operation in their efforts. It is glaringly evident in this case of Forest fire protection with community involvement.

It is due to the efforts of foresters - right form forest guard to the Divisional Forest Officer - now people have clearly understood the urgent need for forest protection which could be achieved only through their involvement. Forest fire which has been responsible for extensive damage to the forests of this area has came in handy to the forest department to convincingly demonstrative the effects of the of forest destruction to the people. How much people have realized the magnitude of the problem is quite evident from the remark of the elderly person, Mr.Venkatesan of Nathagodenpudur "if a tree is cut, there is a chance for its regeneration. But if it is burnt, it is dead, no question of its regeneration. This statement does not imply that he is for cutting the tree, but it clearly shows that the strategy of forest department by taking up the forest fire - visual evidence of vast destruction of forests - as the major issue and first step in forest protection has succeeded in lagging the community efforts with their own mission.

Reorientation at the grassroots level of the department- shedding the fallacy about their uniform - has helped them to build good rapport with the local people. Though the forest guards and range officers still wear uniform, because of their attitudinal and behaviourial change they are now largely approachable by the people. We observed that in all villages, the people right from school children to old people including women - converge to approach the officers whenever the forest department vehicle enters into the village rather than disperse away as a mark of fear and distaste. This perceptional change on both sides has triggered the mutual dynamism to work together for the common cause of forest protection.

The fringe area of Western ghats coming under Coimbatore territorial forest division is highly prone to fire, especially in summer seasons. Since the whole coimbatore district falls under rain shadow area, its forests are all the more vulnerable to fire. Compared to Irular tribal community, the other neighbourhood rural communities are less dependent on forest. Their main occupation is agriculture and due to industrialization, their focus of dependency for income has gradually shifted from forest to urban centres. In many of the villages it has been observed that number of dwellings have decreased due to out migration. In addition, the diversification in occupation, for example towards brick line (particularly in Thadagam area) also reduces the people's dependency on forests. Though the brick cline, by and large have a destructive influence over the ecology of this area, one beneficial effect observed is that it has been successful in reducing the biotic pressure on neighbouring forests. The local people now earn many more times than what they used to earn through forest based products earlier. Moreover their working schedule is also highly regulated. Yet another impact of these bricks cline is to be seen in agriculture and its allied activities. Agriculture has adversely affected as many farmers (the farmers of this area were supposed to be highly progressive and agricultural productivity of this region was very high.) have leased out their productive land for brick cline which are more remunerative. Most of the brick cline are managed and owned by outsiders who have only business interest and least bothered about ecological sustainability of the area. They indiscrimately exploit the productive topsoil and have made the large stretch of the area unsuitable for agriculture. Days are not far away when the local people would be forced to pay heavy price for this kind of exploitation of nature.

The reduction in the agricultural activities has resulted in the decline of animal power. The cattle population sent for grazing into the forest has also reduced. Farmers in these villages mostly maintain only productive cattle. Thanks to cattle improvement programme of the Animal Husbandry department, most of the productive cattle are the improved breeds and require stall feeding. Usually the unproductive cattle are sold to the traders who in turn sell them in neighbouring Kerala for slaughter. The elders of the villages recount the drastic reduction (almost 10 -15 times) in the cattle population over the period of 40 years. As the result the grazing pressure on the neighbouring forest has also considerably reduced. Few unproductive cattle of these villages and the cattle belonging to the Irular tribal community go to the forest for grazing.

According to the villagers the requirement of fuel wood collected from the forests also has in these days reduced as they have got access to diversified sources of fuel including the bio-gas and methane gas. Since the cattle are stall fed, the cow dung collected has become the major source of fuel. Under the present circumstances, the major cause for the degradation is the forest fire as perceived by the foresters and villagers. The appreciable aspect of the whole campaign is the systematic approach adopted by the forest department. Before launching the campaign, the department thoroughly studied the area and identified that the forest fire is single most important cause for the destruction of forest in this region.They had also come to the definite conclusion that except rare cases, almost all the fire incidence in this region are caused by human interventions. Though the location is highly vulnerable to catch fire, the factors promoting natural fire are seldom present here.

Through its initial survey, the department has also found out the types of human activities that causes forest fire.

The grazier and the wood collectors who regularly go to the forest, While smoking, unintentionally throw the burning buds inside the forests. When they fall on the dried leaves and the twigs, especially in summer seasons easily catch fire. This is found to be the one of the common causes. Such a casual practice but the destructive one also exist among the labourers who are engaged in large numbers by the contractors for the collection of NTFP's during the seasons - the summer months starting from the January to April, potentially dangerous in the forest fire point of view.

There are certain locally famous temples and tourist spots inside the forests. Many tourists/local people visit the spots/temples on holidays and festivals. Many of them smoke and casually throw the burning buds inside the forest causing fire during the festivals, many of the neighbourhood communities/tribal communities visit the forest-temples to offer prayers. One of the common rituals is to cook rice with milk (locally known as Pongal) and offer it to God. Many times they do not properly put off the fire after cooking which spread fire in the forests when the wind blows. Such kinds of fire are very difficult to check.

The graziers are also reported to deliberately put fire in the forests in order to get good growth of grass in next seasons. The fire wood collectors do burn the trees to get charcoal. However these incidences are gradually reducing as the dependency of the neighbouring village communities on these products are becoming less. (The villagers almost deny the existence of such practices.)

The tribal Irular are found to deliberately put fire inside the forest to collect grass, dried fire wood, charcoal etc. on which their daily life depends. (This was also verified while talking to the Irular at Sadivayal near Siruvani foot hills. They completely depend on the forest for grazing their cattle and fire wood.They do not practice stall feeding and usually require 8-10 kg of fire wood per day per family for their own consumption. In addition they sell grass and fire wood outside.)

The tribals in this region are the major collectors of NTFP's. They collect NTFPs for their own consumption and for sale. (They sell the NTFPs either directly in the open market or through the co-operative societies set up by the government depending upon the prevailing price.) They constitute the major junk of the labour force engaged by the private contractors (yearly leasing out by the Government thorough the auction) for the collection of NTFPs. The common complain is that these tribals put fire in order to clear off the forest floors so as to collect the NTFPs easily. (This was denied by the tribals while talking to them at their settlements.)

The entire Coimbatore forest division is infested by wild elephants. The villages bordering the reserve forests are the most affected. Crop damages by these wild elephants is very common, almost a daily affair. Local people adopt many methods to drive away the elephants including crackers and fire. Possibility of forest catching fire during this cooperation is not ruled out. (Now the use of crackers to drive the elephants away is prohibited in the villages adjoining the Range forests falling in Sirumugai and Mettupalayam ranges as it creates confusion the local police task force between the crackers and the gun fire of the Veerappan gang, the notorious poacher group.)

The illegal wood cutters and the poachers (the most notorious of the Veerappan gang) also to a large extent responsible for the forest fires.

Every one in the forest department, right from the guard to the Divisional Forest Officer and even above - has realised that these identified cause of fires can be checked only with the involvement of the local people. However, they did not directly approach the offenders as it was not feasible option. Past attempts to directly deal with these people have not been successful because these people could not identify themselves with the forest department.It is the traditional fear of uniform which has kept them away from the forest department. The change in the approach of the forest department has not yet been properly perceived by them. The best way to approach them is through the opinion leaders of the same village who have been regarded by these people. This is the well proven method of extension , and precisely adopted by the forest department. (Opinion leaders are undoubtedly proved to be more effective in communicating with local communities than the external extension/change agents due to their hemophillous character. The forest department, though not scientifically [socio-metric method], but almost accurately has identified the opinion makers in the villages and utilised their services through fire protection committees to educate the other local community including the offenders.)

Apart from this personal contact, this forest division under the guidance of the District Forest officer (Rajiv.K.Srivastava), has been trying various innovative campaign methods to motivate/inform people about forest fires. Their target group has included all the sections of the community right from school children. The good example is the Government Elementary school in Sirumugai.The head master of this school, also a member of the Lingapuram village FFPC, is impressed by the efforts of the forest department, and has taken extra interest to integrate the school activities of that forest department. The school with the walls bearing full of teachings on environment and forest resource conservation has created lasting impact on the minds of the young children and stands an ideal community education centre. On recommendation of the DFO, the head

master Shri Ramaswamy got the state award for the best teacher in 1995.

Not only in Sirumugai, but in all villages, school children have shown significant awareness about the forest conservation efforts by the community and the forest department. This is due to the competitions held by the forest department among the school children and rewarding them in public meetings, involving children in social forestry and afforestation programmes, distribution of uniforms to the children and even conducting regular meetings of the FFCPS in the school premises also create awareness among the children.

The demonstrations conducted by the department staff to show to counteract the forest forests have became very popular as they were most effective means to learn the skill. (Demonstrations have been proved to be one of the most effective extension teaching method over the years among different kinds of population as it engages more number of senses simultaneously while learning taking place). Usually the demonstration are being conducted after the mass/group meetings in the villages. Many times villagers are also taken to the actual forest area prone to fire and demonstrations are shown, particularly how to create fire line and control the fires. such exercise have given them the idea how the human interventions cause major forest fires and dispelled their misconception that the forest fires were natural occurrences and cannot be prevented. Now the villagers even prepared to form a special task force to prevent and control forest fires comprising of village youths.

In addition to the mass meeting and demonstrations, the campaigns of the forest department include many innovative popularization methods like distribution of uniform with a message to prevent forest fire to school children, community feast oath taking to prevent forest fire at the village temple. Since it was realised that the villages in which protection committees were formed alone cannot prevent forest fires in isolation of neighbouring villages who also have equal access to the forests, it was felt necessary to spread the message to them also. The committees themselves had come up with innovative ideas like padayatras (long march) and human chain. Even in some villages like Lingapuram in Sirumugai range, the committee members were suggesting to take up a awareness campaign by autorikshaws when we had interaction with them.

The department, apart from personal and group contact methods, has also used mass media like radio and newspapers effectively for its campaign. These media are being used not only spread the messages on forest fire prevention but also to give wide publicity to the constructive/appreciable works carried out by the village forest fire protection committees. Such kind of publicity gives the committees immense pride and sense of achievement and thus acts as a motivating force for further action. It is also seen to be inducing a competitive spirit among the committees. The media message are being well supplemented by poster and leaflets/pamphlets. They serve to create further interest among the villagers who became aware about the forest fire prevention through the mass meeting and media. Sustained campaign actually creates immense desire among the community to participate in the task and ultimately leads them to conviction and action.

While promoting community action to prevent forest fires the forest departments strict action against the offenders is also being appreciated by the villagers. This is great attitudinal change among the villagers who are ready to support any legal actions such as fines and imprisonment of offenders, even if they are locals. In fact the huge fines inflicted upon the offender in Thadagam village of Periyanakampalayam range and Mangalapalayam of Boluvampatti range had created wide spread awareness among the villagers in those ranges. What could be learnt from this experience is that had the forest department taken only legal action against the offenders, as done during the past, it would have only recovered the hostile reaction from the local communities. But the educational campaign immediately following the imposition of fines, had in fact earned public support.

The forest department has come closer to the local community by taking up non-conventional but needful services such as conduction rural/tribal health camps, non-formal education providing facilities to local schools, prevention of school dropouts, organizing community sports and recreation activities, providing alternative energy/income generation activities and championing the community causes with other development departments/agencies. The forest guard no more just guards the forests but guards the whole community interests. He has become the real extension agent - friend, philosopher and guide to the local people.

Summary

Unnatural forest fire causes imbalance to the nature which reflects very badly on the bio-diversity and reduces

floral and faunal wealth. Old traditional methods of preventing fire is not playing much role in front of the will to put fire. Forests in developing countries which are adjoining the habitat of rural masses the people are not aware of the importance of the forests. At this juncture, awareness alone can bring down the incidence of forest fire. During campaigning, it was found that people are totally unaware of biodiversity conservation concept. After awareness the committee which was formed has shown progressive result due to interaction between the staff, committee members and local people. Initial period of interaction, on the other hand, has often brought forward the individuals who had long term commitment to the cause.

This case study was documented by a team of scientists, from Indian Institute of Forest Management, Bhopal, India along with the then District Forest officer Mr. Rajiv K.Srivastava who launched the innovative scheme in the division.

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INDONESIA

Fire in the Rubber Jungle…
Fire Prevention and Sustainable Tree Crop Development in South Sumatra

Abstract

This paper investigates the interactions between tree crop development and vegetation fires in South Sumatra. Since 1910, farmers have turned rice-based, slash-and-burn cultivation into rubber-based agroforestry, replacing the forest fallow with a mixture of rubber and other tree species. This system sustains densities of population up to 100 people per sq.km in a forest environment, with a limited use of fire.

Since the 1970s, new patterns of land use have been imposed by the government and private groups. Logging, transmigration, large-scale planting of oil palm and *Acacia mangium* have destroyed large areas of forest traditionally belonging to the local people. This has led to the increased use of fire in land clearing, land disputes, and the replacement of forests with fire-prone vegetation, especially *Imperata cylindrica*.

Fires affect tree crop farmers by destroying their plantations, their forest reserves, and making it more risky for them to invest into more productive rubber plantations using high-yielding clones. Participatory smallholder tree crop development programs could reduce the incidence of fires by limiting its use in large-scale land clearing, helping farmers to convert degraded forest into productive plantations with adequate control of *Imperata cylindrica*, while respecting the rights of local people to avoid land disputes.

Introduction

Vegetation fires have existed in Indonesia for longer than records exist. However, it is mostly since 1982 that they have been identified as a repeated problem causing major environmental, economic and social losses to the Indonesian people, their neighbours and mankind as a whole.

The fires are eased by natural factors such as the long droughts associated to El Niño (occurring every three years during the last two decades, instead of every five years before: Fox 1998), and the existence of coal and peat deposits. The development of human activity in Sumatra and Kalimantan, and lately in Eastern Indonesia, has led to an increase of fire hazards and risks. Inadequate methods of logging and land clearing carried over a large scale, mostly by agro-industrial companies and transmigration projects, have left a patchwork of degraded forest covers that burn easily. Land acquisition by large agro-industrial companies without sufficient consideration for the rights of local people has led to land disputes, which are often solved or avenged through fire. These practices, which have warranted large short-term profits to the companies, are unlikely to change unless responsible land use policies are implemented.

Within such an agenda, there is a scope for involving tree crop smallholders, especially rubber farmers, in the prevention of vegetation fires. Smallholder tree crop farming represent the main land use type in the peneplains of Sumatra (especially in Riau, Jambi and South Sumatra) and in parts of Kalimantan (especially in West and Southeast Kalimantan), covering about 10 million ha nation wide. Smallholders practice various land use types in a continuum including the exploitation of natural forests, the planting of mixed tree stands associating planted and natural species, and pure mono-crop plantations. They have a direct interest in preserving the forest and plantation cover and protecting it from the fires, as long as their long-term rights over the land are respected.

South Sumatra provides a good example of many of the changes in land use taking place in other regions. Having experienced these trends for a bit longer than most of the other Indonesian Provinces outside Java, South Sumatra provides insights of what could happen in the rest of the country if the present methods and policies were to be repeated in the future.

Methods

The present paper is based on the report of a study conducted between February and June 1999 for the Forest Fire and Prevention Control Project (FFPCP) and the International Cooperation Center for Agricultural

Research and Development (CIRAD), France, as part of the Indonesian Forest Sector Support Programme (IFSSP) - a cooperation of the European Union and the Indonesian Department of Forestry and Plantations (see full report: Gouyon, 1999). The aim of the study was:

* to assess the present status and trend of smallholder tree crop development in the areas of South Sumatra which have been most affected by land fires;
* to analyze the interactions between tree crop development in South Sumatra and vegetation fires;
* to recommend further studies and project interventions with a view to reduce vegetation fires by taking into account tree crop development.

Since rubber is the main smallholder tree crop in the areas of South Sumatra which have been the most affected by fires, the study concentrated mostly on smallholder rubber development. However, other aspects of tree crop development such as the fast progress of large estates, especially oil palm, as well as industrial forest plantations *(HTI* or *Hutan Tanaman Industri)* have also been investigated since they have direct consequences on smallholder tree crops and fires.

The study made use of the following materials:

* existing studies on fires and tree crop development in Indonesia. The references include reports and articles by Amypalupy (1997), Bertault (1991), Byron and Shepherd (1998), Bromley (1998), Durand (1998), Ellen and Watson (1997), Gönner (1998), Potter and Lee (1998a,b), Saharjo (1997), Schindler (1998), Schweithelm (1998), Sunderlin (1998), Tomich *et al*. (1998), Wasson (1998), CIFOR, ICRAF (1998, 1999), the FFPCP project , the UNDAC mission (Claasen *et al*. 1998), the State Ministry for Environment and UNDP (1998), WALHI (1998) and the World Wildlife Fund (1998);

* data on land use and socio-economic activity collected by the FFPCP as well as the experience of the Project on fire prevention and control since 1995 (see for example Anderson *et al*. 1999, Bompard 1997; IFSSP & FFPCP 1997; Nicolas 1999, Nicolas and Beebe 1999, Nicolas and Bowen 1999),

* field visits and interviews carried during 4 weeks with farmers, village leaders, local officials, NGO leaders, and managers of agro-industrial companies and wood factories;

* the experience and data gathered by the of the author, who studied smallholder tree crop development during 3 years in South Sumatra and other provinces of Indonesia (Riau, Jambi, Bengkulu and South Kalimantan) in 1988-1991, and has carried several studies on the same topic in Sumatra, Sulawesi and outside Indonesia since then (see for example Gouyon *et al*. 1993 & 1995, Gouyon 1995 & 1997).

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Results: Forest, Tree Crops, People and Fires in South Sumatra

1. From *ladang* to Jungle Rubber

Until the introduction of rubber, the inhabitants of the peneplains of South Sumatra lived from a combination of wet land rice, fruit trees planting and ladang. Ladang is based on rice cultivation after slashing, felling, and burning the forest. Rice is planted for one or two years with other temporary crops, then the field is abandoned to forest regrowth. The long fallow (20 years) regenerates the fertility accumulated in the biomass,

which will be made available to the crops through the next burning. This system can sustain densities of population until 25 people per km^2 at most; beyond such densities, fallows are shortened and invaded by grasses.

In South Sumatra, however, like in some other Provinces of Sumatra and Kalimantan, rubber and agroforestry enabled farmers to go beyond these densities of population without endangering their environment. At the beginning of the century, rubber was introduced in Indonesia by traders, and farmers started planting it systematically in their ladang. The forest fallow was replaced by "jungle rubber", a mixture of rubber, forest species and fruit trees which is equivalent, in terms of biodiversity and structure, to a secondary forest (Gouyon *et al*. 1993). After 30 to 40 years, when the trees cannot be tapped anymore, farmers can replant their rubber trees using the same method of slash-and-burn. Hence the system is sustainable.

Under the price conditions prevailing until now, rubber agroforestry enabled farmers to support one household of five people with about three hectares of plantations, with about 80% of the income coming from the sales of the latex, and the rest from the other species associated with rubber (Gouyon 1995, Gouyon 1999). The use of fire is very limited in this system; it is only used for the creation of new plantations and for replanting once every 30 or 40 years. Since jungle rubber has a dense canopy, similar to a secondary forest cover, it presents a low fire hazard - apart from the immature period (about 8 years) during which the young plantation is susceptible to fire (Tab.1).

2. Investors and Projects: Logging, Transmigration, Oil Palm and *Acacia*

For farmers, the possibility to secure a sufficient income with this system was linked with the possibility to create new plantations for the young expanding generation. Since rubber plantations are considered as individual property under traditional land rights, young farmers usually had to go away from their villages to create new plantations by clearing common forest land belonging to their tribe or marga. In 1983, however, the authority of the tribes was officially abolished and replaced by the government administrative structure that is still in place until now (Gouyon 1995, Bompard 1997).

This considerably weakened the control of farmers over their land, by suppressing the basis of their traditional land rights. The government did not recognize common rights of the tribe over land that is not permanently cultivated. Farmers lost their land reserves, which were increasingly allocated by the government to logging companies, transmigration projects or agro-industrial companies (especially oil palm plantations and industrial forestry or HTI). Since 1980, and moreover since 1990, the land use pattern changed dramatically in South Sumatra (Tab.2).

Transmigration allocated 850,000 ha to newcomers from Java, mostly since 1980. Most of them were supposed to grow food crops, but this soon proved unprofitable and unsustainable on the acid leached soils of the peneplains. The large areas cleared for transmigration by bulldozer were largely left unused or abandoned, and turned into Imperata grasslands, a major fire hazard. The transmigrants were lately allowed to plant tree crops and became one of the main beneficiaries of government assistance to grow oil palm or high-yielding rubber.

Logging companies, which activity developed quickly in the 1980s, turned vast areas into logged-over forests filled with waste that burns easily. In the 1990s, a new type of forestry developed in South Sumatra under the name of HTI, i.e. industrial forestry plantations using mostly fast-growing species like *Acacia mangium* (Tab.3). These plantations represent one of the major fire hazards in the Province, since they are planted with species that drop their leaves, dry up easily and are mixed with Imperata and bushy regrowth.

Agro-industrial corporations started developing oil palm at a fast rate in 1990 (Tab.4). Like HTI companies, they use fire for land clearing, and this is a major source of voluntary and accidental fires, since these large scale fires are difficult to control and often escape to neighbouring vegetation or plantations. HTI and plantation companies burn about 40,000 ha of land every year: despite contrary regulations, burning is still considered as the easiest and cheapest way to clear land.

Tab.1. Fire risk and hazard in various man-made and natural covers in South Sumatra (On a 0-10 scale from lower to higher degree of risk and hazard)

Type of cover	**Fire risk (source of ignitions)**	**Fire hazard (fuel that burns easily once ignited)**
Primary forest	0	1
Secondary forest	0	2
Logged-over forest	1 (cigarette smoking by small loggers)	7
Jungle rubber agroforests:		
Creation/ replanting	5 (fire is used for land clearing but controlled)	
1-2 years (rice + other crops between young rubber)	2 (burning of rice straw)	2
3-10 years (rubber grows with forest species)	0	5 (opened canopy with bushes)
10-30/40 years (mature rubber + forest species)	1 (cigarette smoking during tapping)	3 (rubber drops its leaves and the vegetation dries up during long droughts)
Smallholder clonal rubber:		
Creation/replanting	5 (same as above)	
1-2 years (same as above)	2 (idem)	1
3-6 years (growth of rubber)	1 (cigarette smoking when cleaning the plantation)	1 if the plantation is clean 5 if invaded by bushes 8 if invaded by *Imperata*
7-20/30 years (mature rubber)	1 (same as above)	1 if the plantation is clean 3-6 if poorly maintained
Industrial rubber/oil palm plantation		
Creation	8 (large scale land clearing with fires + land conflicts)	
Replanting	2 (limited use of fires)	
1-5 years	5 (conflicts)	3 (well cleaned, but covercrops may dry up and burn)
5-20/30 years	1	1
Industrial forest (HTI)		
Creation	10 (large scale land clearing with fires + land conflicts)	
Replanting (1/10 years)	2 (same as above)	8 (*Imperata)*
1-10 years	5 (conflicts)	8 (*Imperata* and regrowth)
Transmigration Project		
Creation	5 (land clearing with fire)	9 (grasslands)

Source of ranking data: evaluation of the author based on interviews with farmers and experts.

Tab.2. Land allocated to transmigration, forestry and agro-industry in South Sumatra

	Land allocated	**Period**	**Rate of allocation per year (ha)**
Large plantations (private)	876,000	1988-1997	87,600
Logging concessions (HPH)	1,752,000	1979-1997	92,200
Industrial forests (HTI)	685,000	1988-1997	68,500
Transmigration	596,000	1979-1997	31,368
Total	**3,909,000**	**1979-1997**	**205,736**

Source of data: Dinas Perkebunan, Kanwil Deptrans, Kanwil Kehutanan, and FFPCP.

Tab.3. Area under HTI (Industrial Forest Plantations) in South Sumatra

Types of Industrial Forest Plantations	**Concession area (ha)**	**Planted area (ha)**
Pulp wood *(Acacia mangium)*	393,068	213,000
of which PT MHP (private company)	296,400	194,364
Timber species	291,920	21,000
of which PT Inhutani V (State company)	270,670	6,200
Total	**684,988**	**234,000**

Source of data: FFPCP, data from HTI companies and Regional Forestry Office (June 1998)

Tab.4. The development of large plantations and smallholders in South Sumatra

Plantation Types	**Planted Area in 1997 (ha)**	**Planted Area in 1991 (ha)**	**Growth per year (1991-97)**
Smallholder	**1 156 000**	**944 000**	**+4%**
Rubber	780 000	566 000	+6%
Coffee	256 000	241 000	+2%
Others	120 000	137 000	-3%
Large plantations	**272 000**	**76 427**	**+24%**
Private, of which	*241 000*	*46 690*	*+31%*
Oil palm	187 000	20 445	+45%
Rubber	48 000	19 850	+16%
Public, of which:	*31 000*	*29 737*	*+1%*
Oil palm	11 000	9 549	+1%
Rubber	7 000	6 353	+2%

Source of data: Dinas Perkebunan, excluding Nucleus Estates and Smallholders Projects. Other crops than Oil palm and rubber include mainly coconut, pepper and clove (in smallholdings), clove, pepper and cocoa (in large private plantations) and coconut, cocoa, tea, and cane (in State plantations).

3. Consequences on the smallholders economy

All together in South Sumatra, nearly 4 million ha of land or 35% of the total Province area were allocated to transmigration, logging and agro-industrial companies in less than 20 years – i.e. 200.000 ha per year in average. It would have been extremely difficult to sustain such a pace of land allocation while respecting environmental regulations and the local people's rights. In most cases, the land allocated to projects and companies was considered by farmers as their common traditional property, and sometimes included smallholder plantations. This resulted in conflicts over land, in which fires are commonly used by both parties to drive the other one away or as revenge. Besides, farmers felt increasingly deprived of their land and alienated from the development process.

The government extended some assistance to the farmers to raise the income from their rubber plantations, although on a limited scale, reaching less than 10% of the smallholder planted area. These projects enabled the farmers to plant high-yielding rubber varieties or clones, which doubled the net income of the farmers per ha (Tab.5). These clonal plantations are usually maintained free of other species between the rubber trees, since the clones do not develop well with competing vegetation. These plantations, if they are maintained clean, represent a very low fire hazard. The beneficiaries usually have a high income (about 4 million Rp per ha per year) and are able to re-invest it in other clonal plantations.

Unfortunately, for the majority of farmers, who own less than 4 ha of rubber and are close to subsistence level, developing clones with their own means is too expensive and too risky. Their only solution to increase their income is to develop plantations in unoccupied areas. These areas are usually close to logged-over forests, transmigration and agro-industrial companies, which all represent major fire hazards. Hence, the young smallholder plantations in those areas are often destroyed by the fires.

Some of the non-project farmers, however, are trying to develop clones with their own means. They often face difficulties in controlling the growth of bushes and Imperata grasses between the young rubber. Hence, their young plantations are very prone to fire (see for example Gunawan 1997). It is estimated that about 40,000 ha of smallholder plantations burned in 1997, of which 6000 ha were young clonal plantations. The resulting loss can be estimated at 8.9 million dollars (Tab.6).

Discussion: Proposed policies and complementary studies

Since fire control is nearly impossible on large areas in Indonesia, fire prevention should be the priority. Sources of ignition linked with human negligence will always exist, hence the most efficient way to prevent fires is to reduce the large voluntary fires and the fire hazards.

1. Reducing the use of burning in land clearing

Zero-burning or limited burning for land clearing is used in several countries and has advantages and constraints. Under present socio-economic conditions, it would be far from the reach of any smallholder, because it entails the use of heavy mechanical engines, as well as chemical fertilizers to replace the nutrients made available from the biomass by burning. Indonesian companies could use zero-burning or limited burning methods, but they consider them as expensive, unpractical and not well adapted to the Indonesian context (Tab.7).

This means that there is still a need to develop and promote a method of land clearing with zero-burning or limited burning adapted to the Indonesian conditions. This could be done by research institutes working in cooperation with selected private firms.

In all cases, however, land clearing with zero or limited burning should be used only on degraded forest covers which are abundant in Indonesia, no more land clearing of primary or old secondary forest should be considered. Degraded forest covers are usually easier to clear without burning than old, untouched forests, hence this means that there is a good potential to develop new methods of land clearing that would be adapted to Indonesia and respectful of the environment.

Tab.5. Average incomes (per ha and year) of farmers with jungle rubber and clonal rubber

Type of Plantation	Yield (kg of dry rubber)*	Gross income (Rp)**	Costs (Rp) (including amortisation of initial costs)	Net Income per ha/year (Rupiah)	Number of ha needed to sustain a household
Old jungle rubber (above 30 years)	400	1,200,000	50,000	**1,150,000**	3.8
Jungle rubber	600	1,800,000	100,000	**1,700,000**	2.6
Clonal seedlings plantation	750	2,225,000	225,000	**2,000,000**	2.2
Young clonal plantation (7- 10 years)	1000	3,000,000	500,000	**2,500,000**	1.8
Mature clonal plantation	1500	4,500,000	500,000	**4,000,000**	1.1

Source of data: interviews with farmers.

*Rubber is processed by farmers into thick blocks of coagulated latex called "slabs", which contain about 50% of dry rubber and 50% of water and dirt.
**World rubber prices have fallen since the Asian crisis because of the depreciation of the currency of the three major world producing countries (Thailand, Malaysia and Indonesia, which represent 80% of the world rubber production). At the farmer level, rubber is sold 1500 Rp per wet kilo or 3000 Rp per dry kilo. The world price is around 50 US cents or 4000 Rp per kilo.

Tab.6. Estimation of the value of the plantation areas lost due to fires in 1997

		Area Burned (ha)	Value (Rp/ha)	Total Value (Rp)	Total Value ($US) *
Small-holders	Immature, clones	6,000	5,000,000	30,000,000,000	3,750,000
	Immature, others	14,000	1,500,000	21,000,000,000	2,625,000
	Old jungle rubber	20,000	1,000,000	20,000,000,000	2,500,000
	Total	**40,000**		**71,000,000,000**	**8,875,000**
Large plantations		**11,371**	**5,000,000**	**56,855,000,000**	**7,106,875**
Total		**51,371**		**127,855,000,000**	**15,981,875**

* On the base of an exchange rate of 1 US$ = 8000 Rp

Source of data: Dinas Perkebunan and field interviews. The value of the plantations is calculated based on development costs and represents a low valuation. For smallholders, we have considered that the clonal plantations burnt were aged four years in average, and that the actual value was a bit lower than the costs calculated in Table 4 since the burnt plantations had probably been only partly weeded. For other immature smallholder plantations, we have made an estimation based on their costs of development until the age of four. For old jungle rubber, we have used the market value minus the price of the land itself. For large plantations, we have made an estimation based on the costs of development until the age of four with an average of rubber and oil palm plantation costs.

Tab.7. Advantages (+) and constraints (-) of burning and *Zero-Burning* in land clearing

Effect	**Burning**	**Zero-burning**
On the environment	(-) Releases smoke and haze	(+) No pollution
On fire risks and hazard	(-) May spread to surrounding vegetation	(-) Leaves piles of dead fuel that may burn during subsequent droughts
On planting operations	(+) Simple and easy way to prepare the field (-) Requires precautions to avoid the fire to escape (-) The operations are tied to the dry season	(-) Leaves piles of vegetation that hamper field supervision and movement (-) Many contractors and plantation managers are not familiar with the method (-) Stacking or placement of vegetation can be difficult on hilly terrain (+) Windrows can be used for contouring (+) More flexibility in the calendar of operations
On soil and fertility	(-) Bad effect on the soil: friable, sensitive to erosion, lower pH (-) loss of nutrients: at least 50% of N and S is lost in the atmosphere, while P, K, Ca and Mg may be washed away by rains	(+) unburned soil is a better growth media (-) heavy engines compact the soil (-) the nutrients take more time to be released and initial growth of the plants can be more slow (-) If bulldozers are used they have to be used carefully to minimise top soil disturbance (+) Nutrient locked up in the wood material are released slowly to the feeder roots of the planted rubber or oil palm when the dead trees decay
On pests and diseases	(-) Trees that are not uprooted may propagate root diseases	(-) Pests accumulate and multiply on the windrows (especially rats and *Eurycthes* attacking oil palms). They can be partially controlled with cover crops and traps.
On weed control	(-) The growth of bushy weeds is suppressed but *Imperata* may grow more quickly	(+) Less problems with *Imperata*
On costs and profit	(+) Less expensive to implement	(-) More expensive: requires heavy engines and special care (+) If used properly, will reduce the use of fertilisers and improve the growth and yield of the plantation

Source of information: Ling and Mainstone (1983), IOPRI (1998), Yew et al. (1998), D. Boutin (pers.comm.), A.Vincent (pers.comm).

2. Helping farmers to fight *Imperata cylindrica*

For smallholders who cannot use zero-burning because of the cost constraints, the amount of biomass burnt during land clearing could be gradually reduced in the long run by promoting the use of rubber wood (see Ministry of Forestry, Ardes and Enso 1998, Nandika *et al.* 1989). This could be done by identifying group of farmers with a good potential to sell their rubber wood to furniture factories in and around Palembang.

The income from the sales should be used freely by smallholders, with technical assistance to purchase planting material and inputs to develop high-yielding clonal plantations free of bushes and Imperata, hence reducing the fire hazard. The Sembawa research center has already initiated a project in that direction with the

local rubber wood factories and the plantation services, and such initiatives need to be supported.

Extending financial assistance to smallholders who have planted clones and who find it difficult to maintain their plantations free of undergrowth and *Imperata cylindrica* remains by far the main way to reduce fire hazard in rubber plantations while raising the income of the farmers. This could be done by setting up a credit fund extended to smallholders for cleaning their plantations, especially when invaded by Imperata and during El Niño years.

3. Democratic land-use policies with more room for smallholder tree crops

Finally, the only lasting way to reduce the incidence of fires in Indonesia is to promote reforms of land use policies. At the National Level, better concertation is needed to integrate all aspects of development into national policies, including forestry, plantations, environment and socio-economic concerns, and to take into account the needs of local populations.

Smallholder tree crop development programs like the ones funded in the past by the World Bank and the ADB until recently should be revived. These projects provide a unique way to improve the capacity of smallholders to sustain themselves in the long run from high-yielding plantations while creating an environment free of fire hazards.

Oil palm could also be developed as a smallholder tree crop using participatory methods (Boutin and Girseng 1998). This would have the advantage to increase the income of farmers who would then be in a better way to control *Imperata cylindrica* and hence limit fire hazards, while reducing their resentment towards large oil palm plantations leading to arson by fire.

Such projects, however, should be carried with precautions in the choice of beneficiaries and the land allocation process, to avoid the concentration of all the project benefits to a few well-connected villagers controlling land access.

At the Local level, the capacity of the local institutions to develop mapping and participatory land use planning should be increased and the results should be used as the basis for project interventions.

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Bibliography

The extensive bibliography to this report can be found on the internet version of this IFFN issue under:

< http://www.ruf.uni-freiburg.de/fireglobe/iffn/iffn_21/content.htm >

Pilot Project Planning for Fire Suppression Mobilization in Riau and South Sumatra Provinces

Background

The United States East Asia and Pacific Environmental Initiative includes a component to assist the Association of Southeast Asia Nations (ASEAN) to strengthen fire management and fire suppression coordination capabilities within the region. Under the auspices of the Association of Southeast Asia Nations Haze Technical Task Force (HTTF), fire suppression capability surveys were conducted in selected ASEAN countries and Indonesian provinces during the summer and fall of 1998. In collaboration with an Asian Development Bank Regional Technical Advisory Team (RETA), the United States Forest Service (USFS) took a catalytic role in initiating and coordinating this activity, providing USFS fire experts to work with the teams, and funding costs for Indonesian participants. Findings from this assessment identified strengthening fire suppression organizational structure and mobilization capacity within Indonesia as important issues. A conceptual mobilization plan framework was developed by the USFS and presented at the December, 1998, joint meeting of the Sumatra and Borneo Sub-Regional Fire Fighting Arrangement (SRFA). A pilot project to develop a prototype fire suppression mobilization plan for the provinces of Riau and South Sumatra was endorsed by the Sumatra SRFA. A USFS representative arrived in Southeast Asia on 24 February 1999, to collaborate with the RETA in laying the groundwork for the mobilization plan development activity. During 4 April to 6 May 1999, a team that included two USFS fire suppression technical advisors travelled within Riau and South Sumatra provinces to collect information necessary to develop a prototype mobilization plan of selected areas within the provinces. This information also served as an analytic tool for identifying strengths and weakness in the existing fire suppression mobilization system and developing recommendations for improvement.

Objectives

Forest and land fire management issues in Indonesia are complex and controversial. The focus of this activity is fire suppression mobilization capacity in the event of unwanted fire or haze.
Objectives of the fire suppression mobilization plan activity were as follows:

* Build capacity for developing fire suppression mobilization plans

* Develop a nucleus prototype plan reflecting the existing fire suppression mobilization capacity for selected areas within Riau and South Sumatra provinces

* Based on information collected during development of the prototype plan, analyze strengths and weaknesses of existing fire suppression mobilization system

* Develop recommendations at a provincial level for improving fire suppression mobilization capacity.

Methodology

An international and multi-agency team concept was determined as the best approach for this activity. The team roles were identified as follows: a leader from the Indonesian Ministry of Forestry and Estate Crops (Echelon III or IV), national fire experts from selected ASEAN countries, a local provincial fire expert from Dinas Kehutanan (Province Forestry Agency), a local provincial environmental expert from BAPEDALWIL/DA (Province Environmental Impact Agency), two USFS international fire specialists, and one translator/liaison officer. The team spent 2 1/2 weeks in Riau Province (5-22 April) and 1 1/2 weeks in South Sumatra Province (25 April - 6 May), travelling to selected locations to conduct interviews and visit sites. Individuals interviewed included government officials from a variety of agencies at all levels with responsibilities for fire management, military officials, forest concessionaires, private companies utilizing forested land, NGO representatives, village chiefs, and firefighters. The team visited emergency command centers and a variety of field sites, examined fire fighting equipment, and collected inventory lists, maps, cooperative agreements, and other pertinent documents. Only observable and verifiable, or reasonably conclusive information, was included in the prototype mobilization plan. The information provided the basis for identifying strengths and weaknesses of the existing system and developing recommendations.

Findings of the Fire Suppression Mobilization Team

* Indonesia is recognizing the need to move from a fire protection system based on economic/livelihood interests, towards a system responsive to government determined priorities. This recognition is fuelled by global concerns of the health and economic impacts of episodic regional haze caused by forest and land fires.

* For a variety of reasons, government agencies are not prepared to support forest and land fire suppression activities. The Ministry of Forestry (MOFEC) and the provincial Forestry Agency (Dinas) have minimal forest fire suppression capabilities and focus their limited resources on monitoring and reporting. The minimal fire suppression resources of the Civil Defense are focused on protecting human life and community. A province level mapping exercise, displaying areas covered by fire protection entities would reveal vast areas with either no identifiable responsible entity or identified responsible entities with inadequate suppression resources.

* Seasonal haze is not perceived as a major problem by local people and is accepted as an episodic inconvenience that is simply endured. Among villagers, there is a lack of awareness of the adverse health impacts of haze and even less awareness of the implications of transboundary haze. Thus, the presence of seasonal haze is not considered a situation warranting fire suppression action. If a reduction in haze occurs as a result of fire suppression action, it is an incidental by-product and not an objective.

* In the fire prone provinces of Indonesia, provincial government agencies are recognizing and grappling with the regional concerns over health and economic impacts of haze caused by forest and land fires in Indonesia. Among government agencies, the haze problem is recognized as a symptom of more fundamental and profound socio-economic issues of land management. These larger issues contribute to a general sense of powerlessness within government agencies to take effective suppression action. Attempts to move towards a fire suppression system responsive to government priorities are in the tentative stages.

* Riau and South Sumatra provinces have potential to develop and implement effective fire suppression mobilization processes within existing structures and organizations. However, all available resources and coordination mechanisms are not recognized or utilized to the fullest extent possible.

The matrix (Tab.1) lists the components of an effective fire suppression system and, if relevant, the possible causes of unrealized potential for each, as noted in Riau and South Sumatra provinces.

Results of the Fire Suppression Mobilization Planning Activity

* A significant outcome of this activity is a strengthened capacity of team members for developing mobilization plans. Initially the international fire specialists took a lead role describing the format and contents of a mobilization plan, identifying important entities to visit, and formulating interview questions. As the teams progressed, Indonesian team members took an increasingly active role in the plan development and ended up writing the entire prototype plan with minimal assistance. As information was collected, the team developed capacity for analyzing the strengths and weaknesses of the existing fire suppression capability and developed recommendations for improvement.

* The Indonesian team members in both Riau and South Sumatra initiated an environmental NGO and student group seminar to introduce the plan and forge collaborative relationships for fire suppression activities. The seminar participants were fully engaged and supportive of the intent. On the last day of the South Sumatra trip, the team leader initiated an interagency meeting to introduce the prototype plan and generate support for developing a comprehensive province-wide plan.

* As the team met with various agencies, it became apparent that these agencies had not previously met together to discuss fire suppression issues and were unaware of resources that each could offer. The meetings provided a forum for dialogue around fire management issues and a better understanding of the role each might play in mobilizing to fight fire. Many previously unrecognized resources were identified as available and willing to become involved in fire suppression efforts. In some of these meetings, informal agreements were made for future collaborative training and sharing of information.

* Changing land use, previous fire activity, institutional structures, the presence of donor country activities,

and other factors may influence the progress of fire suppression mobilization planning between provinces.

Tab.1. Matrix list of components of an effective fire suppression system

	Functions Well	Lack of Expertise	Un-recognized Resources	Lack of Program Support	Economic or Social Disincentive
Coordination Mechanisms		X	x		
Funding Mechanisms				X	x
Adequate Human Resources			X	x	
Community Response Capability	X				
Adequacy of Fire Fighting Tools			X		
Fire Training		X	X	X	
Adequate Logistic Support			X	x	
Cooperative Agreements	X (informal)	X (formal)			
Concessionaire Fire Protection Resources					X

X – major cause of unrealized potential -- x – minor cause of unrealized potential

Follow-up Activities

Developing prototype mobilization plans is one step in an on-going process to strengthen Indonesia's capacity for fire suppression. Developing a comprehensive, province-wide mobilization plan, implementing the recommendations from the prototype plans, and working on areas of identified unrealized potential are logical next steps in the process.

Further Information

Additional information or a copy of the final report entitled "Pilot Project Planning for Fire Suppression Mobilization in Riau and South Sumatra Provinces" can be obtained from Gary Man, United States Forest Service Asian and Pacific Program Manager (Tel: + + 1-202 273-4740) or Deanne Shulman, Fire Management Specialist, United States Forest Service (address: see below). The final report includes prototype mobilization plans from both Riau and South Sumatra provinces.

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ITALY

Forest Fires in Italy 1998

Between 1 January and 31 December 1998 a total of 31,9540 forest fires occurred in Italy, involving a total area of 155,553 ha, of which 73,017 ha were wooded and 82,536 ha were non-wooded.

As compared to 1997, forest fires worsened greatly, not so much in terms of the number of fires as in terms of the area burned. The area burned in 1998 was 60% higher than the average of the last ten years. The total area struck by forest fires is three times that of 1995 and 1996, despite the increase in defence capabilities. This increase depended largely on the weather conditions: in fact, the summer was the hottest and muggiest of the last six centuries. Compared to the same period, the wooded area affected by fire increased by 4 times during 1998.

Tab.1. Number of forest fires and area burned by fires from 1987 to 1998

Year	Number of fires	Area burned			
		Wooded (ha)	Non-wooded (ha)	Total (ha)	Average (ha/fire)
1988	13,558	60,109	126,296	186,405	137
1989	9,669	45,933	49,228	95,161	9.8
1990	14,477	98,410	96,909	195,319	13.5
1991	11,965	30,172	69,688	99,860	8.3
1992	14,641	44,522	61,170	105,692	7.2
1993	14,412	116,378	87,371	203,749	14.1
1994	11,588	47,099	89,235	136,334	11.8
1995	7,378	20,995	27,889	48,884	6.6
1996	9,093	20,329	37,659	57,988	6.4
1997	11,612	62,775	48,455	111,230	9.6
Average	11,875	52,999	72,010	125,009	10.5
1998	9,540	73,017	82,536	155,553	16.3

What is definitely alarming about theses statistic is the average area per fire, which went from 9.6 ha per fire in 1997 to 16.3 ha per fire in 1998. Extending the observation period from January to December, the Regions most affected in terms of the areas struck by fire are consistently Calabria, Sicily, and Sardinia. In Calabria, each fire covered in average 49.2 ha, in Sicily 40 ha, and in Abruzzo 32.2 ha, values clearly over the national average registered in the past 10 years.

Forest fires in the last decade have taken on a specific characteristic in terms of time and space, affecting mainly, during the summer, the Regions of Southern Italy and the Tyrrhenian Coast, and in the winter, the Alpine regions. Also in 1998, climate influenced the winter fires: wind and a lack of precipitation made the vegetation prone to fire.

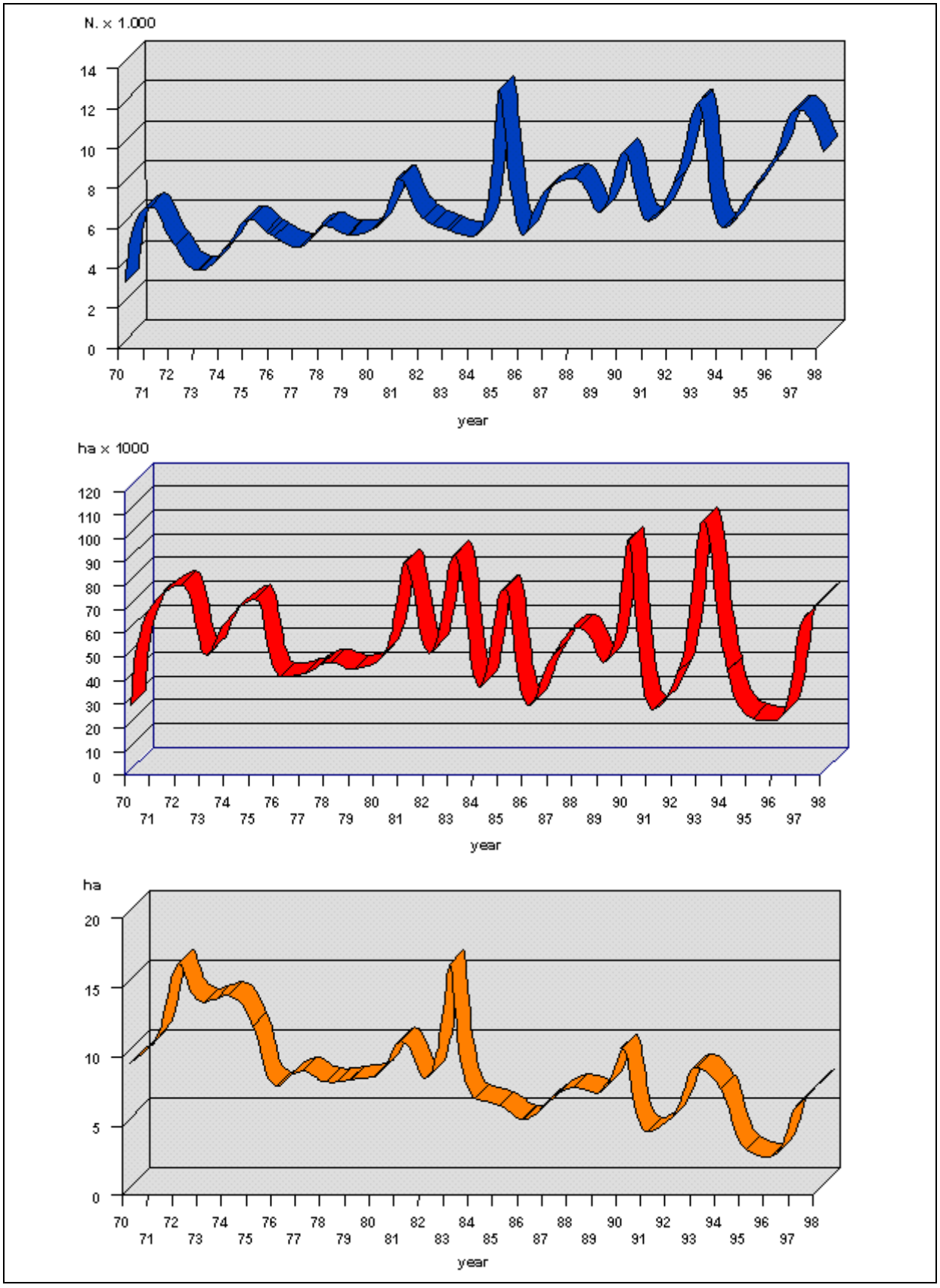

Fig.1. Long-term fire statistics of Italy for the period 1970-1998: Annual number of fires (upper), area affected by fire (middle), and average area burned per fire (lower)

Tab.2. Forest fires in 1998 by Region

Regions	Number of fires	Area burned by fire		
		Wooded (ha)	Non-wooded (ha)	Total (ha)
Piedmont	459	2,096	2,224	4,320
Aosta Valley	17	51	13	64
Lombardy	455	3,320	1,430	4.750
Trentino A. A.	102	148	34	182
Veneto	101	454	235	689
Friuli V. G.	118	401	264	665
Liguria	499	3,879	2,118	5,997
Emilia Romagna	207	855	622	1,477
Tuscany	567	3,640	1,040	4,680
Umbria	138	608	346	954
Marches	83	589	85	674
Latium	439	2,746	2,218	4,964
Abruzzo	77	1,407	1,069	2,476
Molise	44	121	375	496
Campania	533	2,150	1,564	3,714
Puglia	345	2,424	1,858	4,282
Basilicata	263	1,362	1,317	2,679
Calabria	1062	17,446	26,537	43,983
Sicily	894	16,543	19,243	35,786
Sardinia	3,137	12,781	19,943	32,724
TOTAL	**9,540**	**73,017**	**82,536**	**155,553**

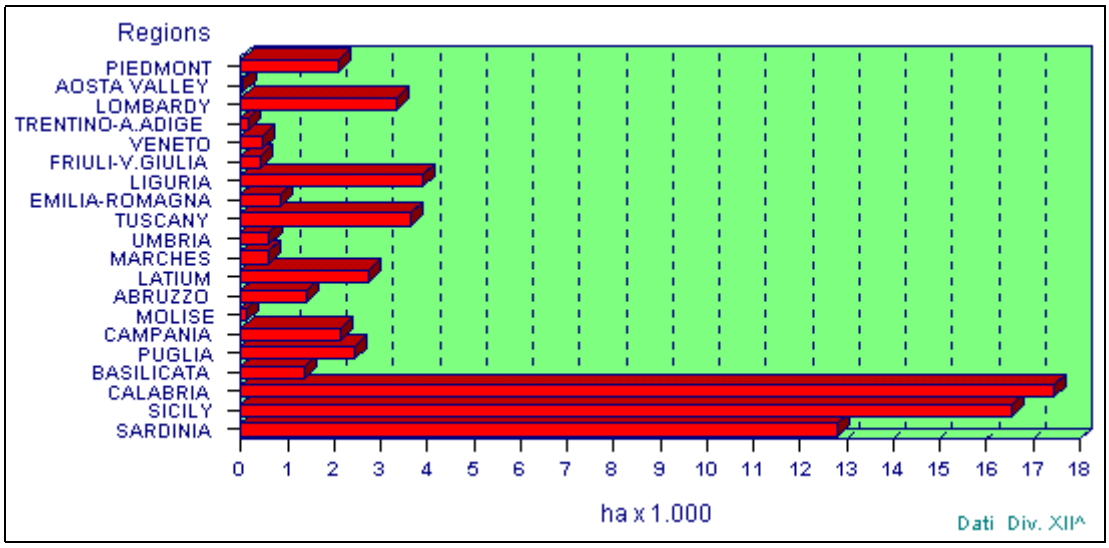

Fig.2. Graphic illustration of wooded area burned in 1998 by Region

Tab.3. Forest fires by month

Month	Number of fires	Area burned by fire		
		Wooded (ha)	Non-Wooded (ha)	Total (ha)
January	68	158	149	307
February	647	2,717	2,746	5,463
March	1,045	6,650	3,221	9,871
April	240	930	209	1,139
May	88	263	116	379
June	874	9,448	9,852	19,300
July	2,637	33,471	49,520	82,991
August	2,469	15,459	11,601	27,060
September	1,076	2,306	3,451	5,757
October	117	658	293	951
November	164	521	199	721
December	115	436	1,179	1,615
Total	**9,540**	**73,017**	**82,536**	**155,553**

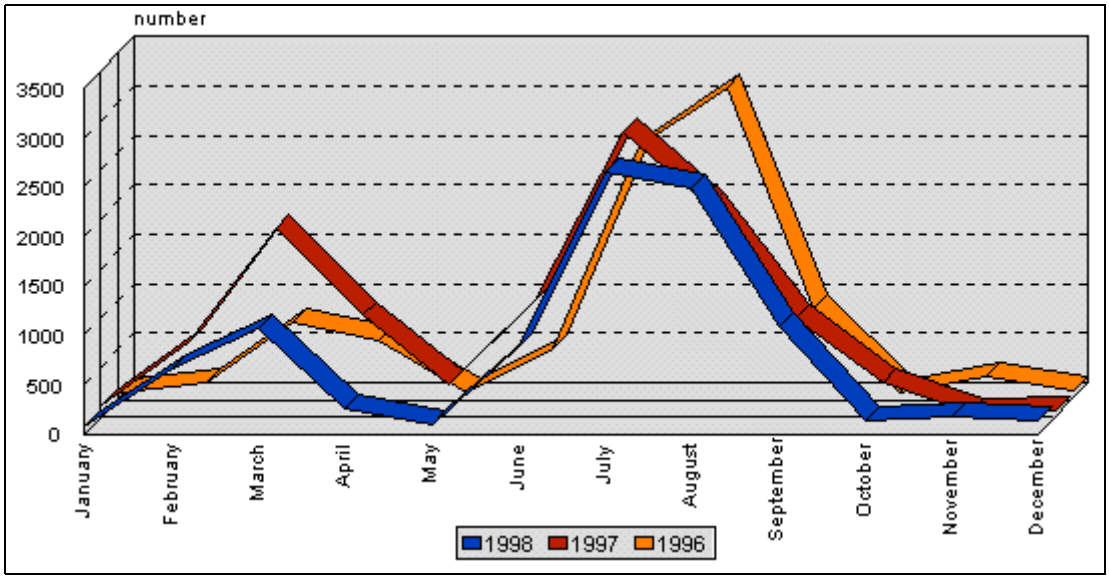

Fig.3. Distribution of the number of forest fires by month during the period 1996-1998

Over the winter period, from January to March, 1,760 fires occurred, while the area struck by fire was equal to 15,641 ha, of which 9,525 ha wooded, over 10% of the wooded area that burned in the entire year of 1998. During the winter, the Regions most affected were, in decreasing order: Liguria, Lombardy, Piedmont, and Tuscany, in terms of total burnt area.

In the summer period, characterised by prolonged drought, very high temperatures, strong winds and touristic mobility, fires were particularly serious: 6,182 fires occurred (65% of the annual total), involving a total area of 115,808 ha (74% of the annual total), of which 51,236 were wooded areas (70% of the annual total).

The Regions most affected were, in decreasing order: Calabria, Sicily, Sardinia, both for the total area struck by fire, and for the wooded areas burnt. Again, Sardinia, Calabria, and Sicily were the Regions that registered the most number of fires in the summer period.

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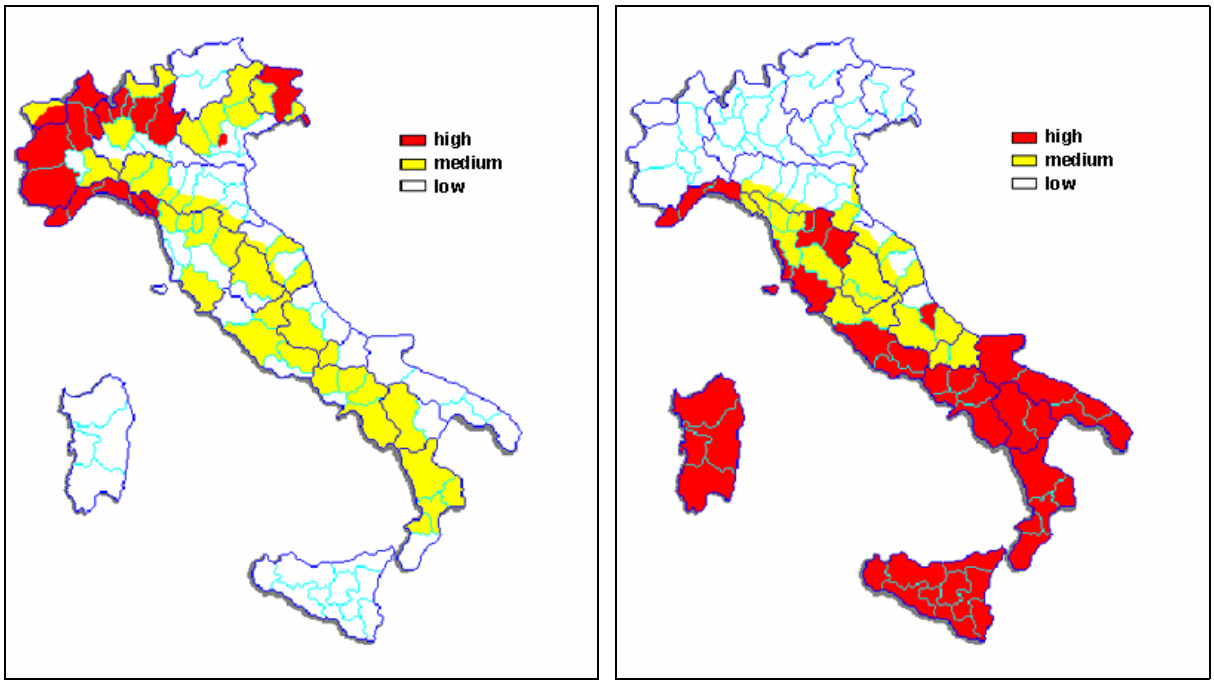

Fig.4. Left: Areas at risk of forest fires in the first quarter (1989-1999 period). Right: Areas at risk of forest fires in the third quarter (1989-1999 period).

Most fires began on Sundays, confirming the trend of previous years:

Fires by the days of the week (%)

Monday	14,0	Friday	13,6
Tuesday	14,8	Saturday	14,4
Wednesday	13,8	Sunday	15,9
Thursday	13,5		

From the analysis of fires by the size of the area, it comes out that the worst damage caused by fire is due to those fires that struck an area of over 100 ha. Such fires affected 54.2% of the wooded areas burned in 1998. Fires that affected less than 1 ha were 52.1% of the total.

Tab.4. Fires in size of area (%)

Size	1997		1998	
	Number of fires	Wooded area	Number of fires	Wooded Area
< 1 ha	48.23	1.6	52.09	0.95
1-5 ha	34.8	13.2	30.31	8.07
5-100 ha	16.9	49.1	16.52	36.81
> 100 ha	0.07	36.1	1.08	54.17

The worst fires of 1998 took place, in winter time, in Lombardy and Veneto, and, in summer time, in Calabria and Sicily. In all cases, the average area per fire was extremely high. In Calabria, 17 fires were over 1,500 ha in size on average for each fire.

Tab.5. Number of fires affecting wooded land exceeding 100 ha

Regions	Number of fires	Average area burned per fire
Piedmont	2	370
Lombardy	7	275
Friuli V.G.	1	210
Liguria	7	238
Emilia Romagna	2	235
Tuscany	5	376
Marches	1	225
Latium	2	174
Abruzzo	2	615
Campania	2	345
Puglia	4	175
Calabria	17	1.853
Sicily	31	549
Sardinia	20	827
Total	**103**	**730**

The analysis of the percentage incidence of the number of fires by the orographic type of territory shows that 61.9% of fires developed in the hillsides and 30.9% in the mountains (Tab.6).

Tab.6. Percentage incidence of the number of wildfires by orographic type of terrain and by altitude in 1998.

Flat lands	6.4	up to 500 m altitude	53
Hillsides	61.9	from 500 to 1000 m	39.6
Mountains	30.9	from 1000 to 1500 m	6.6
Mountain tops	0.08	over 1500 m	0.8

The majority of fires developed at altitudes under 1000 m a.s.l.: Only 7.4% of all fires occurred on altitudes > 1000 m a.s.l.. Conditions of moderate or strong winds favoured the spreading of 50.3% of fires, while conditions of very strong winds affected 1% of fires.

Causes of Fires in 1998

The analysis of the causes of fires in 1998 confirms once again the high incidence of human responsibility for the destruction of wooded areas struck by fires, of which 76.3% is due to deliberate action.

The analysis of accidental causes in 1998 allows us to affirm that most fires that occurred for these reasons were due to agricultural activity, followed by cigarettes and matches, which contributed significantly to the starting of fires. Recreational activities had a modest effect, confirming that civic sense is continuously increasing among citizens.

In order to put out fires, 155,752 interventions were necessary in all of Italy (excluding Sardinia), including forestry personnel, fire brigades, police, armed forces, workers, and volunteers.

Unfortunately, again in 1998, fires took victims. Six people, specifically one worker, one member of the police force, two citizens, and two arsonists died in Piedmont, Emilia Romagna, Calabria and Sicily. The wounded amounted to 81, of which 34 were workers and volunteers, 12 were forestry personnel, 13 firemen, 14 from local organisations, and 8 arsonists.

The global evaluation of damages, in terms of wood mass destroyed and costs related to the restoration of forest cover, amounts to approximately 90 billion lire, of which 60 for fires caused deliberately.

Tab.7. Causes of fires in 1998

Causes	Incidences as a percent of the number of forest fires	Incidences as a percent of the total area
Natural	1	0.3
Deliberate	50.7	73.7
Accidental	12.6	8.1
Unknown	35.7	17.9

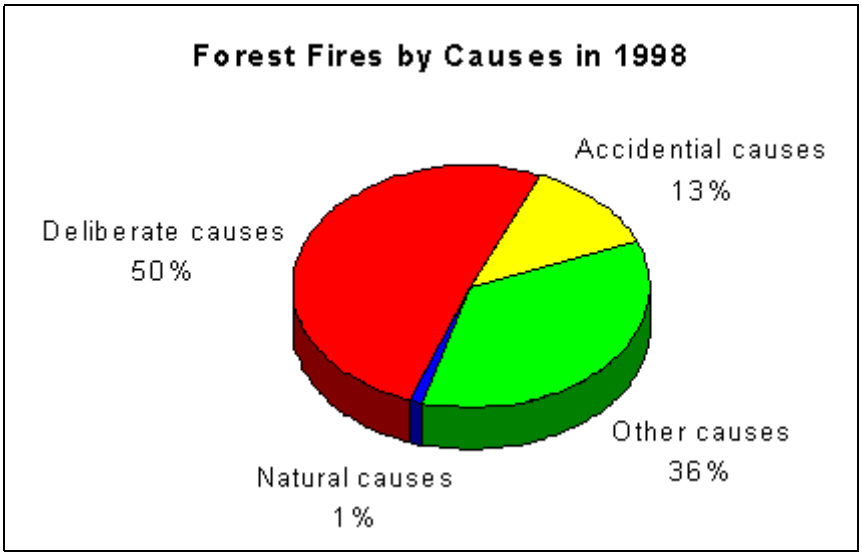

Fig.5. Forest fires by causes in 1998

Use of Aircraft in Forest Fire Fighting

In 1998, the Unified Aircraft Operations Centre co-ordinated the use of aircraft over 1,400 fires, carrying out 2,787 missions for a total of 6,464 hours of flying time. For the fire-fighting missions co-ordinated by the Unified Aircraft Operations Centre, the following aircraft were uses (Tab.8):

Tab.8. Types of aircraft, flying times, missions and launches involved in fire protection operations in Italy in 1998

Type of aircraft	Hours of flying time in missions	Missions	Launches
AB 204	16:05	5	83
AB 205	141:55	48	774
AB 212	474:29	200	2.608
AB 412	999:17	473	6.334
CH 47	441:12	189	1.459
CL 215	1189:35	387	2.809
CL 415	2047:41	784	9.618
G 222	407:21	387	383
NH 500	746:44	315	6.622

The Aircraft Operations Centre of the State Forestry Corps

The Aircraft Operations Centre of the State Forestry Corps, which is involved with its own helicopters in the fight against forest fires, has at its disposal 13 Breda Nardi NH500 helicopters and 9 Agusta Bell 412. The helicopters of the State Forestry Corps operate both in activities of a preventive character and in direct intervention on fires by dropping water from helibuckets.

The helicopter of the State Forestry Corps are also used for the transportation of personnel and fire-fighting equipment, as well as for the co-ordination work of other fire-fighting aircraft sent by the Unified Aircraft Operations Centre of the Civil Protection Forces.

Tab.9. Fire-fighting aircraft missions by regions
(total number of missions: 2,787)

Latium	457	Puglia	91
Liguria	368	Umbria	87
Sicily	323	Lombardy	75
Sardinia	321	Veneto	70
Calabria	321	Emilia Romagna	52
Tuscany	203	Marches	47
Abruzzo	129	Piedmont	7
Campania	123	Molise	6
Basilicata	103	Friuli V. G.	5

Tab.10. Use of helicopters of the State Forestry Corps in 1998

Activity	AB 412 Helicopter	NH 500 Helicopter	Total
No. of direct interventions	6,640	3,989	10,629
A.I.B. Missions	377	291	668
A.I.B. Flying time	708	573	1,281

A.I.B.: Anti Incendi Boschivi = Anti Forest Fire Mission

Tab.11. Activities carried out on fires, by month flying hours

January	5:30	July	427:55
February	43:45	August	530:15
March	136:50	September	80:45
April	38:20	October	1:25
May	--	November	--
June	16:10	December	--

The helicopters of the State Forestry Corps are stationed at the main base of Roma–Urbe Airport and are repositioned over the national territory in high risk periods to reduce as much as possible the time required for intervention against fires.

The European Union Information System on Forest Fires - «The Common Core»

In 1994, the European Commission adopted the 804/94 Regulation, related to the activation of the information system on forest fires. Thanks to this regulation, the survey of a series of data for each fire (the **Common Core)**, is carried out systematically in all the areas that Member States have classified as being at risk.

Currently, the information system The Common Core contains information on over 500,000 forest fires in 319 provinces of the six member states Germany, Spain, France, Italy and Greece for the period of 1985 to 1996.

Tab.12. Detailed composition of the minimum common core of information on forest fires

a) Date of first alarm	Indication of the local date (day, month, year) on which the official forest-fire protection departments were informed of the outbreak of the fire.
(b) Time of first alarm	Indication of the local time (hour, minutes) at which the official forest-fire protection departments were informed of the outbreak of the fire.
(c) Date of first intervention	Indication of the local date (day, month, year) on which the first intervention units arrived at the scene of the forest fire.
(d) Time of first intervention	Indication of the local time (hour, minutes) at which the first intervention units arrived at the scene of the forest fire.
(e) Date of extinction	Indication of the local date (day, month, year) on which the fire was extinguished, i.e. when the last intervention units left the scene of the forest fire.
(f) Time of extinction	Indication of the local time (hour, minutes) at which the fire was extinguished, i.e. when the last intervention units left the scene of the forest fire.
(g) Location of the outbreak	Indication of the municipality and its successive hierarchical authorities (province or department, region, State) where the outbreak of the fire was reported.
(h) Total area burnt	Indication of the total area swept by the fire and the unit of measurement of the area used.
(i) Breakdown of the area burnt into wooded and non wooded land	Indication of the wooded and non-wooded areas swept by the fire.
(j) Cause of the fire	Indiction of the presumed origin of the fire, subdivided into four categories: i. fires of unknown origin ii. fires of natural origin iii. fires of accidental origin or due to negligence, i.e.linked to human activities, but without there having been any intention to destroy a forested area iv. fires of deliberate origin, i.e. linked to the will to destroy a forested area for various reasons

We also have an instrument that provides useful indications of the adoption of forestry strategies for the safe-guarding of forests against fires. This instrument allows us to understand and analyse the phenomenon of fires, to examine the incidence of the actions taken and to highlight the strong and weak points of current defence structures, providing quality indicators for the evaluation of these structures.

The Common Core also provides useful indications for ample international co-operation:

- for the activation of Resolution No. 3 of the Ministerial Conference of Strasbourg related to the protection of forests in Europe against fires (Strasbourg, 1990), the objective of which is to facilitate and encourage the exchange of information on forest fires as homogenous as possible between the various signatory states, with the intention of jointly promoting and improving preventive measures
- in the sphere of the activities of the ECE/FAO committee, concerning forestry statistics
- in the Mediterranean basin, in the context of the work of the CFFSA/CEF/CFPO committee regarding Mediterranean forestry questions "*Silva Mediterranea*" and the International Centre for Mediterranean Agronomic Studies.

Legal references in the forest fire sector

- **Law no. 47 of 1 March 1975:** "Additional norms for the protection of forests against fires".
- **Decree no. 616 of 24 July 1977:** "Activation of the delegate from art. 1 of law no. 382 of 22 July 1975.
- **Law no. 689 of 24 November 1991:** Modifications to the penal system".
- **Law no. 424 of 4 August 1984:** Inclusion of administrative sanctions regarding forest fires defence norms".
- **Law no. 431 of 8 August 1985:** Converting Decree no. 312/82, "Urgent measures for the safe-guarding of areas of special environmental interest".
- **Law no. 752 of 8 November 1966:** "Long-term law for the activation of planned intervention in agriculture".
- **Law no. 183 of 18 May 1989:** "Norms for the reorganisation of soil defence".
- **Law no. 225 of 24 February 1992:** "Founding of the National Civilian Protection Service".
- **Law no. 428 of 29 October 1992:** "Urgent measures to confront the risk of fires in protected areas".
- **Law no. 497 of 8 August 1994:** "Urgent measures to confront forest fires nationally".
- **Law no. 339 of 8 August 1995:** "Urgent measure to prevent and to confront forest fires nationally".
- **Law no. 112 of 31 March 1998:** "Transfer of functions and administrative tasks from the State to the Regions and local organisations, in accordance with Law no. 59 of 15 March 1997".
- **Law no. 61 of 30 March 1998:** "Urgent measures against forest fires."

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MONGOLIA

Forest and Steppe Fire Monitoring in Mongolia Using Satellite Remote Sensing

Introduction

Mongolia is a country located in Central Asian highland with an area of 1,565,000 km^2 and a population of 2.3 million, which makes Mongolia as one of the least populated countries in the world. The country is borders Russia in the North and China in the South. Mongolia is located deep within the interior of the Eurasian mainland far from seas and oceans, is a highland country and has a marked continental climate with poor soil fertility, scanty surface water resources, and harsh natural conditions.

Forests and grasslands play an important role in the economic development of the country. Forest covers 10% and grassland 70% of all territory. Mongolian nature and geography, its economic and social features account for its considerable vulnerability to natural disasters. Winters are often very cold, springs are difficult with blizzards, tornadoes and regular wildfires. Heavy rains and floods occur in summers and in autumn heavy snowfalls, frosts and blizzards are common. This means that throughout the year the country is under pressure of some of these natural disasters.

Some of the disaster experts have estimated the disaster proneness based on the number of human losses. Most of them do not include such natural hazards, like heavy snowfall, drought or wild fires to disasters unless there are not so many human deaths. But in the case of Mongolia, such hazards cause directly and indirectly much more losses to the livestock and, also damage to the environment. Animal husbandry is one of the most important sectors in the Mongolian economy and still is the base of our living conditions. This is why meteorological hazardous phenomena and wildfires, which are affecting on pasture conditions, have such a negative influence on the Mongolian development as a whole.

Satellite Remote Sensing in Wildfire Disaster Monitoring

There are several satellites for monitoring of natural resources, which have been used also in studies on wildfires over the world. In the beginning of the 1970s American researchers have studied forest fire mapping and inventory by using Multi-Spectral Scanner (MSS) imagery on board of Landsat satellite series.

The Geostationary Operational Environmental Satellite (GOES) is part of a network of geosynchronous orbiters designed to provide meteorological observations for the entire world. Besides its usefulness in monitoring and measuring cloudiness, GOES have been used to detect large-scale fires indirectly by the identification of smoke plumes

Also European Resource Satellite ERS-1, American Defence Meteorological Satellite Program (DMSP), Japanese JERS-1 and National Ocean and Atmospheric Administration (NOAA) series satellites are used for vegetation fire studies.

Of the above mentioned earth resources satellites, NOAA series satellite is the most suitable for monitoring after the rapid development of natural disasters, such as wild fires, floods, meteorological phenomena, and so on.

The current sequence of NOAA satellites has been in continuous operation since 1978. There are four major advantages of using NOAA series satellites for fire detection and fuel mapping (early warning).

1. Spectral Resolution. The AVHRR (Advanced Very High-Resolution Radiometer) sensor on board of NOAA satellite acquires data in 5 spectral channels. The Spectral location of Channel 3 (3.55-3.93 (m), coincides with the radiation of maximum intensity from a black body with a temperature 780 to 800K, and is therefore well suited to the detection of elevated heat sources, which indicate the presence of active fires. Channels 4 and 5 (near infrared channels) are located in the thermal infrared part of electromagnetic spectrum where all radiation is emitted by the earth surface according to its temperature and radiation and used for estimation of cloudiness, cold surface of the earth. Channels 1 and 2 are in visible and near-

infrared parts of the electromagnetic spectrum where all radiation is reflected sunlight and widely used for estimation of vegetation cover.

2. Spatial Resolution. Resolution of AVHRR data is 1.1 square kilometres. Although the resolution is rather low, due to very high sensitivity of the channel-3 to the hot sources, even 50m long fire fronts can be detected in the steppe. Full (1.1 km) and lower resolution (4 km) data can be recorded and transmitted directly from the satellite in the High Resolution Picture Transmission (HRPT) for selected areas of the world within a radius of 2500 km from a receiving station.

3. Frequent temporal coverage. Currently, there are 2 NOAA satellites in complementary near-polar orbits, NOAA-12 and NOAA-14, one crossing over Mongolia at local solar times of approximately 07:30 and 19:30, and the other at 02:30 and 14:30. The orbital characteristics are such that with two satellites in operation, the possibility exits for twice daily and twice nightly coverage at any point in Mongolia.

4. Overpass time. The current afternoon, approximately 14:30 overpass time of NOAA-14 is the best available in terms of fire detection and monitoring in Mongolia

Fire damage of the last three years in Mongolia

Forests and grasslands play an important role in the economic development of the country. Forest cover is 12.5 million ha or 8.1% of the Mongolian territory. Forests consist mostly of larch, pine, birch, cedar, spruce and saxauls (*Haloxylon ammodendron*). Grassland covers 70% of all territory. During the last few years Mongolia has experienced various natural or non natural hazards and of them, one of the most dangerous is Forest and steppe fires.

In an average year, 50-60 forest fires and 80-100 steppe fires occur, annually. About 95 percent of steppe and forest fires in Mongolia are caused by human activities. Although the humans cause most fires, nature has the burning materials.

Winters and springs from 1996 to 1998 were extremely dry and were lacking of snow in most areas. From late February to early June, Mongolia suffered from large-scale forest and steppe fires that devastated large parts of the country. Fire damage data are given in Table 1.

Tab.1. Fire damages in Mongolia 1996-98

Year	Provinces affected	Village affected	Number of fires	Area burned (million ha)	Damage (million MN¥)
1996	16	120	417	10.19	371.6
1997	14	98	239	12.44	127.4
1998	15	69	132	3.64	93.9
Total			**788**	**26.27**	**592.9**

Casualties

29 people died, 82 people had different kinds of injuries, and 11,700 livestock died, 218 family houses, 1066 communication facilities, 750 fences, 26.3 million ha pasture and forest burned. Total cost of property 820.2 million MN¥ (Mongolian Tugrig). Ecological and economical damage estimated as 1,850.5 million MN¥.

According to the statistics since 1963 we can see that the frequency of forest and steppe fires has increased (Fig.1).

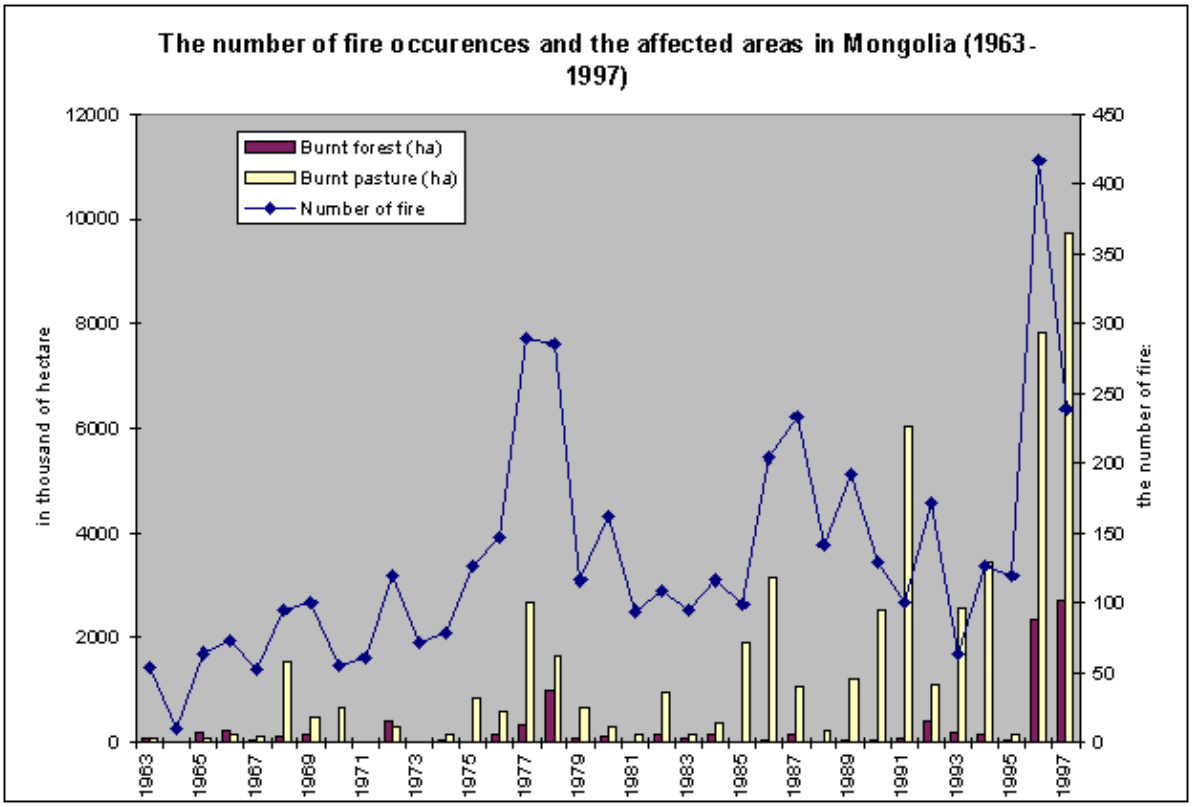

Fig.1. Number of fires and area burned in Mongolia 1963-1997

The methodology of fire detection and main results of fire disaster monitoring

Since establishment of NOAA satellite receiving station at the National Remote Sensing Center of Mongolia, in 1987, the staff of the Center has developed and tested technologies for natural disaster monitoring, such as forest and steppe fire, drought, floods, meteorological phenomena etc.

Recent fire danger situation in forest and steppe zones challenged staff of the National Remote Sensing Center to test and improve their operational technology to quickly process and transfer data containing burning sites to disaster related and administrative organizations. In the last three years, 788 fires were detected primarily by satellite data and thus millions of money was saved. The accuracy of detected hot spots as a fire is estimated as 76.9 % of total number of cases in the last five years.

Figure 3 (see remark further down) shows an example of grassland fire dynamics from 27 March to 7 April 1998: Territory of Dashbalbar village, Dornod Province, northeastern part of Mongolia near the border with the Russia. A total of 984,000 hectares of grassland was burnt in this incident.

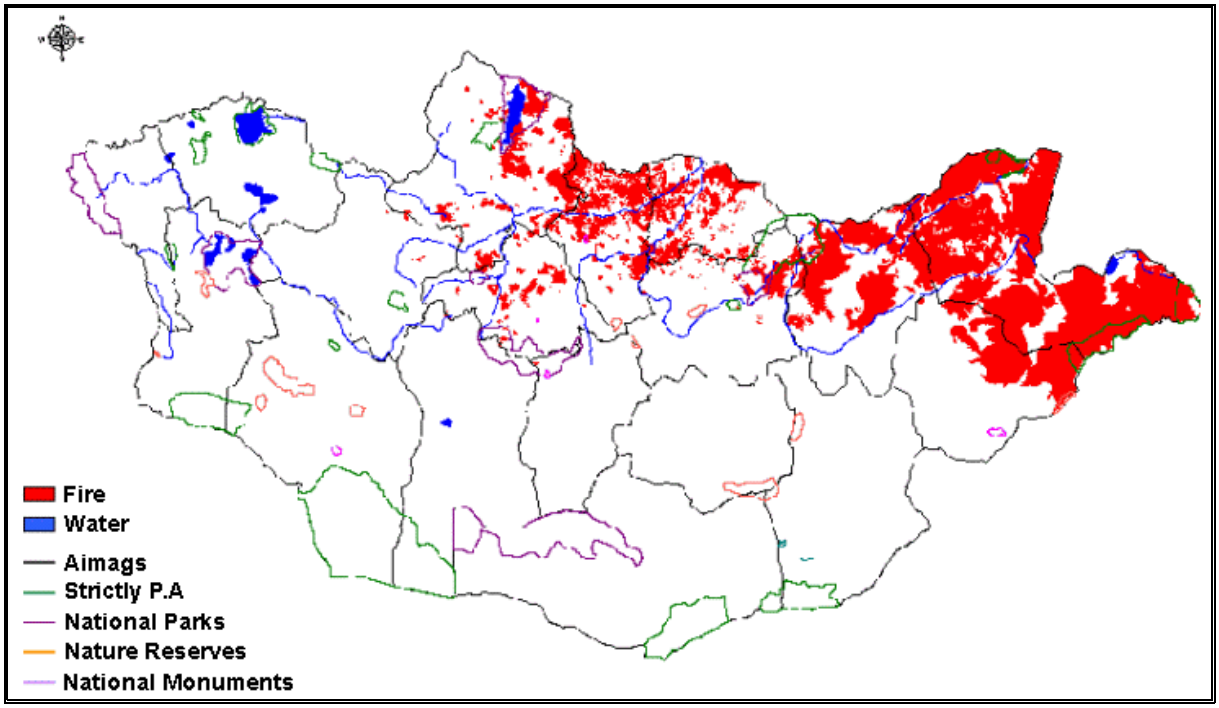

Fig.2. Total fire coverage map of Mongolia 1996-1998

For viewing the satellite imageries the reader of IFFN is kindly referred to the GFMC website version of this contribution. This issue of IFFN can be found at: < http://www.ruf.uni-freiburg.de/fireglobe/ iffn/iffn_21/content.htm > . The satellite imagery section contains a set of well-investigated and documented examples of remotely sensed fires in Mongolia.

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The Social Conditions of Wildfire in Mongolia

Introduction

The increased awareness in the 90s of "natural disasters" and their effects on the human population has been widely publicized. The destruction which wildfires pose in various parts of the world has not escaped the media's attention. Yet, seldom reported are the effects which anthropogenic activity has on the natural environment surrounding human populations. There exists a two-way street rarely spoken of. As pointed out by Machlis (1995) the conservation movement has come to recognize that biophysical and social systems are "inextricably intertwined". Not only are humans effected by natural catastrophes but, to some extent and without intention, even affect them. Hence, the global wildfire trend in many parts of the world is only an example of the effects of human activity in anthropogenically engineered landscapes. It is undeniable that human and social conditions potentially play a critical role in the shaping of the natural environment.

Mongolia, like other countries having abandoned a centralized command economy in the early 90s to embrace an open market one, is currently undergoing the effects of this transition. In addition, the challenges to adapt to political changes from a socialist system to a democratic one in 1996 requires the element of time. Both political and economic level transitions are effected by, and bear consequences at the social level. Similarly, changes at the social level often have a direct impact on the surrounding natural environment. It is with this awareness that plans for the implementation of changes must be considered if they are to be successful in alleviating anthropogenically induced environmental disasters.

Based on the recognition of an inherent symbiotic relationship between the social and natural environments pertaining to the wildfire problem in Mongolia, a four month intensive research study was conducted under the auspices of the GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit) to identify the underlying reasons for increased wildfire occurrence, particularly acute in Mongolia since 1996. The research findings were extensive, touching upon all aspects (political, economic, and social) of Mongolian culture as they pertain to wildfire. This article, for purposes of brevity, will therefore only summarize some of the more particular social conditions relating to the current wildfire problem in Mongolia.

Mongolia's Current Wildfire Situation

Though Mongolia's forest types are naturally adapted to fire, the increase in fire frequency and intensity within the past few years has disturbed this naturally occurring cycle. Forests cover approximately nine per cent of its territory (Valendik et al. 1998). This would amount to approximately 17.5 million ha of land. Since 1990, more than one half of the forested area, has been effected by fires, while 10.7 million ha of this amount was burnt in 1996 alone (Tsedendash 1991). In 1996, 368 fires occurred effecting 14 *aimags* (provinces), more than doubling the figures for normal years of fire occurrence (Mongol Messenger 1998). The continuing trend of fire in Mongolia has been highlighted post 1996 by the fact that 239 fires occurred in 1997, and the latest figures indicate that more than 3.1 million ha were burned during the spring fire season of 1999.[3] All of these fires are thought to be anthropogenically caused. The general belief among those interviewed is that there is a definite correlation between the increase in fires within the past three years and the current economic situation. It is felt that the rise in anthropogenically caused wildfires is a direct result of changes to the country's socio-economic conditions.

Mongolia's Current Social Condition

The basic fact is that since the transition to democracy and open market economy Mongolia has, and continues to, develop rapidly. Domestic economic instability in 1991 provided the challenges of inflation and unemployment, plus a large deficit inherited from the absence of Soviet budgetary support. In addition, the country's economic growth has since this time been largely stagnated perpetuated by its small population, poor transport and communication networks, the existence of few industrial establishments, poor infrastructure, lack of domestic markets, increased poverty, and high unemployment (the most notable change).

[3] It should be noted that exact figures relating to Mongolia's fire history continue to be either rare or non-existent making accurate comparisons extremely difficult.

Since the beginning of the transition period, 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. 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.

Hence, dependency on natural resources for means of subsistence has led to dramatically increased pressures on natural surroundings and protected areas. It was reported that there is generally no choice for people but to use natural resources for subsistence survival. Some people have exhausted their numbers of livestock by selling them off for food and clothing and have in the process become very poor with little alternative but to gather and sell natural resource products. Particularly the young are forced to sell these products 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, the collection of non-timber forest products (deer antlers, pine nuts, berries, herbs and grasses). As alternatives for income diminish, so does the concern for nature in general: "People are interested in nature in order to find a profit, instead of protecting it. Because Mongolians export deer horns and deer tail at high prices" (personal interview). It was said that the past three years has been particularly "bad" in terms of the numbers of people going into the forest due to everyone's current need for a means of acquiring an income.

Physical Mobility: A Move for the Better?

To accentuate the problem of increased human activity in natural areas is the general trend in increased migration patterns. Increased human activity in more natural areas is contributed to by the general increase in physical mobility, as people more actively move about in the hopes of improving current social conditions. Not only is the rural population dependent on natural resources, but so also the urban population. Hence, the impact of physical mobility on wildfires is said to be significant as urban dwellers travel to natural areas and are believed to, out of inexperience and carelessness in dealing with nature, cause the occurrence of wildfires.

Significantly contributing to the rise in physical mobility is, in particular, the return to the traditional occupation of livestock herding. The basic reason for this shift to a pastoral way of life is largely, if not solely, due to the current economic downturn since the onset of market economy. Many feel that raising livestock is the only sensibly viable solution against increasing unemployment, poverty, and inflation. However, this trend has significant impacts on the shaping of, not only the communities or social environments which it effects but also, the natural environment, upon which the communities depend. Against the backdrop of uncertain economic times, a large portion of the population are no doubt merely trying to survive. However, this means of survival cannot be deemed sustainable if the current trend is to continue. As is the case in many developing countries, a compromise is currently being made, whereby human subsistence is weighed against humanly dependent natural areas.

A direct result of these additional pressures, connected to the trend in occupational herding, is the increasing potential for anthropogenic wildfire occurrence through increased factors of risk. Risk factors include intensive natural resource utilization and rangeland preparation - possibly with the use of fire. Hence, it is to be expected that an increase in occupational herding, unless better controlled, will inevitably have a significant impact on the future of the environment and fire management strategies.

Impediments to the Reduction of Anthropogenic Wildfire

Measures to alleviate the wildfire problem has been said to have been hindered by the challenges dealing with environmental law implementation and enforcement. It was said that law enforcement improvements should be the onus of the people to not only be more careful with fire, but also be more responsible in the appropriate implementation of environmental laws. Since the jobs of law enforcement officers is seen to be difficult, it was expressed that local citizens must assist them by informing them of activities in the forest. However, difficulties in social conditions is said to be largely responsible for the inability of local citizens to act responsibly in enforcing the laws.

Fig.1. The rural communities in Mongolia face difficult living conditions after the political and socio-economic changes in the country.

Fig.2. Mongolian herdsmen at the highly flammable steppe-forest interface of Mongolia. Photos: Soo Kuen Ing

The problems of weakening social controls has been associated with the transition to democracy and market economy. The attitude expressed by many is that, for most people, "watching over our livestock is our only concern" (personal interview). People tend to show a lack of interest in getting involved with the dealings of others during difficult times, as was expressed by a local in this way: "if one of them were my acquaintant, I would not automatically betray him to the police. Since it is a small *soum* (county), there are only a few people, so we do not automatically betray each other" (personal interview). Law enforcement is hindered as empathy for the other is high in the face of current economic hardships.

In addition, the general lack of knowledge on laws was blamed on poor information dispersal since democracy. Though it was said that radio and television stations do, on occasion, broadcast laws, many citizens have no access to either source. It was often mentioned that newspapers and other methods of obtaining information are also difficult for rural citizens to acquire, coupled with a general lack of interest on legal issues. Those who had some knowledge of environmental laws claimed the inappropriate implementation of some of them. An example mentioned was the 1997 issued Order by the Minister of Nature and Environment which prohibits people to enter the protected area from 10 March - 1 June (since this time period coincides with the spring fire season). However, as this time of year also coincides with the period for antler collection it was voiced to not be in conformity with the needs of the people, resulting ironically in increased wildfire risk: "If we allowed people to go they would not cause a fire. If we forbid people to go then they would go secretly. If they happen to see us going to do our usual check up in the forest they run away after causing the fire" (personal interview with forest ranger). Hence, there is a clear problem noted in regards to the appropriateness of the Order. Whereas people used to go with permission (enabling monitoring and control), the new Order no longer allows the issuing of permission during this period, resulting in people stealthily entering the forest. The implementation of the Order is, therefore, inappropriate and counterproductive to meeting objectives to reduce wildfire risk.

The breakdown in law enforcement effectiveness is thought to rest upon the general weakening of responsibility at the federal and provincial levels. It was expressed that if these levels of government were to tighten up on law enforcement controls then local law enforcement would also improve. In cases pertaining to violations of environmental law it is usually the rangers and the environmental state inspector who enforce the law. However, 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 enforceable under the 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 social conditions are 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 to the extent that it is not fully supported by higher government levels resulting in haphazard, largely inefficient, and non-standardized practices.

Toward a Holistic Socio-Ecological Understanding of Wildfire

With closer examination, it becomes obvious that the current wildfire problem in Mongolia is complex. The basic underlying reasons for the increase in wildfire occurrence, particularly noticeable since 1996, are directly related to the effects of the fundamental issues of poverty and inappropriate development. These issues are at the heart of most of the potentially negative trends.

Increased herding practices supplemented by lowered education, resulting in an increase in natural area and resource utilization, and the elevation of anthropogenic wildfire risk must be broken in order to effectively and sustainably tackle the problem of recently increased anthropogenic wildfire occurrence. Alternatives addressing the above social issues is necessary to counter the trend in lifestyle change. Sustainable herding practices would mean a reduction in the numbers of herders and the creation of a better infrastructure to provide avenues for business and trade, while education, particularly targeting male youths, must become more accessible in preparation for other occupations.

Urban to rural mobility has a great impact on the increased numbers dependent on natural resources. As support measures to rural areas become limited or absent due to governmental constraints employment or development opportunities continue to decrease thereby increasing poverty, and further promoting dependency on natural resources for locals' subsistence and income. 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. In addition, if local statements indicating an increase in the use of rural environmental areas by urban dwellers for purposes of income generation are accurate then fire management plans need to address this issue with increased and more widespread active prevention programs within more urban areas as well. Due to the obvious correlation between poverty in rural areas with the amount of dependency on natural areas and their resources, physical mobility trends must be more fully understood so as not to become immense barriers to the successful implementation of fire management plans in the reduction of anthropogenic wildfire occurrence.

As poverty is one of the main reasons for the heavy reliance on natural areas and their resources, the development of rural areas is crucial for the alleviation of current pressures. Unemployment and the current trend in the uneven distribution of wealth and opportunity since the transition to market economy only further emphasizes the need to address these problems. Under the present situation, rural development would require conscious efforts to be made in the creation of incentives focusing on decreasing human dependency on natural areas. Living conditions to address the level and extent of poverty must be improved. Only through these changes can both physical and social mobility patterns hope to be altered as social demands on natural areas be reduced to minimalize anthropogenic wildfire risk and potential occurrence.

Some of the research's findings, as given here, illustrate 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 needs 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 revealed in the research serve to assist in the recognition of the wider social conditions currently having an impact on the recent increase in anthropogenic wildfire for the areas of Batschireet and Mongonmort.

Support for the conservation of nature must be accompanied by a valuing of it at all levels - individual, local, national, and global. In Mongolia, this issue is a sensitive one. Current social conditions have caused an overvaluing of the natural environment for its resources resulting in an elevation in wildfire risk and occurrence.

It is hoped that the results of this study will assist in addressing pertinent social issues before they become unsurmountable and cause irreparable damage to the natural environment upon which the social environment in Mongolia so greatly depends. If not addressed, the social problems revealed in this research study will continue to exist regardless of whether wildfire occurrence continues to be the symptom. 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 around Batschireet and Mongonmort - 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 after. Improvements need to be made to the area of law implementation and enforcement. The trend toward a breakdown in social controls is but yet another symptom of the serious concerns which need to be confronted within society. Poverty, inflation, and unemployment are some of the major societal ills which need to be addressed.

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 consequence could very likely be a turn to the adherence of laws.

Conclusions

The study revealed that the current problem of wildfire in Mongolia is largely a result of the causal relationship which exists between the social conditions now existent in Mongolia and the activities which are born out of the needs of the people. According to those interviewed, it is a fact that the increase in the number of wildfires since the mid-1990s corresponds to changes in social conditions.

Recognition of the symbiotic relationship between social conditions, human activity in natural areas, and the occurrence of anthropogenic wildfire stresses the importance of each of these components for the effective minimalization of the current anthropogenic wildfire problem in Mongolia. Since both natural and social environments are so closely interconnected and interdependent of one another for a healthy existence, a fragile balance must be strived for to ensure the well-being of both. There is a very strong anthropogenic component to the seemingly "natural" wildfire problem in Mongolia. In recognizing the importance of this relationship, it is necessary to address the problem of wildfire in Mongolia holistically and in accordance with social scientific values. Local needs and sustenance requirements must be considered since natural resource utilization is bound up with these needs. If the basic social and economic requirements of the local population were to be adequately met then future pressures on these environmental areas would be reduced as a direct consequence. An awareness of the symbiotic relationship which humans share with their environment is of fundamental importance in understanding the causes and effects of this interaction in order to alter the current negative wildfire trend.

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NEWS FROM INTERNATIONAL ORGANIZATIONS

UN-FAO/ECE/ILO Team of Specialists on Forest Fire Report of the 1998-99 Activities

After the last team meeting which was held in conjunction with the 1st Baltic Conference on Forest Fire which was held in Warsaw, May 1998 (see IFFN No. 19 - October 1998), the following international organizations were supported and actions were taken:

Food and Agriculture Organization (FAO)

The FAO Expert Meeting "Public Policies Affecting Forest Fire" was held in Rome, October 1998 (for general update information: see below "News from FAO"). Several team members (E.Bilgili [Turkey], E.Davidenko [Russia], H.Frelander [Finland], J.Goldammer [Team Leader, Germany], R.Velez [Spain]) and UNECE (J.Najera) contributed to the meeting and the final FAO report by a preparatory paper, country report or rapporteur.

Publications: Bilgili, E. 1999. Forest fires and fire management policies in Turkey. In: Proceedings, FAO Meeting on Public Policies Affecting Forest Fires, 357-361. FAO Forestry Paper 138.

Davidenko, E.P. 1999. Comments on the situation in Europe and boreal/temperate Asia. In: Proceedings, FAO Meeting on Public Policies Affecting Forest Fires, 165-167. FAO Forestry Paper 138.

Goldammer, J.G. 1999. Public policies affecting forest fires in Europe and boreal/temperate Asia. In: Proceedings, FAO Meeting on Public Policies Affecting Forest Fires, 113-164. FAO Forestry Paper 138.

The expert meeting was followed by the FAO meeting of the ministers of forestry (March 1999). The recommendations of the FAO meeting were included in the "Rome Declaration on Forestry" (see IFFN No. 19, pp.84-85).

World Meteorological Organization (WMO)

The WMO organized the Workshop on Regional Transboundary Smoke and Haze in Southeast Asia, Singapore, 2-5 June 1998.

Publication: 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.

World Health Organization (WHO)

The WHO prepared the "WHO Health Guidelines on Vegetation Fire Events". After a workshop in Lima, Peru, October 1998, the preparation of the guidelines are now finalized. The team leader was chair of the Lima workshop and is co-editor of the guidelines. The guidelines are in press and will also be published on the website of the Global Fire Monitoring Center (GFMC).

Publication: Schwela, D.H., J.G. Goldammer, L.H. Morawska, and O. Simpson. 1999. Health Guidelines for Vegetation Fire Events. Guideline document. Published on behalf of UNEP, WHO, and WMO. Published by Institute of Environmental Epidemiology, Ministry of the Environment, Singapore (in press).

Goh, K.T., D.H. Schwela, J.G. Goldammer, and O. Simpson. 1999. Health Guidelines for Vegetation Fire Events. Background Papers. Published on behalf of UNEP, WHO, and WMO. Published by Institute of Environmental Epidemiology, Ministry of the Environment, Singapore (in press).

United Nations Educational, Scientific and Cultural Organization (UNESCO)

UNESCO convened the International Scientific Conference on Fires in the Mediterranean Forests, Athens, 3-6 February 1999.

Report: Goldammer, J.G. 1999. The contribution of the Global Fire Monitoring Center (GFMC) for early warning and management of wildfire. UNESCO International Scientific Conference on Fires in the Mediterranean Forests, Athens, 3-6 February 1999 (in press)

International Decade for Natural Disaster Reduction (IDNDR)

The team contributed to the IDNDR Scientific and Technical Council (STC) meeting in Washington, August 1998, and the IDNDR Programme Forum (the final IDNDR event), Geneva, July 1999 (see News from the IDNDR).

Report: Goldammer, J.G. 1999. Fire disasters, ecosystems and societies: Changing vulnerabilities. Contribution of the Global Fire Monitoring Center (GFMC) and Max Planck Institute for Chemistry to the IDNDR Programme Forum, Thematic Session "Disaster Reduction and Preparedness through Protection of Natural Resources", Geneva, 5-9 July 1999 (in press).

Goldammer, J.G. 1999. Environmental and technological hazards: Wildfire. In: Natural disaster management (J.Ingleton, ed.), 67-69. Tudor Rose, Leicester, England

The World Bank

The preparatory meeting for the establishment of the Consortium on Natural and Technological Catastrophes (NAT-CAT) (initial draft designation: "Consultative Group for Global Disaster Reduction") of the World Bank was held in Paris, France, 1-2 June 1999, and supported by the GFMC.

Report: Goldammer, J.G. 1999. The Contribution of the Global Fire Monitoring Center (GFMC) for Early Warning and Management of Wildfires. Paper presented at the preparatory meeting of the Consortium on Natural and Technological Catastrophes (NAT-CAT), Paris, France, 1-2 June 1999. The World Bank, Disaster Management facility (DMF) (in press).

A World Bank Seminar on Forest Fires was held in Surabaya, Indonesia, 9-12 December 1998.

Report: Goldammer, J.G. 1999. Relevance of international experiences in forest fire management to South East Asia. Paper presented at the World Bank/EDIEN Workshop on Fire Hazards, Transboundary Haze, and Sustainable Forestry in East Asia and the Pacific, Surabaya, Indonesia, 9-12 December 1998 (in press)

The World Conservation Union (IUCN)

At the World Bank NAT-CAT Establishment meeting in Paris the IUCN and GFMC decided to seek close collaboration and interaction of activities, including the joint IUCN-WWF programmes FIREFIGHT. IUCN decided to officially sponsor the GFMC and IFFN. The Thematic Session "Disaster Reduction and Preparedness through Protection of Natural Resources" was jointly organized at the IDNDR Programme Forum (report: see under IDNDR).

Association of South East Asian Nations (ASEAN)

ASEAN intended to compare ECE and ASEAN procedures and rules on transboundary pollution, and how the two regions could learn from eachother. The team leader provided inputs from the point of view of fire-related transboundary smoke-haze pollution.

Report: Goldammer, J.G. 1998. Land use, climate variability and fire in South East Asia: Impacts on ecosystems and atmosphere. Germany-Singapore Environmental Technology Agency. Asia-Pacific Regional Workshop on Transboundary Pollution, Singapore, 27-28 May 1998 (mimeo).

The International Cross-Sectoral Forum on Forest Fire Management in South East Asia, Jakarta, 7-8 December 1998, hosted by the Government of Indonesia, the International Tropical Timber Organization (ITTO) and JICA was supported by the team leader.

Report: Goldammer, J.G. 1999. An overview of international guidelines: The ITTO Guidelines on Forest Fire Management. In: Tropical forest fire. Prevention, control, rehabilitation and trans-boundary issues. Proceedings, International Cross-Sectoral Forum on Forest Fire Management in South East Asia, Jakarta, 7-8 December 1998, 179-200. BAPPENAS/ITTO/ JICA, Jakarta, 589 p.

Establishment of the Global Fire Monitoring Center (GFMC)

In June 1998 the Global Fire Monitoring Center (GFMC) was established as a joint activity of the home institute of the team leader (the Fire Ecology Research Group of the Max Planck Institute for Chemistry, c/o Freiburg University) and the team.

The Global Fire Monitoring Center (GFMC) monitors, forecasts and archives information on vegetation fires (forest fires, land-use fires, smoke pollution) at global level. With this information decision makers at national and international levels are supported in evaluating fire situations or precursors of fire which potentially endanger humans or may negatively affect the environment. The GFMC is financed by a German contribution to the IDNDR operates in co-operation and in line with the

* objectives of the UN International Decade of Natural Disaster Reduction (IDNDR);
* objectives of work of the UN-FAO/ECE/ILO Team of Specialists on Forest Fire;
* recommendations of the International Tropical Timber Organization (ITTO), the World Health Organization (WHO) and various scientific and policy conferences;
* policies of the UNESCO, the World Bank, Disaster Management Facility (DMF), and the World Conservation Union (IUCN), expressed by the co-sponsorship of these organizations; and the
* research agendas and co-sponsorship of international science programmes devoted to Global Change Research: The International Geosphere-Biosphere Programme (IGBP), the International Union of Forestry Research Organizations (IUFRO), and the International Boreal Forest Research Association (IBFRA).

The GFMC was inaugurated at the FAO Expert Consultation in Rome, October 1998. The daily updated GFMC products are public domain, accessible through the internet < http://www.uni-freiburg.de/fireglobe > .

International Forest Fire News (IFFN)

With the financial support of the US Bureau of Land Management, the ECE/FAO continues to produce the IFFN twice per year. Starting with IFFN No. 19 (October 1998) the comprehensive newsletter is also available on the website of the GFMC.

Contact of the UN-FAO/ECE/ILO Team of Specialists on Forest Fire and the GFMC:

J.G.Goldammer (address on p. iv)

News from the Food and Agriculture Organization (FAO)

On 28-30 October 1998 the FAO Meeting on **Public Policies Affecting Forest Fires** was convened in Rome (see IFFN No. 20, pp. 80-86). The results of the meeting are now published and include regional analyses on fire in the Asia-Pacific region, the Mediterranean Basin, the Americas and the Caribbean, Europe and temperate-boreal Asia, and Africa. Contributions from international organizations are provided by the UNEP, UNESCO, WHO, the World Bank, ITTO, and WWF. Several country reports highlight the variety of underlying causes of fire and fire effects in different parts of the world.

> *FAO (1999) Meeting on Public Policies Affecting Forest Fires, Rome, 28-30 October 1998. FAO Forestry Paper 138. Food and Agriculture Organization (FAO) of the United Nations, Rome, Italy.*

The publication can be obtained through the authorized FAO sale agents or directly from:

Sales and Marketing Group
Food and Agriculture Organization (FAO)
Via delle Terme di Caracalla
00100 Roma
ITALY

International Decade for Natural Hazard Reduction (IDNDR)

IDNDR Programme Forum, Geneva, July 1999

A Safer World in the 21st Century: Disaster and Risk Reduction

Introduction

While hazards are inevitable, and the elimination of all risk is impossible, there are many technical measures, traditional practices, and public experience that can reduce the extent or severity of economic and social disasters. Hazards and emergency requirements are a part of living with nature, but human behaviour can be changed. In the words of the Secretary General,

"We must, above all, shift from a culture of reaction to a culture of prevention. Prevention is not only more humane than cure; it is also much cheaper… Above all, let us not forget that disaster prevention is a moral imperative, no less than reducing the risks of war".

Vision

To enable all communities to become resilient to the effects of natural, technological and environmental hazards, reducing the compound risks they pose to social and economic vulnerabilities within modern societies.

To proceed from protection against hazards to the management of risk through the integration of risk prevention into sustainable development.

Goals

* Increase public awareness of the risks that natural, technological and environmental hazards pose to modern societies.

* Obtain commitment by public authorities to reduce risks to people, their livelihoods, social and economic infrastructure, and environmental resources.

* Engage public participation at all levels of implementation to create disaster-resistant communities through increased partnership and expanded risk reduction networks at all levels.

* Reduce the economic and social losses of disasters as measured, for example, by Gross Domestic Product.

Objectives

* Stimulate research and application, provide knowledge, convey experience, build capabilities and allocate necessary resources for reducing or preventing severe and recurrent impacts of hazards, for those people most vulnerable.

* Increase opportunities for organizations and multi-disciplinary relationships to foster more scientific and technical contributions to the public decision-making process in matters of hazard, risk and disaster prevention.
* Develop a more proactive interface between management of natural resources and risk reduction practices.

* Form a global community dedicated to making risk and disaster prevention a public value.

* Link risk prevention and economic competitiveness issues to enhance opportunities for greater economic partnerships.

* Complete comprehensive risk assessments and integrate them within development plans.

* Develop and apply risk reduction strategies and mitigation measures with supporting arrangements and resources for disaster prevention at all levels of activity.

* Identify and engage designated authorities, professionals drawn from the widest possible range of expertise, and community leaders to develop increased partnership activities.

* Establish risk monitoring capabilities, and early warning systems as integrated processes, with particular attention being given to emerging hazards with global implications such as those related to climate variation and change, at all levels of responsibility.

* Develop sustained programmes of public information and institutionalized educational components pertaining to hazards and their effects, risk management practices and disaster prevention activities, for all ages.

* Establish internationally and professionally agreed standards / methodologies for the analysis and expression of the socio-economic impacts of disasters on societies.

* Seek innovative funding mechanisms dedicated to sustained risk and disaster prevention activities.

Implementation

* Conduct a national audit or assessment process of existing functions necessary for a comprehensive and integrated national strategy of hazard, risk and disaster prevention, projected over 5-10 and 20 year time periods.

* Conduct dynamic risk analysis with specific consideration of demographics, urban growth, and the interaction or compound relationships between natural, technological and environmental factors.

* Build, or where existing, strengthen regional/sub-regional, national and international approaches, and collaborative organizational arrangements that can increase hazard, risk and disaster prevention

capabilities and activities.

* Establish coordination mechanisms for greater coherence and improved effectiveness of combined hazard, risk and disaster prevention strategies at all levels of responsibility.

* Promote and encourage know-how transfer through partnership and among countries with particular attention given in the transfer of experience amongst those countries most exposed to risks.

* Establish national, regional/sub-regional, and global information exchanges, facilities, or websites dedicated to hazard, risk and disaster prevention, linked by agreed communication standards and protocols to facilitate interchange.

* Link efforts of hazard, risk and disaster prevention more closely with the Agenda 21 implementation process for enhanced synergy with environmental and sustainable development issues.

* Focus multi-year risk reduction strategies on urban concentration and mega-city environments.

* Institute comprehensive application of land-use planning and programmes in hazard prone-environments.

* Develop and apply standard forms of statistical recording of risk factors, disaster occurrences and their consequences to enable more consistent comparisons.

* Undertake periodic reviews of accomplishments in hazard, risk and disaster reduction efforts at all levels of engagement and responsibility.

* Study feasibility of specific alternative funding and resource allocation modalities that can ensure continued commitment to sustained risk and disaster prevention strategies.

Responsible Parties

Governments have the primary responsibility for protecting citizens from risks and disaster, however, local communities and elements of civil society most threatened by hazards emerge as key initiators of important risk and disaster prevention actions. They must work through partnership, and together, receive necessary encouragement and support to realize the vision of disaster resilience.

Regional/sub-regional and international collaboration is essential, especially with regard to the dissemination of experience and information, scientific and technical applications, continual advocacy and the coordination of strategies to assist in the development of national capabilities.

The United Nations system has a special leadership role in global risk and disaster reduction by its universal character, inter-disciplinary and multi-sectoral scope, and role as a forum for global dialogue. It should address global risk issues, ensure coherence among humanitarian aid, disaster prevention and development, and promote collaboration among countries.

Review

The strategy ***A Safer World in the 21st Century: Risk and Disaster Reduction*** should be closely monitored by the risk and disaster reduction community, and a global review of progress and accomplishments should be undertaken by all concerned parties within a period of five years.

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IDNDR International Programme Forum
Geneva, 5-9 July 1999

The Geneva Mandate on Disaster Reduction

We, participants in the IDNDR International Programme Forum - Towards Partnerships for Disaster Reduction in the 21st Century, - recognise that the world is increasingly being threatened by large scale disasters triggered by hazards, which will have long term negative social, economic, and environmental consequences on our societies and hamper our capacity to ensure sustainable development and investment, particularly in developing countries.

We have to act decisively now, to guarantee a safer world for future generations. We must build on progress achieved during the IDNDR, so that risk management and disaster reduction become essential elements of government policies. The Yokohama Strategy (1994) and the strategy "A Safer World in the 21st Century: Risk and Disaster Reduction" (1999) chart the course. Political will is essential to ensure that appropriate policies and institutional arrangements foster a culture of prevention at all levels of our societies.

We shall adopt and implement policy measures at the international, regional, sub-regional, national and local levels aimed at reducing the vulnerability of our societies to both natural and technological hazards through proactive rather than reactive approaches. These measures shall have as main objectives the establishment of hazard-resilient communities and the protection of people from the threat of disasters. They shall also contribute to safeguarding our natural and economic resources, and our social wellbeing and livelihoods.

Furthermore, scientific, social and economic research, and technological and planning applications will be required at all levels and from a wide range of disciplines in order to support risk management and effective reduction of our vulnerabilities. In this connection, there is need for increased information exchange, improved early warning capacities, technology transfer and technical co-operation among all countries, paying particular attention to the most vulnerable and affected.

These last ten years have shown the multisectoral, interdisciplinary and cross-cutting nature of broad risk management and its contribution to disaster reduction. Continued interaction and co-operation on the above basis, among all disciplines and institutions concerned, are considered essential to accomplish commonly agreed objectives and priorities. This interaction shall be based on the strengthening of co-operation and partnerships engendered by the IDNDR Programme.

We stress the importance of developing and strengthening regional approaches dedicated to disaster reduction in order to take account of local specificity and needs. We emphasise in this respect, the need to support institutional initiatives and mechanisms for strengthening regional, sub-regional national and local capabilities, coordination, and applied research. We recognise the particular need for establishing an institutional arrangement to coordinate disaster reduction in Africa, and in this regard, invite existing and evolving mechanisms for inter-regional co-operation to accord priority to these concerns.

Appropriate financial resources will be needed to ensure the development and implementation of prevention and mitigation policies and programmes in all countries particularly developing countries. Innovative approaches should be explored including the funding of international initiatives. However, full use should be made of existing regional and national financial mechanisms involving those communities most directly exposed to risks. All bilateral and multilateral development assistance should include disaster reduction components.

We recommend to the international community and to the United Nations that, based on the proven success of the functional responsibilities and organizational arrangements during the IDNDR, the international co-operative framework for disaster reduction be maintained and strengthened. This framework should ensure partnership and synergy among all elements of risk management and disaster reduction, and promote a shift from a mentality of reaction to a culture of prevention. The growing threat of political, social and economic disruption caused by natural and technological disasters calls for bold action from member States of the United Nations in this regard.

Geneva, 9 July 1999

News from the International Union of Forestry Research Organizations (IUFRO)

IUFRO Group 8.05 Forest Fire Research

Recommendations from the Rogow Conference on Remote Sensing and Forest Monitoring 1-3 June 1999, Rogow, Poland

Background

IUFRO Group 8.05, along with the Groups 4.12, 4.02.05 and the Faculty of Forestry of the Warsaw Agricultural University, organized the Rogow Conference. A session on Remote Sensing and Forest Fires was held at Rogow with the presentation of 12 papers. These papers were representative of the two main directions of joint remote sensing/fire research initiatives around the world today: the use of high-resolution satellite imagery to map burned areas at a local to regional scale for fire management purposes, and the use of lower-resolution imagery to map the distribution of fires around the world for input into global environmental issues such as climate and land use change, biodiversity, and transboundary smoke transport.

Fire management agencies in developed countries generally do not require satellite mapping of fires in order to effectively manage fires in their protected areas, as their emphasis is on preparedness and early detection and control, and satellite overpasses are currently too infrequent to assist in this approach. However, the use of satellite capabilities to map and monitor fires in remote areas of developed countries, where fire protection efforts are deliberately modest, has been shown to be economically beneficial. Likewise, satellite data could provide key and more timely information to developing countries with a reduced fire management capability.

Gas and aerosol emissions from vegetation fires are now recognized as a major perturbation to atmospheric chemistry, with direct impacts on the global environment. Over the past decade there has been a strong recognition of the need to quantify the extent and impact of biomass burning in ecosystems throughout the world. Statistical information has been compiled (e.g. UN-ECE/FAO) and remote sensing analysis conducted (e.g. IGBP-DIS, IGBP-IGAC GEIA), but the record is far from complete, and much work remains. The World Fire Web, the ATSR Fire Atlas, and the M3 Fire Monitoring, Mapping and Modeling System, current initiatives described in papers at Rogow, are an indication of the internet-based capability being generated to disseminate global fire data quickly, but further information is required in order to address many unresolved global change science issues. The concept of the Global Fire Monitoring Center (GFMC), which has been jointly promoted by the UN International Decade for Natural Disaster Reduction (IDNDR), the United Nations Educational, Scientific and Educational Organization (UNESCO), and the World Bank, involves the utilization of near-real time and archived satellite data provided by several remote sensing centers around the world. This spatial-temporal information on fire activity is explained by scientific background information, and the cultural, socio-economic and political context of fire.

Recommendations

That IUFRO strongly endorses and supports ongoing remote sensing efforts to quantify the extent and impact of vegetation fires burning globally, recognizing that this information is critical to global environmental concerns such as climate and land use-change, and loss of biodiversity.

That IUFRO recognizes the strong need to build on existing efforts to assemble a global capability to monitor active fires and smoke plumes globally in near real-time (within 24h of satellite overpass), in order to provide strategic fire management knowledge and response options dealing with fire activity and regional environmental (smoke/visibility/air quality) issues.

That IUFRO supports efforts to compile monthly maps of burned areas globally that can be combined with ecosystem parameters to determine emission levels and impacts on biogeochemical cycles (particularly the carbon cycle), information critical to global change research.

While it appears that current and planned remote sensors provide suitable raw data, IUFRO recommends the further development of ground infrastructure capability in ensuring global reception of all appropriate data,

developing (and validating) improved data extraction algorithms, and the establishment of suitable networks and other mechanisms for distribution of products.

IUFRO supports ongoing research and development in these areas, including the efforts of many international organizations (e.g. UN, IGBP), and wishes to promote the active participation of IUFRO member organizations and scientists to ensure scientific collaboration that will lead to the development of the required global capability, recognizing that all nations will benefit from improved knowledge of the extent and impact of fire globally.

Next IUFRO 8.05 meetings: See announcement of the XXI IUFRO World Congress under "Meetings planned for 2000"

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NEWS FROM FIRE RESEARCH

CANADA

The International Crown Fire Modelling Experiment - an Update

The third phase of the International Crown Fire Modelling Experiment (ICFME) was successfully completed in late June and early July of 1999 near Fort Providence in Canada's Northwest Territories. Designed primarily to develop knowledge and data essential to predicting the initiation and propagation of high-intensity crown fires, ICFME has been expanded to include the evaluation of personal protective equipment (including fire shelters), smoke chemistry analyses, investigations into the effect of fuels modification on fire behaviour, and the assessment/evaluation of community housing fire protection standards.

Conducted under the auspices of the International Boreal Forest Research Association (IBFRA) and the International Geosphere-Biosphere Program (IGBP), and coordinated by the Canadian Forest Service (CFS), the Government of the Northwest Territories (GNWT), and the United States Forest Service (USFS), the ICFME has brought together 50-70 research and operational personnel annually during the past three years. In addition to CFS, GNWT and USFS participants, researchers from the National Aeronautics and Space Administration (NASA), the National Center for Atmospheric Research (NCAR), the National Institute of Standards and Technology (NIST), the United States Geological Survey (USGS), the Russian Academy of Sciences, the Commonwealth Society of Industrial Research Organizations (CSIRO) in Australia, the Max Planck Institute for Chemistry (MPIC) in Germany, and universities in Canada, the United States, Japan, the Netherlands, and South Africa have participated. The GNWT and the community of Fort Providence have provided the cooperation and logistical support necessary to undertake this large research endeavour.

To date, eleven successful crown fires have been conducted (three in 1997, two in 1998, and six in 1999). These have been the most complex and heavily-instrumented experimental crown fires ever conducted in the northern hemisphere, and a large amount of data has been successfully gathered. This data is currently being evaluated, and a data reduction workshop which will involve all key participants is scheduled for December 1999. Data and knowledge gaps identified at this workshop will be addressed next summer in the final phase of

ICFME. Background information, summary progress reports, media coverage, and selected photography from the ICFME is available at the ICFME Home Page (http://www.nofc.cfs.nrcan.gc.ca/fire/fmn/nwt/).

Submitted by the ICFME Co-Coordinators:

B.J. Stocks, Canadian Forest Service (CFS)
M.E. Alexander (CFS), and
R.A. Lanoville, Government of the Northwest Territories (GNWT)

ICFME Home Page: http://www.nofc.cfs.nrcan.gc.ca/fire/fmn/nwt/

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Fig.1. Aerial view of the ICFME experimental plots in the Northwest Territories, Canada.

GERMANY

Estimation of Future Forest Fire Development in the State of Brandenburg

Background and Challenge

The state of Brandenburg is the region in Germany that is most strongly exposed to forest fires. From 1991 to 1995, there were on average 6 fires per 10,000 ha (average in Germany: 1.8 fires per 10,000 ha). Since the occurrence of forest fires is strongly influenced by climate, the question arises how the risk of forest fires will develop under changing climate conditions.

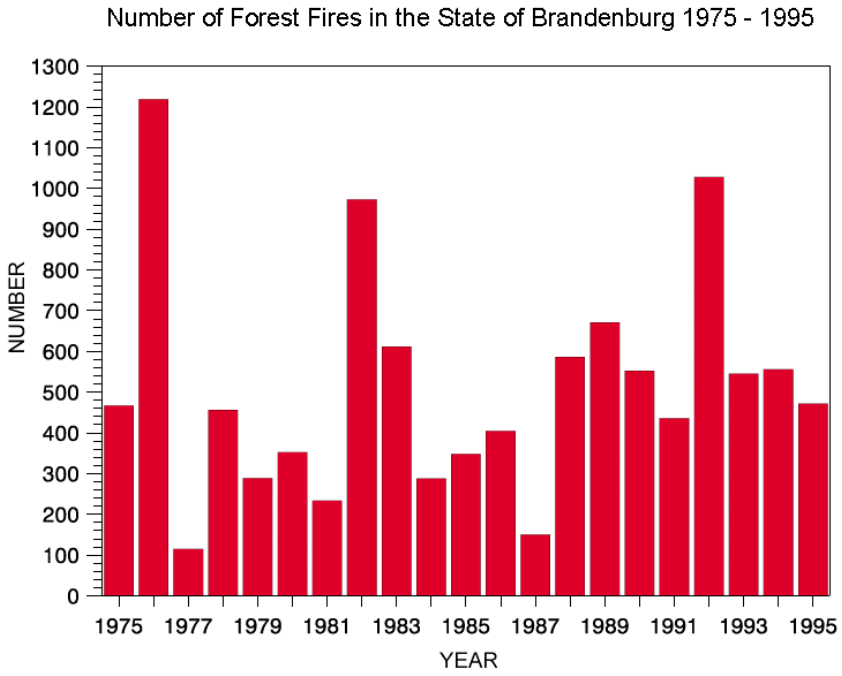

Fig.1. Number of forest fires in the state of Brandenburg 1975-1995

Approach

The future climate development is estimated by means of regional scenario models that consider large-scale climate tendencies as well as locally observed meteorological values. The development of climate and forest fires are connected by an index that is based on climate parameters. The calculation of this forest fire index (FFI) is based on temperature and precipitation conditions during the vegetation period:

$$FFI = \sum_{i=v_b}^{v_e} sd_i \,/\, \sum_{i=v_b}^{v_e} p_i$$

$sd = 1$ *if the daily maximunm of air temperature ≥ 25.0°C*
0 in all other cases
p = *daily sum of percipitation*
v_b = *beginning of vegetation period (1 April)*
v_e = *end of vegetation period (30 September)*

Results

Calculation of the average number of forest fires in nine almost equally sized regions of Brandenburg as of 2050 with an assumed temperature increase by 1.5(C. The moderate temperate increase is connected with a decrease of the annual sum of precipitation by 50-100 mm (Fig.2a and b). As a consequence, an increase of the average number of annual forest fires in the whole state from 512 to 605 forest fires is to be expected. This increase varies between 5 and 30 in the different regions (Fig.2c and d).

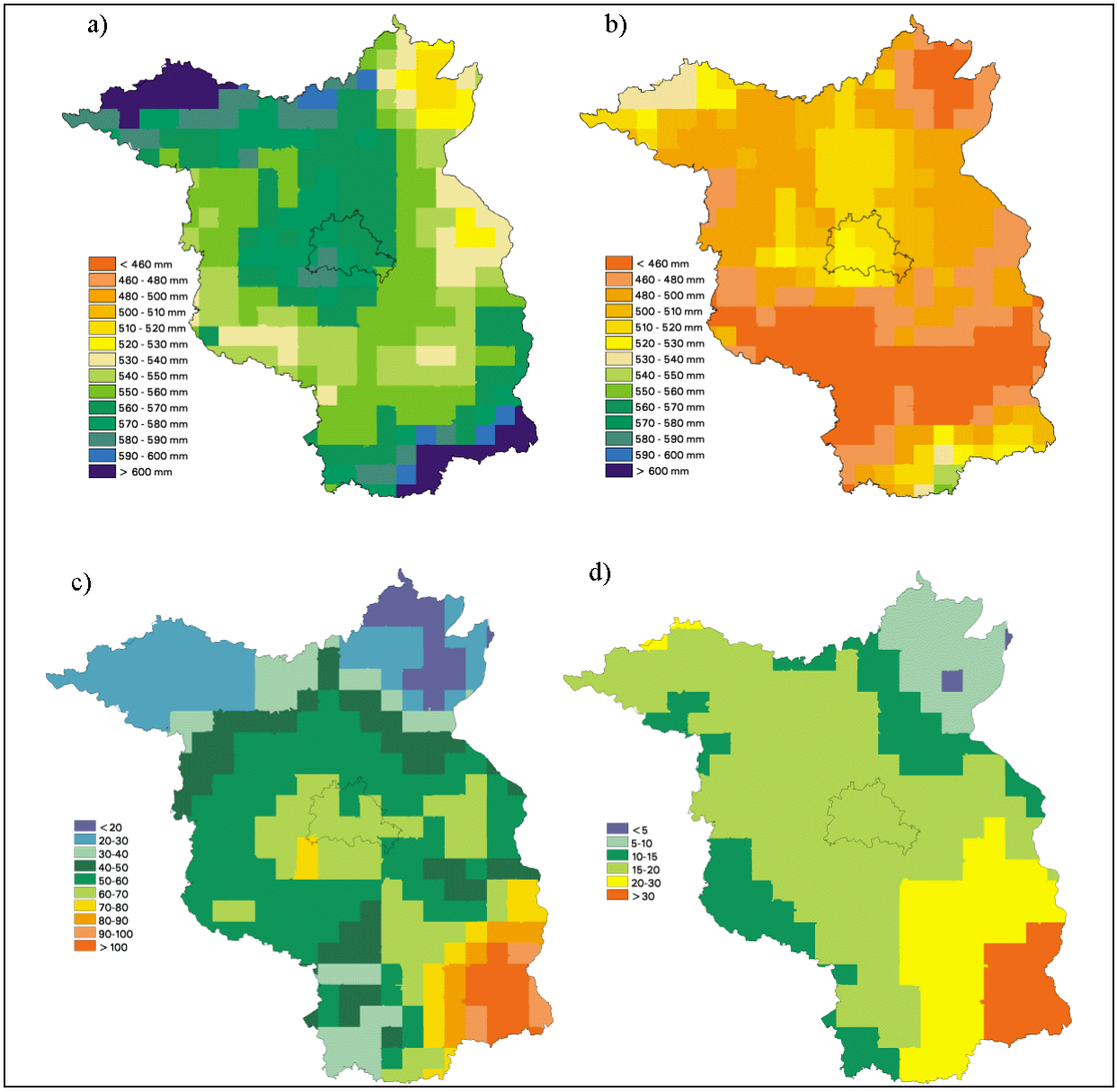

Fig.2. (a) Mean annual total precipitation 1951-1990; (b) mean annual total precipitation as of 2050 based on scenario calculations, (c) mean regional number of forest fires 1975-1995, (d) mean regional increase of annual forest fires as of 2050 based on scenario calculations. (These figures are provided in high-resolution colour on the internet version of this paper (see < http://www.uni-freiburg.de/fireglobe/iffn/iffn_21/content.htm >).

Conclusions

Climate changes can lead to a distinct increasing risk of forest fires in the state of Brandenburg. With the climate scenario model used, climate changes will be calculated for different regions. Based on this, climate impacts can now be better estimated than before. The results are valuable as a basis for decision-making in forest management. For example, adaptive forest management strategies aiming at a modified species composition could help to reduce the susceptibility of forest stands to forest fires.

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RECENT PUBLICATIONS

Indians, Fire, and the Land in the Pacific Northwest

Instead of discovering a land blanketed by dense forests, early explorers of the Pacific Northwest encountered a varied landscape of open woods, spacious meadows, and extensive prairies. Far from a pristine wilderness, much of the Northwest was actively managed and shaped by the hands of its Native American inhabitants. Their primary tool was fire.

"Indians, Fire, and the Land in the Pacific Northwest," edited by Robert Boyd, offers an interdisciplinary approach to one of the most important issues concerning Native Americans and their relationship to the land. Hans Page from the Fire Ecolgy Research Group read the book:

Robert Boyd, the editor of "Indians, Fire and the Land in the Pacific Northwest", is an anthropologist and ethnohistorian from Portland and author of a series publications about the aboriginal cultures in the USA. His new book volume contains a collection of 12 contributions withn additional introductory and final chapters written by the editor. The contributions are from different disciplines. They approach the role and importance of aboriginal fire and the resulting consequences for the landscape development in the Pacific Northwest of the USA from distinct perspectives and with different methodologies. The contributors range from ethnobotanists, anthropologists, archeologists, historians to botanists and foresters. The papers cover all parts of the native Northwest, and nine of them were previously published in different journals. In this book they are presented in chronological order from 1957 until 1999.

The main approach of this complete volume is that most parts of the Pacific Northwest were not wilderness untouched by humans when the first Euro-Americans arrived at the beginning of the 19th century. The collection of these articles refutes in an impressive way the old prejudice that the north American aboriginals were "children of the nature" who only took what nature gave them. It is shown that the hunter and gather communities who lived here for some thousands of years systematicly formed the ecosystems for their needs. Fire was one of the most important tools they had in their hands, and they knew how to use it in ways that not only met immediate demands but also modified their environment. Today it is known that the most lawns and prairies in the Pacific Northwest, which impressed the early trappers and explorers, had been actively manipulated and managed, if not created, by their native inhabitants. The main reasons for this type of fire

management were to stimulate the productivity of different useable plants, for example different berry species or camas (*Camassia quamash*) and to create attractive habitats for game. With the replacement of aboriginal inhabitants by the white Euro-Americans, the treatment of the landscape changed fundamentally because the white settlers and the young, upcoming industrial society had totally different demands on the environment than the old gather and hunter societies. Therefore former prairie plant communities are mostly extinguished and with them many currently threatened species of the Northwest which inhabited such ecosystems.

This book is not only interesting for ethnologists or (landscape) historians. The compact arrangement of articles highlighting the native influence on the landscape history in the Northwest also provides an important background for the development of todays's landscape conservation and management strategies for this part of the U.S.A., especially for maintenance of the remaining prairies and related ecosystems.

Although mostly nearly all the articles of this book concentrate on aboriginal gather and hunter societies of the Pacific Northwest the volume also provides interesting basic material for the understanding of landscape and environmental history in other parts of the world. H.T.Lewis and T.A.Ferguson (in this publication) highlight the cross-cultural and intergeographical parallels in the ways in which hunter-gatherers use habitat manipulation fires. For example it is probable that nomadic or half-nomadic societies in Europe during the middle and younger stone age, with a comparative cultural level as historical Indians of the Pacific Northwest, used fire for simular reasons and in a comparative way. This could explain how so many species, adjusted to open and more continental stands, spread and survived in the post-Ice Age Central Europe in which natural forests dominated.

Hans Page / GFMC

R.Boyd (ed.).1999. Indians, Fire and the Land in the Pacific Northwest. Oregon State University Press, Corvallis, Oregon, 320 p. (ISBN 0-87071-459-7). Paperback, $34.95.

Remote Sensing of large wildfires in the European Mediterranean Basin

Emilio Chuvieco, University of Alcala, Spain, has taken the initiative to edit an important new book volume. The book gives a systematic review of the different applications of remote sensing and geographical information system techniques in research and management of forest fires. The authors have been involved in this topic of research for several years, resulting in more than 100 papers in reviewedjournals and proceedings. The book also benefits from data generated within the Megafires project, founded under the DG-XII of the European Union. Most of the contributors to this book have been involved in the Megafires project, and therefore a clear integration of research and experience is provided. New data from fires affecting European countries between 1991 and 1997 are included as well as satellite images and auxiliary cartographic information.

The contents of the book contain the following topic areas:

* The Role of Fire in European Mediterranean Ecosystems
* Short-Term Fire Risk: Foliage Moisture Content Estimation from Satellite Data
* Meteorological Fire Danger Indices and Remote Sensing
* Integrated Fire Risk Mapping
* Fire Detection and Fire Growth Monitoring Using Satellite Data
* Spectral Characterisation and Discrimination of Burnt Areas
* Regional Scale Burnt Area Mapping in Southern Europe Using NOAA-AVHRR 1 km data
* Burnt Land Mapping at Local Scale

System requirements for the CD-ROM: PC or Macintosh, double speed CD-ROM drive or faster, 8 MB RAM, Internet browser. The CD-ROM can be navigated with any browser since it is written in plain html. The files are written in easily accessible ascii and binary formats.

Chuvieco, E. (ed.). 1999. Remote sensing of large wildfires in the European Mediterranean Basin. XII, 212 pp. 45 figs., 16 in color, 33 tabs., with CD-ROM. Springer-Verlag (ISBN 3-540-65767-3), DM 169.00.

OTHER MEETING REPORTS

AUSTRALIA

Australian Centre for International Agricultural Research (ACIAR) Workshop Fire and Sustainable Agricultural and Forestry Development in Eastern Indonesia and Northern Australia Darwin, April 1999

Northern Territory University (NTU), Darwin, Australia was host to a highly successful workshop in April on the constructive use of fire for sustainable land management in eastern Indonesia and northern Australia. The workshop was part of a project coordinated by NTU and funded by the Australian Centre for International Agricultural Research (ACIAR). The workshop was also supported by the Tropical Savannas CRC, Bushfires Council of NT and World Wide Fund for Nature (WWF). The workshop brought together more than 50 delegates from government and non-government agencies and universities in Indonesia and Australia.

Workshop presentations and discussions demonstrated that fire is an integral component of savanna environments and the constructive use of fire has a vital role in sustainable land management. Some current fire practices are undesirable for social, economic and ecological reasons. Eastern Indonesia includes some of the poorest and least developed of Indonesia's provinces and most of the population relies on subsistence agriculture. Environmental degradation results from poor fire management practices and the people living on that land are "trapped in a poverty cycle".

Workshop participants were committed to further cooperation and collaboration. Future research and training projects on fire management in the region are planned with the aim of improving living standards.

The existing knowledge base of fire management in the region includes:

* remotely sensing images of fires, with fire histories derived from these images for areas of northern Australia (courtesy of NTU, Bushfires Council NT and other CRC partners)

* some assessment and predictive understanding of the impacts of different fire regimes on the environment of northern Australia (including grazing productivity and maintenance of biodiversity) (DPIF, CSIRO), and

* some traditional burning practices in northern Australia (NLC).

The major deficiencies in the knowledge base include:

* limited use of existing remote sensing images and technologies in eastern Indonesia,

* insufficient assessment of the impacts of different fire and grazing regimes for various ecosystems and land use systems,

* few records of traditional burning practices with little critical assessment of the appropriateness of practices for current situations.

Future collaborations will address these deficiencies. Burning practices will be developed for land sustainability. They will be tailored to suit the resource base, cultural restraints and the land types and land uses in eastern Indonesia and northern Australia.

Papers presented covered a wide spectrum of topics, including issues of land use, management of fuel and fire, atmospheric indicators and the role of remote sensing. Many presented position papers describing particular areas in eastern Indonesia or northern Australia, highlighting the issues of traditional practices in the use of fire and their implications for land management.

Proceedings are in preparation and will be in print in early 2000. All workshop participants will receive a complimentary copy and they are available free of charge to any scientist, administrator or research institution library from a developing country with a legitimate need. Please write to

The Communications Manager
ACIAR, GPO Box 1571
Canberra ACT 2601
AUSTRALIA

or e-mail: comms@aciar.gov.au

There is a charge for others not covered by the above criteria. No price is available as yet. Ordering details, when available, will be posted on ACIAR's web page < www.aciar.gov.au > .

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MEETINGS PLANNED FOR 2000

XXI IUFRO World Congress
"Forests and Society: The Role of Research"
7-12 August 2000, Malaysia

The next IUFRO World Congress will be held in Malaysia, 7-12 August, 2000. The Congress title is "Forests and Society: The Role of Research". The responsibility for its scientific programme lies with the IUFRO Executive Board, which has established a Congress Scientific Committee (CSC) for this purpose. The practical organisation is in hands of the Congress Organizing Committee (COC) in Malaysia.

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General information on the XXI IUFRO World Congress: < http://iufro.boku.ac.at/iufro/congress >

The congress information package is available on: < http://iufro.boku.ac.at/iufro/congress/cip-98.pdf >

IUFRO Group 8.05 Contacts: < http://iufro.boku.ac.at/iufro/iufronet/d8/hp80500.htm >

IUFRO XXI World Congress: Sessions of Group 8.05 Forest Fire Research

The programme of scientific meetings of IUFRO Unit 8.05.00 Forest Fire Research is given below (state: 19 October 1999). Updated programme information is available on-line at:
< http://iufro.boku.ac.at/iufro/congress/csc/ >

8 August 1999: Sub-Plenary "Sustainable management of natural resources: Fire and forests"

1- Johann G.Goldammer. The fire and smoke episode of 1997-98 in South East Asia: implications on regional and global fire research programmes.

2- Adriana G. Moreira and Daniel C. Nepstad. Forest fires in tropical America : challenges for research.

3- Brian J. Stocks and Susan G. Conard. Forest fire research in north America and Russia. Past accomplishments and future trends.

4- Ertugrul Bilgili and Johann G.Goldammer. Fire in the Mediterranean basin: towards an interdisciplinary science programme.

Organisers: Johann G. Goldammer and Brian J. Stocks

Posters "Fire weather and behaviour"

1- Bulent Saglam, Ertugrul Bilgili. Fire occurrence in relation to weather conditions

2- Ronaldo Viana Soares. Performance of the Monte Alegre formula on fire danger evaluation in different regions of Brazil

3- Shoji Inoue. An analysis of forest fire behaviour based on estimation of wind direction and wind Velocity at the time of the fire

4- A.P.Sapozhnikov. About necessity of new approach to pyrological estimation of forests

5- A.V.Volokitina, L.Ph.Nozhenkova, M.A.Sofronov, D.I.Nazimova. Prognosis of emergency situations under wildland fires

Posters "Fire effects, ecology and country profiles"

6- K.Owusu-Afriyie et al. Seedling survival, mortality and regeneration after fire in a tropical high forest in Ghana

7- Ranjith B. Mapa. Effect of fire on soil properties in pine and natural forest in Sri Lanka

8- George Mathew, P.Rugmini, C.F.Binoy. Impact of fire on forest insect species diversity. A study in the Silent Valley

9- Andre M. Tandjiekpon. Influence des feux de brousse sur la dynamique des forêts seches. Cas des formations forestières degradées du Nord-Benin

10- H.H.Liwangsa et al. Forest plantation fire. The SAFODA experience (Sabah Forestry Development Authority)

11- Ronaldo Viana Soares. Wildfire occurrence in a forest district and other Brazilian protected areas

12- Daniel Otu. Natural regeneration of *Tectona grandis* and *Gmelina arborea* after fire in Ikrogon Forest reserve, Cross River State, Nigeria

13- Yamaguchi Tsunashi, Tsuyuki Satoshi, H. Siswanto, and Y.Ruslim. Assessment of forest fire impacts in East Kalimantan using satellite remotely sensed data

14- Angelo M. Carvalho Oliveira, Jaime S. Luis. Growth and development of a maritime pine stand after fire

8 August 2000: Session Forest Fires in Southeast Asia (I)

1- M.Hasmadi Ismail, Kamaruzaman Jusoff. Forest fire. Monitoring and management using satellite remote sensing data (Malaysia)

2- Yousif Ali Hussin, Heri Sunuprapto. Forest fire monitoring and damage assessment using remotely sensed data and GIS. A case study from East Kalimantan, Indonesia

3- Samsudin Musa, S.Ibrahim, I.Harun, R.Barizan, A.Hassan, W.M.Shukri, I.Parian. Haze forest fires and land-use practices. An assessment (Malaysia)

4- Gusti Z.Anshari. A study of fire history and the vegetation change of a lowland, peat swamp forest in the Lake Sentarum wildlife reserve, West Kalimantan, Indonesia

5- Bambang Hero Saharjo. Fire research and society interest as limiting factors in minimizing large forest fires burn in Indonesia

Organisers: Brian Stocks and Johann G. Goldammer

9 August 2000: Forest Fires in Southeast Asia (II) and in Other Tropical Regions

1- Eulis Retnowati. Managing smoke in forestry and crop estate sector in Indonesia

2- A.R.R. Menon and K.J. Martin Lowel. Fire-related regeneration dynamics in the moist deciduous forests of Western Ghats. A case study

3- Paul Kankan. Sustainable management of natural resources: Forest and fire (Ghana)

4- Marcos Pedro Ramos Rodriguez, Ronaldo Viana Soares. History of forest fires in the province of Pinar del Rio, Cuba

5- Lailan Syaufina. The interest of students on forest fire studies (Indonesia)

Organisers: Brian Stocks and Johann G. Goldammer

11 August 2000: Forest Fires in Temperate and Boreal Forests. Scientific Session and Panel Discussion

1- Susan G. Conard, Brian J. Stocks. Fire in temperate and boreal forests. Global change, fire management, and sustainability

2- E.S. Arzybashev. Forest fires in Russia

3- Panel Discussion

Organisers: Brian Stocks and Johann G. Goldammer

RUSSIA

International Conference "Conjugate Problems of Mechanics and Ecology" Tomsk, Russian Federation, 4-9 July 2000

The conference is organized by Tomsk State University, the Centre on Reactive Media Mechanics and Ecology, the Naval Surface Warfare Center, the Novosibirsk State University of Architecture and Civil Engineering, the Siberian Branch of the Council on Combustion of the Russian Academy of Sciences, and the Tomsk Society of Mechanics-scientists and Thermophysicists. The conference will elaborate on the following topics:

* Natural and technogenic catastrophes
* Understanding of accidental explosions in nature and industry
* Predicting motion and distribution of dangerous celestial natural and man-made dangerous objects
* The problem of celestial bodies entering the dense layers of the atmosphere and the methods of changing a flight trajectory
* Mechanisms of thermochemical destruction of celestial bodies in the atmosphere of the planets and the Earth
* Catastrophic floods and ecology of existing water-development works
* Principles, methods and technical facilities of the ecological monitoring of natural complexes and geotechnical systems
* Physico-chemical foundations and control methods of contaminating media and their regeneration
* Forest fires: initiation, spread and ecological impacts
* Methodology of risk-analysis of new technologies for improving the ecological production safety
* The physical and mechanical properties of aerosols and dispersed fluids
* Computer programmes and methods for predicting ecological impacts of catastrophes
* Higher ecological education and social monitoring
* Ecological and social aspects of the collision catastrophe

The working languages of the conference are Russian and English. The Conference program is as follows:

* "Round table" discussions of different aspects of the conference
* Sale-exhibition of computer programs and methods

Sponsors are invited for mutual cooperation and participation in the conference. The program will include the names of the participants and organizations that will support the conference.
To be registered, conference participants are requested to send their preregistration forms to the organizing committee, together with the application and abstracts for foreigners not later than 30 May 2000.
A registration fee of $US400 will be charged for foreign participants. The registration fee will cover the costs of hotel accommodation, all meals, and the conference book proceedings. After the conference (9-10 July 2000) it is planned to conduct a forest fire (surface fire) experiment to investigate fire behaviour and spread and the application of new methods of fighting them. The design of scientific experiments can be expanded in accordance with the interests of new participants.
There will be a special cultural program for the participants of the conference, including excursions over the historical places of Tomsk.

Please request your pre-registration form through the following contact addresses of the Organizing Committee:

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LETTERS TO THE EDITOR

Forest Fire Prevention and Control Strategies in India

The Government of India and trained high Forestry personnel are taking very casually forest fires on some plea or the other. Some advance, paucity of funds, others refer to ground fires and they are of not much consequence. Even some talk of NWFP quantity and graziers set fire in expection of greener grass to graze. Very few only take forest fires as seriously as the subject calls for. This very concept goes to the forestry secretariat ultimately to the ministry. The finance minister's allotment to the cause of forest fires suppression is misguided by the Forest Minister.

Though the Indian Forest Act makes it compulsion on all, but more pronouncedly those who receive Government emoluments / and Forest privileges / any livelihood from forests are legally bound to help foresters on duty in forest fire detection, prevention and spread of fires unchecked in view of the enormous damage caused by forest fires. To assess fire damages, Maharashtra forest researchers arrived on experiment a damage of Rs. 10,240 or roughly US$ 220 per hectare burnt, only accounting for top soil content of organic manure to the forest. In addition, loss of biodiversity and soil moisture occur. Loss of commercial value of wood is very high.

Mr. Bahugana estimates Rs. 440 Crores ($US107 million) as annual loss by way of only tangible, excluding all intangible losses.

In the case study by Srivastava from Nilgiri Biosphere Reserve, the author explains that out of 28 committees, some were active, some were luke warm and a few more could not be motivated. He further observed that a participation and its impact on the prevention and control of forest fires is yet to be made.

Going back to Bahugana's estimates that the standing timber stock in the country is estimated at 4,740 million m^3 and the annual increment at 87.62 million m^3 It is evident that the demands of firewood, and other daily necessities of 950 million (may have reached 1,000 million) and 450 million (may have reached 500 million) can be estimated to be much more than the annual increment estimated, meaning thereby the standing stock is annually decreasing below the figure of 4,740 million m^3.

It is imperative that both the Capital stock need be increased as also the capacity it annually accrues. The first and the most important step should be: check losses due to fire by modern processes through research and intensive touring during fire seasons. The staff should be trained at the recognized fire protection institution with the help and guidance of F.A.O.

Losses due to old age and pest affected stock requires to be culled and it is possible to reduce technical/commercial rotation to that level when trees retain vigour and become strong enough to withstand decay/pests. This silvicultural compunction is overdue as is witnessed in the large scale death of sal (*Shorea robusta*) amongst mature. It is because of these ugly, repeated fires and pernicious grazing coupled with human free collection of headloads of firewood and unregulated tapping of NWFP without providing for any period of rest to recuperate, the site qualities have fallen down resulting in death and decay at rotation age/size a few decades earlier adopted.

The moratorium, cramped by suspending sanctioned working plans has added to the negligence towards protection and cultural operations reflected in fast decaying stock. This moratorium has no silvicultural status.

All decay owes to fires, which induce decay of stems by attacks of pests.

Moral: The Government of India, if the policy of ***Laissez Faire*** is not rejected in favour of strict protection, the country will have to face environmental disaster soon.

Reference: International Forest Fire News No.20 (March 1999), pp. 5-15.

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