

9. Central Asia

This regional summary covers the countries of geographical Central Asia (Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan), as well as those parts of the Russian Federation not covered in the regional working papers on the Baltic region and Northeast Asia (Karelia and the Russian Far East). It also covers the neighbouring states of Afghanistan, the Islamic Republic of Iran, Iraq, Mongolia and the northern territories of China, although no information was in fact obtained for Afghanistan, the Islamic Republic of Iran and Iraq (details are provided in FAO Fire Management Working Paper FM/16/E).

Extent and types of fires

In most countries of the region, the data collected by agencies on the ground or by aerial monitoring do not reflect the full extent of vegetation fires. Forestry agencies or aerial forest protection services may collect data only for protected forests and other protected vegetation under their jurisdiction. In none of the countries are data for grassland, steppe or peat fires entering the databases, even if figures on such fires are recorded by other services, e.g. civil protection or fire services. Unfortunately, these different databases are not merged or published jointly.

There are extremely large discrepancies between the burned forest areas reported by ground or aerial observations in FRA 2005 and the satellite-derived data from GBA2000, which included all burned areas (Table 7). The differences were particularly marked in the case of the Russian Federation and were confirmed by data from an independent remote sensing institution of the Russian Academy of Sciences, the Sukachev Institute of Forest, Krasnoyarsk.

On the other hand, new capabilities in remote sensing have generated datasets of fire information based on various space-borne sensors such as the Advanced Very High Resolution Radiometer (AVHRR) of the US National Oceanic & Atmospheric Administration (NOAA), Moderate Resolution Imaging Spectroradiometer (MODIS), Medium Resolution Imaging Spectrometer (MERIS), Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and SPOT-Vegetation instruments. These datasets include all vegetation types affected by fire, but satellite-derived data cannot be compared directly with the conventionally collected data of forest services unless validated or embedded in a fire information system that includes GIS layers with ecosystem sensitivity and potential fire behaviour and effects.

The Central Asian region constitutes the largest area in the world with a high contamination by radionuclides and it is located in a fire-prone forest environment. A total of 6 million hectares of forest lands were polluted by radionuclides as a result of the failure of the Chernobyl nuclear power plant in 1986. The most polluted forest

TABLE 7
2005 forest fire data derived from FRA 2005 and satellite-derived information from GBA2000

Country	FRA 2005 Total forest area affected by fire (ha)	GBA2000 Total area affected by fire (ha)
Azerbaijan		53 100
Kazakhstan	180 000	8 162 200
Kyrgyzstan		106 700
Tajikistan	4 000	44 900
Turkmenistan		23 300
Uzbekistan		50 600
China	51 000	6 238 800
Mongolia	418 000	2 655 600
Russian Federation	1 268 000	22 380 000
Georgia		18 100
Armenia		7 900
Belarus	6 000	43 500
Ukraine	4 000	2 193 800
Islamic Republic of Iran	6 000	104 200
Iraq		6 500
Afghanistan		
Pakistan	41 000	44 900

area covers over 2 million hectares in Belarus, in the Kiev region of the Ukraine and in the Bryansk region of the Russian Federation. Every year hundreds of wildfires occur in these contaminated forests, peatlands and former agricultural sites. From 1993 to 2001, a total of 770 fires in the closed zone of the Ukraine affected 2 482 ha, while in 2002 a total area of 98 000 ha of wildland burned. In the period 1993–2000, 186 wildfires occurred in the closed zone of Belarus and affected an area of 3 136 ha, including 1 458 ha of forest.

There is a similar situation in Kazakhstan, where more than 450 nuclear tests, including some 100 atmospheric tests, were conducted from 1949 to 1989 at the Semipalatinsk Nuclear Weapons Test Site. Radioactive contamination is highest in eastern Kazakhstan, including the fire-prone pine-strip forests along the Irtysh River on the border with the Russian Federation. Since 2004, the World Bank has financed the Kazakhstan Forest Protection and Reforestation Project, in which radioactive contamination and fire management are key project issues.

CAUSES

As in most regions of the world, the current fire regimes in Central Asian ecosystems are primarily determined by people. On the other hand, successful suppression of lightning-caused fires in some territories – such as the former Soviet Union, where a complete fire protection policy was practiced for many decades – may have resulted in changes in ecosystem properties. Fuel accumulation and the changed species composition and structure of fire-protected stands may have increased the risk of

more intense fires. In addition, extreme droughts in Central Asia have aggravated the risk of extremely large and severe wildfire episodes.

The country report from Russia for FRA 2005 stated that up to 72 percent of forest fires over the past ten years were caused by people, about 7 percent result from agricultural burning, 7 percent from lightning and 14 percent from other causes. However, in some regions – especially the northern areas of European Russia, Siberia and the Far East, where population is sparse and forest fires are not suppressed – the share of lightning-caused fires was considerably higher (up to 50–70 percent).

The amount of lightning ignition in Kazakhstan is comparatively high, owing to the continental climate and the regular occurrence of thunderstorms during the fire season (April–September). A recent analysis of fire data revealed that, in some years, up to 60 percent of the fires were caused by lightning. Recently, however, an increase in human-caused forest fires was recorded (about 50 percent), often associated with illegal activities.

In Mongolia, one of the most sparsely populated countries in the world, it is difficult to obtain accurate information on causes. During the main fire seasons (spring and late fall), there are almost no lightning fires. The recent increase in the number of fires was related to the opening of markets once highly controlled or restricted. The vast majority of fires were not deliberately set to clear land, but were more a reflection of negligence.

According to the fire reports submitted by China to GFMC, more than 98 percent of forest fires there were caused by people. In Pakistan and the Islamic Republic of Iran, most fires were caused by arson and were primarily pasture fires. Some were caused by land mines triggered by cattle and by artillery fire – a side effect of the smuggling of opium and oil through the Islamic Republic of Iran and of refugee activity.

EFFECTS

Information on the damage caused by fire comes mainly from the Russian Federation and Mongolia. The consequences of large, intense fires in Central Asia and its adjoining regions are quite diverse, depending on the specific site conditions and regional climate. The Far East of Russia is an example of fire regimes having changed dramatically over the last decades.

According to information provided by the Russia/USAID Forest Resources and Technology (FOREST) Project, the economic losses from wildfires in Sakhalin from 1998 to 2004 exceeded US\$833 million. In Belarus, in 2004, a damage assessment based on long-term statistics concluded that average annual direct vegetation fire damage amounted to US\$700 000, while indirect (ecological) wildfire damage amounted to about US\$340 000.

A report on the situation in Mongolia in 2005 summarized the damage over the last five years (2000–2004), particularly in the autumn and spring seasons. A total of 853 wildfires affected 5.1 million hectares of forest and 9 million hectares of steppe vegetation. Environmental damage in the country amounted to the equivalent of US\$8.5 million and damage to infrastructure to the equivalent of US\$150 000. The cost of fire suppression amounted to the equivalent of US\$600 000.

A major source of extended smoke pollution in the Russian Federation comes from fires burning in drained or desiccated peatlands.

Measurements of carbon monoxide (CO) from ground-based stations in the Arctic and Europe by Yurganov *et al.* (2004) revealed increased CO concentrations in the summer and autumn of 2002 and 2003 in comparison with the previous two years. The study concludes that the wildfires occurring in Northern Asia are most likely responsible for the hemispheric CO build-up.

PREVENTION

Since most vegetation fires in the Russian Federation and adjoining Central Asian countries are human-caused, the prevention of forest fires is considered a priority. But a recent publication pointed out that the Russian Federation has deficits in public education, as well as insufficient law enforcement. Thus public education and awareness-building are now considered among the primary tasks. Activities include public lectures and reports, articles in the local, regional and national press, and mass distribution of public relations materials.

In Kazakhstan, fire prevention measures consist of awareness campaigns to educate the population on ways to handle fire in a forest and on simple methods of extinguishing a fire. Technical and silvicultural measures for the prevention of fires are implemented by forest enterprises and the mechanized subdivisions of the aviation groups. These measures include the creation of forest edges composed of less flammable and fire-resistant species, firebreaks and fuel breaks, and mineralized strips and removal of debris along roads.

In China, construction of firebreaks by mechanical means, the use of herbicides and prescribed burning are priorities. The total length of firebreaks in China is 490 000 km, and the total length of green-belt fuelbreaks is 172 100 km. In the Far East and Baikal regions of the Russian Federation, prescribed burning of the grass layer has been used extensively in the spring to reduce highly flammable surface fuels.

In Belarus, Kazakhstan and the Russian Federation, aerial patrolling is implemented on a regular basis for detection of forest fires and for reconnaissance/monitoring of ongoing ones.

In CIS countries, fire danger rating systems have traditionally been used to provide early warning of the potential for serious wildfires. FDRS use basic daily weather data to calculate wildfire potential. This early warning information is often enhanced by satellite data, which detect fires early on, and spectral data on land cover and fuel conditions. In Russia, the daily fire danger index is used to determine the preparedness of the fire management organization, including the number of daily patrol flights.

SUPPRESSION

In most CIS countries, the reduction of the financial resources of government agencies as a consequence of the transition to national economies has substantially weakened fire management capabilities. The organizations responsible for fire suppression face severe financial and logistics constraints, resulting in reduced availability of modern

equipment and flight hours to detect and monitor fires quickly and to respond efficiently by aerial and ground means. The number of firefighters employed has also decreased sharply. Despite technological developments in fire management, forestry enterprises of some CIS countries are not provided with adequate technical and financial means for fire management. In the Russian Federation, many forestry enterprises (*leskhozes*) have outdated and generally inadequate equipment for fire suppression, and do not have sufficient financial resources for silvicultural and technical fire prevention measures.

In Belarus and China, unique types of fire suppression equipment are used. Chinese firefighters employ air-jet extinguishers for fighting surface and grass fires (92 000 units are in use), as well as fire-extinguishing bombs. In Belarus, motorized sand blowers are used for fighting wildfires in the forest belt on sandy soils.

In the remote regions of Mongolia, firefighters typically use traditional tools and means of transport. The 2002 fire report of Mongolia revealed that wildfires were fought by 11 464 people using 2 737 horses, among other forms of transportation.

INSTITUTIONS, RESPONSIBILITIES AND ROLES

Despite the transition from centrally planned to market-based economies by most Central Asian countries and the attempt in some countries to decentralize the formerly strong and highly centralized system of forest management, the responsibility for forest fire management is still mainly centralized and predominantly under the forest services.

In the Russian Federation, responsibility for fire suppression is under the overall auspices of the Federal Forestry Agency. Repeated discussions have been held regarding a transfer of overall forest fire suppression responsibility to the Ministry of Emergency Situations. The Aerial Forest Protection Service, Avialesookhrana, is the main institution for forest fire suppression over a total protected area of 690 million hectares, including 12.9 million hectares of reserved forests.

In Kazakhstan, forest protection, including fire protection, remains under the control of the State Forestry Committee at the national level, and of provincial administrations for forest reserves and nature parks under provincial jurisdiction. The Aerial Forest Protection Service is under the State Forestry Committee.

In Mongolia, the National Disaster Management Agency and its subordinate bodies at provincial and local levels are responsible for forest fire suppression.

COLLABORATION

The international dialogue between most countries in the region has a long tradition. With the establishment of the FAO/UNECE/ILO Team of Specialists on Forest Fire in 1981, now operating under the auspices of the UNECE Timber Committee and the FAO European Forestry Commission, a platform for exchange and dialogue in forest fire management was created in the UNECE region. The most recent developments brought the team and their home countries into the new regional wildland fire networks that joined, became recognized or were established under the UN-ISDR.

A number of bilateral agreements in forest fire management are in place between China and Mongolia, China and Russia, the Islamic Republic of Iran and Russia, Russia and Finland, and Russia and Mongolia.

A number of regional conferences and consultations held since 2000 have brought some countries of the region together. One important activity was a meeting of the prime ministers of the six member countries of SCO: China, Kazakhstan, Kyrgyzstan, Russia, Tajikistan and Uzbekistan. The first SCO summit, held in September 2001, concluded that member countries needed to work together in a variety of fields, including forest fire prevention.

Numerous scientific initiatives have been undertaken in recent years to clarify the role and importance of natural and anthropogenic fires in forests and other vegetation. The main research issues addressed in Central Asia/Eurasia included:

- recent changes in fire regimes due to anthropogenic and climatic influences;
- carbon pools and carbon fluxes affected by changing fire regimes;
- improvement of monitoring tools;
- the role of fire on permafrost ecosystems.

Several interdisciplinary research campaigns were initiated from 1993 to 2000 (Goldammer, Sukhinin and Csiszar, 2004). The most recent initiatives include establishment of the Northern Eurasian Regional Information Network, the Siberian/Far Eastern Regional Network, the Western Russian/Fennoscandian Regional Network of GOF-C-GOLD, the Siberia II project and the Northern Eurasian Earth Science Partnership Initiative (NEESPI). The Siberia II project contributed to improving assessment of emissions of radioactive trace gases from fires in the Russian Federation. NEESPI is an active, strategically evolving programme of internationally supported earth systems science research. It focuses on issues in northern Eurasia regarding regional and global scientific and decision-making communities. By establishing a large-scale, multidisciplinary programme of funded research, NEESPI aims to develop an enhanced understanding of the interactions between the ecosystem, the atmosphere and human dynamics in northern Eurasia. It is expected that forest-fire research will continue to play an increasing role in the overall NEESPI programme.

COMMUNITY PARTICIPATION

In the Russian Federation, increasing attention to fire prevention indicates the overall involvement of the general public in reducing human-caused wildfires. In Kazakhstan, Civil Defence, Department of Home Affairs, Emergency Office and the Rayon Home Affairs Department stipulate the participation of human resources and equipment for fire management not only from enterprises and agencies, but also from family farms adjacent to forests.

In Pakistan, a community-based forest firefighting system is being established with the assistance of the United Nations Development Programme (UNDP), which is providing firefighting training and equipment to communities living in the forest.

From 1997 to 2000, the Integrated Fire Management Project – supported by Germany – was operational in Mongolia in the Khan Khentii Strictly Protected Area

and its buffer zones. However, the project did not leave any institutional structures that could be regarded as substantial or sustainable.

NEEDS AND LIMITATIONS

The main limitations to fire management in the region are institutional weaknesses and economic constraints (which, in some countries, are a consequence of economic transition) and a lack of awareness, adequate policies and commitment and involvement by civil society.

These limitations translate into the following needs:

- institution-building, especially improved capacities of government institutions, research entities, businesses and NGOs with regard to the planning and implementation of sustainable development programmes;
- improved technological capacity, including the provision of modern fire-extinguishing equipment, use of satellite information and information technologies;
- improved public awareness and increased sense of responsibility of civil society in issues related to fires;
- training and educational programmes;
- a clear legal and institutional basis for forest protection;
- increased and continuing funds for fire management;
- implementation of international cooperation, including compliance with Agenda 21 of the United Nations Conference on Environment and Development (UNCED) and the conventions related to fire issues in Central Asia – notably the CBD, UNCCD, UNFCCC and Ramsar Convention on Endangered Species;
- links to and interaction with the Europe and North Asia Forest Law Enforcement and Governance process, related to the increase in intentionally set fires in conjunction with illegal logging or to obtain salvage logging permits.

ANALYSIS AND RECOMMENDATIONS

Over the past decade, many countries of Central Asia have witnessed a growing number and size of wildfires in forest and non-forest ecosystems, usually caused by people, but also by lightning in sparsely populated areas. These fires have caused considerable ecological and economic damage and some have had transnational impacts, for example through smoke pollution, loss of biodiversity or forest degradation at the landscape level. The depletion of terrestrial carbon by fires burning under extreme conditions in some vegetation types, especially in temperate, hemiboreal and boreal peatlands, is an important factor in disturbance of the global carbon cycle. The increasing vulnerability of human populations living in or around forest environments has been noted throughout the region. Projected trends in the impact of climate change on vegetation cover and fire regimes, as well as observed demographic and socio-economic trends, suggest that fire may continue to play a major role in the destruction of vegetation cover in Central Asia, resulting in the

accelerated formation of steppe conditions, among other effects. Based on this analysis, the following recommendations are made.

Given the significance of Eurasia/Central Asia's boreal forest in the functioning of the Earth's climate, and the continuing and predicted loss of forest cover and terrestrial carbon storage potential, the increasing destruction of these forests should be addressed vigorously at national and international levels.

Forest and fire management are the responsibility and in the interests of all countries. However, currently and for the near future, some countries of Central Asia do not seem to be in a position to ensure sustainable forest fire management practices. Weak institutional capacities in fire management and law enforcement are limiting the ability to halt forest destruction by illegal logging and/or wildfires and these must be addressed.

The international community has a vital interest in preserving the multifunctional role of forests and other vegetation – including wetlands – through efficient fire management in Central Asia. International conventions, other international negotiations and recent international ministerial meetings have confirmed the interest of the international community in cooperating in sustainable forest management, which includes fire management.

Such international cooperation and targeted projects and programmes must rely on accurate and meaningful fire data and information in assessing the current fire situation and trends. Fire statistics from individual countries are often incomplete and are not comparable owing to different methodologies and lack of coverage. Satellite remote sensing is not yet used systematically to assess the extent and impact of fire, and there is no agreed system in place for economic and environmental fire damage assessment.

International cooperation will be important in developing internationally or regionally accepted standards and protocols, and in sharing knowledge, expertise and resources in joint projects and programmes in fire management. Most fire-prone forests and other vegetation in Central Asia are located in countries in which Russian is the official or prevailing language. Thus investments in training materials, guidelines, terminologies, etc. could be easily shared.

The Regional Central Asia Wildland Fire Network, together with its neighbouring networks (the Baltic area and Northeast Asia) may offer a suitable vehicle for developing cooperative efforts and synergies. The recommendations of governments represented at the regional forest congress, *Forest Policy: Problems and Solutions*, held in Bishkek, Kyrgyzstan, in November 2004, revealed a positive atmosphere for enhancing cooperative efforts in the region.

Existing joint activities in fire management research should be continued and strengthened.

10. Northeast Asia

The Northeast Asian region, covered by the UN-ISDR Regional Northeast Asia Wildland Fire Network, includes China, the Democratic People's Republic of Korea, Japan, the Republic of Korea and the Far East area of the Russian Federation. This part of the world is highly diverse in socio-economic, environmental management systems and their trends, and each country faces different driving forces of development, as well as different, but always major, challenges (details are provided in FAO Fire Management Working Paper FM/6/E).

In considering the Russian Federation, it should be appreciated that while much is typical of Northeast Asia, other, western parts of Russia are more typical of Europe. The Russian Far East has closer economic and trade connections with Northeast Asian countries than with most western parts of Russia.

EXTENT AND TYPES OF FIRES

A comparison of national statistics for the Northeast Asian countries shows an average of about 1 million hectares of forests burned each year during the period 1990–2004. The occurrence of forest fires varies with climate variability and the accumulation of combustible materials between years. However, the trend in areas affected by vegetation fires and estimates of the damage show an increase in recent decades.

The average annual number of forest fires in Japan is about 3 000, of which about 150 were larger than 1 ha. During the last 20 years, the largest area affected by forest fires was about 1 000 ha.

The average annual number of forest fires in China during 1990–2004 was 5 337, covering an average of 135 050 ha. The latest peak of fires was in 2004 with 13 401 fires, covering 345 585 ha of forests.

In Russia in recent years, with the advent of international satellite coverage and in collaboration with Russian fire scientists, more realistic burned-area estimates have been made than in the past. For example, during the 2002 fire season, satellite imagery revealed that about 12 million hectares of forest and non-forest land (wildland) had been affected by fire in Russia, while official sources reported only 1.2 million hectares of forest land and 500 000 ha of non-forest land burned in the protected areas of 690 million hectares (Goldammer, Sukhinin and Csiszar, 2003). During the early summer of 2003, remote sensing data indicated that the total area affected by fire in Russia exceeded 22 million hectares (GFMC, 2003). Based on recent remote sensing data, it appears that the annual burned area in Russia can vary from 2 to 15 million hectares per year. In addition, agricultural prescribed burning (e.g. pasture management) in Russia is estimated to affect 30 million hectares annually. Estimates for the Far East are about 1 million hectares per year.

There are two reasons for the official under-recording: insufficient monitoring of fires in the extensive territories of northern Russia, Siberia and the Far East, and an attempt by local authorities to hide their inefficiency in combating fires. This inefficiency is often not technical, however, but rather related to lack of funds.

CAUSES

In Northeast Asian states, human activities in the forest are expanding because of demographic and socio-economic changes in the developing countries of the region, and for mainly cultural/aesthetic reasons in the developed ones. The origins of fires are invariably linked with human activities such as commerce (wood production), cultural-aesthetic spheres (hunting with a camera, tourism, etc.) and arson. Fires are intensified by current non-burn policies in fire-adapted ecologies, and are caused by accidental burning; land conversion (agriculture, pasture lands, industry and construction, forestry practice and plantations); harvesters of non-wood products; cattle herders; tourists; road and rail workers; traditional uses of fire such as hunting; and infrastructure development.

Vegetation fires overwhelmingly originate from human actions: 95 percent in China, 71 percent in the 1990s in Japan, and 79 percent in the Republic of Korea. The present harsh economic realities force the North Korean population to clear forests in order to collect wood for heating and cooking. According to government statistics in Russia, the share of human-caused forest fires in the Far East during the last two decades was 60–80 percent (84 percent in 2004).

EFFECTS

Uncontrolled vegetation fires were the principal causes of deforestation and forest degradation in the Northeast Asia region (Shu Lifu *et al.*, 2004). There have also been estimates that timber losses in the region, due to forest fires alone, are on the order of US\$0.5–1 billion per year.

The temperate and boreal forests of the Northeast Asia region may account for more than 2 percent of both global biomass burning and carbon emissions. Furthermore, there is growing concern that fires on permafrost sites in the region will lead to the degradation or disappearance of forests on these sites, due to the long restoration process. Increased numbers of fires in the boreal forests of Russia are a major threat to the global carbon budget.

The scale of the negative impact of fire on nature and society during the last decades (environmental damage, economic losses, resources spent on fire suppression) seems to be increasing. The impact on human health is also estimated to be growing. The outbreak of large-scale forest fires in October 2004 in two areas of the Russian Far East caused atmospheric pollution, felt also in neighbouring countries.

During the period 1959–1998, China's losses in firefighting were about 100 human lives and 500 injured. Significant human losses were also recorded in 1998 and 2003 in neighbouring Russia. In the Republic of Korea, huge property losses of US\$83 million were recorded in April 2000, with associated severe effects on forests.

It is doubtful that existing methods of data collection provide a true picture of the economic losses to society caused by vegetation fires. There is great variation in the estimation of annual regional forest fire damage. For example, the Russian methodology of post-fire assessment is not able to give a detailed figure. During the spring, summer and autumn of 1998, fires ravaged 2.2 million hectares of forests in the Russian Far East. At the time the damage was estimated at US\$200 million. However, a recalculation of lost resources using world market prices amounts to US\$4.2 billion and provides a more accurate picture (Kondrashov, 1999).

PREVENTION

Northeast Asian countries employ a wide range of preventive and fire awareness measures. Advanced fire management systems, including the use of remote sensing for detecting and monitoring fires, are in place in China, Japan, the Republic of Korea and Russia. The Republic of Korea is introducing a new ground-based system equipped with automatic cameras for detecting forest fires, capable of covering 93 percent of total forest area (6.4 million hectares). No other country in the region has a similar system.

The creation of green fire belts and mineralized strips of soil in China and Russia, air patrolling, fire watchtowers, satellite monitoring and radio communication are all common fire prevention methods in the countries of the region, except in the Democratic People's Republic of Korea (Shu Lifu, 1998; Telitsyn, 1988; Ostroshenko, 2000).

In Japan, the Republic of Korea, the forest region of Daxinganling (China) and the Khabarovsk Territory (Russia), a lightning detection and monitoring system has been established to identify and locate fires ignited by lightning.

In Northeast Asian countries, fire is used for clearing land to plant crops, develop pastures or establish forest plantations. It is appreciated that fire, when properly prescribed and skilfully managed, can be less destructive to site quality than mechanical clearing methods, since soil disturbance is minimized and there is no soil compaction by heavy equipment. Prescribed fires are used to prevent forest fires of high intensity and to improve conditions for the growth of forest trees.

Most countries in the region have adopted a policy of fire prevention through awareness-raising programmes and training for local populations.

SUPPRESSION

Fire suppression practice is advancing in the region, despite often insufficient financing and technical support. There are few differences in the fire suppression techniques of the Northeast Asian countries, but management systems and the level of equipment use are quite varied. For example, in Japan, which is a densely populated country where it is possible to reach forest sites in a relatively short time, fires are eliminated by the urban fire and rescue services, but in the Republic of Korea, firefighters use helicopters to reach fire spots in any part of the country within half an hour.

Russia is currently changing its policy of total suppression of all forest fires, taking into account experience from other parts of the world. The application of a new forest

fire management policy has been delayed due to ongoing changes in state forestry management, earlier problems with adoption of the new forest code, uncertainty regarding the allocation of authority, shortage of financing, and technical problems.

INSTITUTIONS, RESPONSIBILITIES AND ROLES

Forest protection is generally an important component of the national policy of all countries, providing ecological sustainability and preserving ‘green’ potential. But in the Northeast Asian region, legislation and the ability to implement it differ from country to country.

Major achievements have been made in several countries of the region with regard to their institutional framework. In China, Japan, the Republic of Korea and Russia, national and local versions of Agenda 21 have been formulated, directly relating to their national forests. In addition, environmental plans or strategies have been developed, such as Japan’s Basic Environment Plan, the Republic of Korea’s Green Vision 21, the Democratic People’s Republic of Korea’s National Strategy for Conservation and Sustainable Use of Natural Resources, and Russia’s Concept on Forestry Development.

Progress has been achieved in virtually all areas of environmental protection in all countries, but expenses have increased and thus the extent of progress differs. Recent initiatives, such as the creation of the Presidential Commission on Sustainable Development in the Republic of Korea, which involves people from the business sector, academia and NGOs, seem to provide the potential for an effective multistakeholder voice in policy implementation.

China’s Forest Action Plan for its Agenda 21 of 1995 laid the foundation for a comprehensive range of sustainably managed forest ecosystems together with a fully developed forest industry by 2010. In Japan, the nationwide Forest Plan (1996) was developed, together with policy directions and guidelines for forest management. The 4th Forest Development Plan of the Republic of Korea (1998) created the basis for sustainable forest management by improving forest resources, fostering competitive industries and maintaining a healthy forest environment.

Russia has well-defined laws on forest protection, but law enforcement is quite weak. There were not many supporters of the recently prepared forest code, which will radically change the property and management system in Russian forestry and is now set to begin implementation from January 2007. The Russian Far East is a part of the all-Russia forest fire management system, with two lead departments: the Federal Forestry Agency and the Aerial Forest Protection Service. Both departments have subdivisions in the various regions of the country. The Ministry of Emergency Situations becomes involved in extreme circumstances.

The importance of forestry research and education is widely recognized through Northeast Asia as a prerequisite for effective management of natural resources. Research, education and information systems vary across the region, depending mainly on the availability of funding, other resources and facilities. But, without exception, countries invest less in forestry research than in related sectors such as agriculture.

Understanding the need for partnerships in managing forest-fire events, the countries in the region have ratified, accessed to or accepted most multilateral environmental agreements and conventions adopted prior to or after the 1992 UNCED. Despite this, there is still no international forest fire cooperation programme in the region.

Further, the control of fires is a national issue that must be addressed in a coordinated manner on the basis of the resources and expertise of individual nations. Technical assistance may have a key role to play here, together with the development of partnerships. There are fewer federal (central) resources available and many issues have been devolved to local governments, NGOs and partners. New models for partnership, cooperation and, in some cases, trilateral agreements by the private sector, NGOs and national and local governments may be expected in the near future.

COLLABORATION

Unacceptable losses of resources and transboundary pollution have had a positive impact on collaboration between nations, especially between neighbouring countries such as China and Russia. A number of Northeast Asian countries have participated actively in the international dialogue on forests. This includes discussions in the Intergovernmental Panel on Forests, the Intergovernmental Forum on Forests, and subsequently in the United Nations Forum on Forests. A number of countries from the region have sponsored or hosted initiatives and meetings, directly contributing to this international dialogue.

A variety of other regional forestry agreements, institutions and ad hoc meetings promote international cooperation on forestry within the region. FAO, the International Network for Bamboo and Rattan (INBAR), the International Plant Genetic Resources Institute (IPGRI), ITTO, IUCN, UNDP, the World Bank and the World Wide Fund for Nature (WWF), among others, have a range of forestry programmes or involvement in forestry.

A wide variety of forestry-related NGOs also operate in the region, implementing bilateral and multilateral development projects, and they play important roles in facilitating dialogue and exchange. Japan is one of the main donor countries, both in the region and on a global scale, contributing substantially to forestry projects in the Asia and the Pacific region, while the Global Environment Facility is supporting Forest Fire Management in Biologically Valuable Forests of the Amur-Sikhote-Aline Ecoregion. This Russian Far East project involves all components of civil society in its implementation.

In 2004 the Regional Northeast Asia Wildland Fire Network was established under the UN-ISDR GWFN. This regional network is coordinated by the Korean Forest Research Institute and facilitated by the Pacific Forest Forum. It is currently providing a platform for fire information dissemination and exchange, which could, through increased cooperation, lead to effective work on fire management.

COMMUNITY PARTICIPATION

The region is undergoing a positive change with regard to society's perception of the problem of fires. However, people are still not fully aware of the consequences of forest fires.

The countries of the region have recognized the immense pressures on forests in densely populated areas, and also that authoritarian styles of centralized forest management are neither appropriate nor effective in meeting the broader forest management objectives of today. Forest departments have increasingly found their management objectives unattainable, or seriously compromised, unless they empower communities and stakeholders to participate in decision-making.

Many villages in China and some other countries have developed community regulations and agreements and have successfully strengthened forest fire management at the local level. But this is not widespread, nor has technology transfer gone far. The main measures for managing fires are to raise public awareness through publicity and educational activities, legislate for fire management, build firefighting teams, develop an enabling framework for society's involvement in fire prevention and reinforce the development of infrastructure and fire preparedness in key danger zones.

Local people may have extensive knowledge on fire management that is well adapted to the local environment and thus may be in a position to manage or prevent fires without outside assistance. However, in the case of very large fires, communities often cannot manage the situation because of inadequate training, experience and professional expertise.

In the Russian Far East, USAID established the Forest Resources and Technology (FOREST) Project, devoted to forest fire prevention through changing people's behaviour in the forest. The project has been working in Khabarovsk, Krasnoyarsk and Primorski territories and Sakhalin and Irkutsk regions. It introduced an integrated approach to forest fire prevention awareness activities among local citizens. The approach involved three interdependent components: development of educational campaigns and general awareness for targeted groups; development of the Fire Prevention Awareness Program for Preschool and School Age Children; and strengthening of foresters' skills in communication/community participation.

Although changes in people's behaviour and attitudes usually take place gradually over decades, checks showed that, in one year, about 90 percent of the people had become familiar with and remembered some elements of the campaigns and 18 percent declared that they had changed at least one aspect of their behaviour in the forest. As the FOREST Project shows, regular fire prevention awareness activities among citizens cannot be implemented without laws, stable finance and established institutions. Moreover, financing systems and institutional structures must also be in place (Kuzmichev, Kolomytsev and Chekurdaev, 2004).

NEEDS AND LIMITATIONS

Major constraints on forest fire management face Northeast Asian countries:

- limited institutional and technological capacities;
- organizational and financial problems in implementing international cooperation;
- the challenge of full implementation of Agenda 21 measures and actions at national and regional levels;
- lack of public awareness of fire issues;

- lack of technical cooperation, training capacity, educational programmes and the ability to combine the efforts of all components of civil society;
- absence of a clear legal, institutional and financial base, including new measures for taxation;
- absence of measures to increase the responsibility of civil society for the condition of forests;
- the need to enhance the capacity of government institutions, research entities, business and NGOs with regard to planning and implementation of sustainable development programmes;
- the need to develop institutional mechanisms that integrate both the developed and developing countries in the region;
- shortage of modern fire control equipment, insufficient use of satellite data and information technologies.

ANALYSIS AND RECOMMENDATIONS

Comparing the periods 1988–1992 and 1998–2004, an increase can be observed in: scale and frequency of forest fires, area burned, economic damage (albeit with great differences among countries), costs of fire suppression, efforts to regroup forces and attract voluntary firefighters, and awareness among the general public and national/local politicians of the necessity for fire management.

In summary, the goals of sustainable forest fire management are most likely to be achieved through:

- adopting enabling approaches, forming partnerships and activating participatory mechanisms;
- building capacity of partners;
- monitoring and evaluating progress, and learning from each other's successful practices through networking and the use of modern information technologies;
- developing international cooperation to facilitate active participation at all levels of government and by all relevant partners in decision-making, policy formulation, implementation, evaluation and resource allocation.

Vegetation fires and their negative impact continue to be a major issue in Northeast Asia: fires cause deforestation and influence the quality of life, land, air and water. Unacceptable resource losses and the spread of transboundary pollutants need immediate attention by the nations of the region and their international partners.

Integrated programmes and strategies must be developed to address the wildfire problem at its roots, while at the same time creating an enabling environment in which appropriate tools are developed to enable policy-makers to deal with wildfire proactively. The traditional approach of dealing with fires exclusively through fire exclusion schemes must be replaced by an intersectoral and interdisciplinary approach.

Fire management experts from Northeast Asia have a good picture of how to improve methods and incorporate modern technologies of forest fire prevention and suppression. There is also a clear perception of the need to take into account

post-fire ecological consequences and their role in global processes. Fire impact on forest ecosystems is now perceived as many-sided, useful as well as harmful, and a necessary element in fire management. Large forest fires are still the main threat, since they have been increasing proportionally over the last 30–40 years.

However, there is still no regional database on forest fires. Due to different approaches, information is not always compatible among countries. Efforts are underway to further such compatibility, but political will and government support are needed to realize this concept.

Institutional capacities are among the weakest points in forest fire management in the region and need to be improved.

Emergency preparedness and response programmes must be coupled with better land-use policies and practices. Fire prevention should become a priority in the forest protection system, while the application of prescribed fires and preventive controlled burnings as a measure of fuel management should be increased.

The quality of training for fire risk assessment (fire danger index) must be improved, and there is a need to unify approaches to regional zoning according to forest fire risk.

Advanced technologies for forecast and detection of fires should be introduced, and other information technologies as well. There is a need for development and provision of free access to a global early-warning system for fire occurrence and fire risk. The establishment of fire management networks can be a very effective tool to support local communities in fire preparedness.

The interrelationship of fires with climate change and the global carbon cycle, the expected long-term socio-economic consequences and the change in forest resources should be studied.

International cooperation in suppressing forest fires should include not only information exchange, but also the transfer of fire suppression resources such as airplanes, ground forces and equipment from country to country. The main problems facing the use of aerial means are the operational and maintenance costs, but comparing suppression costs with the possible ecological and economic damage, a balanced solution must be found.

There is a need to improve capabilities in local, national, regional and global early warning and risk assessment and in the detection, monitoring and regular assessment of fires.

11. South Asia

This region includes Bhutan, India, Nepal and Sri Lanka. It stretches from the mountain forests of the Himalayas in the north, to tropical evergreen forests in south India and Sri Lanka. The range of landforms and climates in South Asia has resulted in a high diversity of ecosystems and forest types, and consequently diverse fire regimes and vulnerabilities (details are provided in FAO Fire Management Working Paper FM/14/E).

EXTENT AND TYPES OF FIRES

The latest and only data on forest fires in South Asia that are compatible with other regions are provided by the FRA 2005 country profiles (FAO, 2005d). In 1990 the average area in South Asia affected annually by fire was 1.43 million hectares, excluding the Kingdom of Bhutan, where no data were reported before 1992. In 2000 the approximate annual fire-affected area was 4.11 million hectares, of which 90 percent was in India. However, no information is available on fires in other wooded lands.

Moist deciduous forest is the most vulnerable to fire in India. Nearly 15 percent of this ecosystem is frequently disturbed by fire and 60 percent is occasionally affected. Nine percent of the wet/semi-evergreen forests burn frequently and an additional 40 percent burn occasionally. In the northeastern region of India, recurrent fires annually affect up to 50 percent of the forests.

The coniferous forests in the Himalayan region, notably *Pinus roxburghii* stands, are also very fire prone. Many wildfires occur during the winter drought. The 2005/06 winter was a typical example: numerous fires burned in the high-altitude forests and shrublands of Bhutan, Nepal and Sikkim (India). In neighbouring Tibet, a major wildfire burned for almost two weeks at the foot of Mount Qomolangma (Mount Everest) and destroyed valuable bushland in the county of Tingri.

CAUSES

In all countries in the region, fire is used by the rural population as a common tool to clear agricultural land. It is also used to facilitate the gathering of NWFPs and in hunting and herding. Uncontrolled fires are common in regions with a long, intense dry season. All of these fires have the potential to cause major damage.

Over 90 percent of fires are due to human causes. There are very few cases of fires ignited by lightning.

Bhutan's climate conditions during winter (freezing temperatures, lack of rainfall and high wind velocities) strongly favour fires. Moreover, at the end of the dry winter season the fields are prepared, and these fires often escape and cause damage.

In Nepal, analysis revealed that 58 percent of the fires were deliberate, followed by those caused by negligence (22 percent) and accident (20 percent). With human

populations moving into WUIs, an increasing number of fires were human-induced, caused, for example, by discarded cigarette butts and by the collectors of NWFPs and fuelwood. Fires were started deliberately by livestock owners, shepherds and herders, who ignited grasslands to promote a new flush of growth for their animals. These fires often spread to forests – and this was a key threat in the Terai area.

India gave an example of a case study area (the Nilgiri Biosphere Reserve in Coimbatore) in which successful fire management had been practised for a long time, but where it suddenly started to fail (Srivastava, 1999a). The reasons were a reduction in the means and funds for fire prevention and control, continuous encroachment by herders and NWFP collectors, and a decreasing sense of responsibility for fire control among local people.

EFFECTS

The consequences of uncontrolled fires in South Asia are serious degradation of forests, ecological changes and deterioration of social and economic conditions.

According to reports from the region, the main environmental damages to forests included destruction of biodiversity, extinction of plants and animals, soil degradation with erosion and loss of fertility, loss of wildlife habitats and depletion of wildlife, degradation of watersheds and halting or slowing of natural regeneration.

Microclimates were affected, with changes in soil moisture balance and increased evaporation. Important carbon sinks were lost or degraded, leading to an increase of carbon in the atmosphere. Smoke haze polluted the atmosphere and endangered people's health (Srivastava and Singh, 2003).

Economic and social losses due to fire included losses of valuable timber resources, NWFPs, fuel wood and fodder. Loss of employment was seen, as well as destruction of property and loss of lives.

According to the FRA 2005 country profile of India, 3.7 million hectares of forest were affected annually by fire, creating damage of US\$107 million equivalent (Bahuguna and Singh, 2002). In Bhutan from 1981–1985, 232 fires were reported, affecting an area of 29 516 ha and causing damage of US\$19.2 million equivalent (Chhetri, 1994).

In Nepal the average annual loss of saw logs and fuelwood in Bara district in 2004, at market price, was some US\$370 000 (Kafle and Sharma, 2005).

Sri Lanka lost 26 ha due to forest fires in 2000 (FAO, 2005d). In the years from 1994–1998, 641 fires were reported, burning an area of 1 648 ha and causing estimated damage of US\$75 000 equivalent.

ECONOMIC AND SOCIAL BENEFITS

In Nepal firewood collectors evidently prefer *dola daura* (round fuelwood of saplings killed by fire and dried) to freshly cut wood because it burns slowly and produces higher heat yield.

Farmers welcome the first post-monsoon flash floods from burned forest to their lands because they carry organic matter, available phosphorus, potash and nitrogen.

Fires boost the formation of fresh, palatable shoots as cattle fodder. The collection of minor NWFPs, such as seeds of sal (*Shorea robusta*), *niguro* (edible ferns), mushroom and *kurilo* (*Asparagus racemosus*), is facilitated by fire because they are more easily seen, and the forest is more accessible.

PREVENTION AND SUPPRESSION

Among the South Asian countries, only India and Sri Lanka have information on forest fire prevention. Bhutan and Nepal seem to have no preventive methods at all, due to lack of capacity, including human resources.

Preventive measures in India and Sri Lanka consist mainly of traditional practices such as fire lines and tracks, prescribed burning and hiring fire spotters during the fire season. Villagers in the vicinity of forest areas often have permission to gather dead wood free of charge in order to reduce the fuel load. They are also expected, even if not legally required, to assist the forest authorities in fire suppression.

In Sri Lanka forest management plans do not include activities to prevent forest fires. They consist mainly of training programmes for local officers and villagers in firefighting, and few projects have been launched to develop community involvement.

The Indian Ministry provides financial assistance to state governments within the Modern Forest Fire Control Methods plan. Financial support is used to buy hand tools, fire-resistant clothing, firefighting tools and radios, build fire watchtowers and pay spotters. The funds are also applied to the creation of fire lines, as well as for research, training and awareness-raising. This plan has been implemented in more than 70 percent of the forested area.

The Joint Forest Management (JFM) Programme, a UNDP project (1985–1990) and a project in Western Ghats in 1994 served to raise awareness among communities and increase their participation in fire prevention and forest conservation. The programmes were quite successful: fire outbreaks decreased by up to 90 percent in some regions (Srivastava, 1999a).

INSTITUTIONS, RESPONSIBILITIES AND ROLES

In most South Asian countries, the destruction caused by forest fires is well known and acknowledged by governmental authorities. Most politicians are aware of the necessity to practice fire prevention and to have a functioning fire control system. But this awareness and acceptance are often forgotten as soon as the monsoon season starts. Nevertheless, most countries have a forest law, which contains at least a clause prohibiting the setting of fire under certain conditions. This is often the only legal provision for fire control and prevention and its enforcement is often difficult. The Social Forestry Division of the Bhutan Government recently took the first steps to prevent and fight fires through awareness campaigns and building capacity for prevention and control.

Activities of the Nepalese Government towards fire prevention are confined to television and radio broadcasts, since the Nepalese Department of Fire has neither the capacity nor the capability to prevent forest fires. However, the involvement of

volunteer firefighters is increasing and is promoted by the Firefighters volunteer Association of Nepal (www.fan.org.np/).

In Sri Lanka the Forest Department is in charge of all forest fire prevention and suppression activities, which are carried out by provincial district officers. Government support is provided through programmes promoting community involvement, for which fire management plans have been created. A new forest policy was introduced in 1995, but was not implemented until 1999.

In 1988 India had a quite visionary National Forest Policy, which focused on the protection of forests against fire and called for improved and modern management practices to deal with forest fires. The Ministry of Environment and Forests developed a National Master Plan for Forest Fire Control, which introduced a fire management plan focusing on education, research and development.

The Indian Government also set up guidelines for national forest fire prevention and control. The main features are: identification of vulnerable areas on maps, creation of a data bank on forest fires, fire danger and forecasting systems, provision for a crisis management group, involvement of JFM committees and efficient enforcement of legal provisions.

In the future, India intends to create a National Institute of Forest Fire Management, equipped with the latest firefighting technology using satellites. It will carry out research, training and technology transfer on a long-term basis to obtain sound information in order to improve fire management planning in forests.

In South Asia the local people and the administrative authorities are aware of the damage caused by forest fires, but the environmental and socio-economic consequences of these fires are usually underestimated. The governmental environmental/forest institutions of all countries play a key role in any activity related to forest fires. The local forest authorities are responsible for suppression, as well as for detection. Responsibilities are only shared in areas where local people are actively participating in fire management programmes, such as in India, or where the forest is community property and managed by the community, as in Nepal (Kunwar and Khaling, 2005; Sharma, 2005).

In general, there seems to be a lack of feeling of responsibility on both sides – government and local populations. Tackling the difficult issue of fire is postponed by national parliaments as soon as the season changes and the danger recedes. Since law enforcement is rarely practised, nobody feels guilty and therefore nobody feels responsible.

COLLABORATION

Most international cooperation is implemented through organizations such as the Center for International Forestry Research (CIFOR), FAO, ITTO, IUCN, UNDP, UNEP, the World Bank and WWF. Some regional institutions and programmes support collaboration and assist in the dialogue between partners, for example the Asian Development Bank, South Asian Association for Regional Cooperation, South Asia Co-operative Environment Programme and FAO's Asia-Pacific Forestry Commission.

Organizations that have launched programmes explicitly concerning forest fires are few. The Asia Forest Partnership is addressing the problem of forest fires and in the future is planning to assign some projects to forest fire prevention. Furthermore, the Asia-Pacific Regional Workshop on Scientific Dimensions of Forest Fires, held in India in 2000 and initiated by the Committee for Science and Technology in Developing Countries, was organized to discuss how science and technology can be used to improve fire prevention, management and mitigation.

Specific cooperation agreements among the South Asian countries pertaining to forest fire management, as proposed by Sharma (2005) and the GWFN, is not yet in place.⁹

COMMUNITY PARTICIPATION

Community involvement in forest fire management in South Asia is receiving increasing attention.

In India community involvement is actively promoted through the creation of JFM committees, which have been founded throughout an area of over 10 million hectares. They are now an essential component of the Modern Forest Fire Control Plan and have been given responsibility to protect forests from fire.

As a result, forest fires were reduced significantly. Moreover, the forestry authorities accepted the control plan willingly and dialogue with the villagers improved, with the result that people were much more willing to cooperate in fire prevention and control.

Other attempts of the Indian Government to apply a fire management system have been more negative, since they replaced traditional, community-based fire management systems, for example in the Mizoram region. The governmental management systems deprive people of responsibilities and tasks, so they no longer feel in charge of fire prevention (Darlong, 2002).

In Nepal there is increasing interest in community involvement and participatory approaches (CBFiM) (Kunwar and Khaling, 2005; Sharma, 2005).

In Sri Lanka community involvement in forest fire management has been voluntary, but few programmes have been developed to attract villagers' interest. A new management plan was created containing a "participatory management working circle". The government intends to launch another participatory forestry management programme to enhance fire prevention and communication between communities and the forest authority.

NEEDS AND LIMITATIONS

Most countries of the South Asian region lack a national focus and the technical resources required to sustain a systematic forest fire management programme. Facing such a situation, it is clear that the needs and limitations are considerable.

⁹ In September 2006 representatives of the fire research community in India and Nepal agreed to begin establishment of the UN-ISDR Regional South Asia Wildland Fire Network by early 2007.

They include:

- establishment of a fire division within the Forestry Departments, which would be in charge of all fire issues;
- provision of a legal and financial base for fire management;
- enforcement of existing or revised laws;
- absence of a specific forest fire management plan, or of fire management provisions within the forest management plan;
- launching of forest fire management programmes;
- introduction of community-based fire management;
- improvement of the present limited institutional and technological capacities;
- capacity-building within the forestry department as well as among local populations;
- provision of basic tools and materials for fire prevention and fighting;
- education of the population, including awareness-raising campaigns;
- lack of cooperation among South Asian countries, especially for knowledge and data exchanges;
- improvement of cooperation with international organizations, NGOs, etc.

Additional research is needed on fire outbreaks, suppression and fire ecology for better forest fire management. Modern technologies, such as remote sensing and satellite imagery, should be used for fire detection. India has already undertaken some initiatives in the use of these technologies (Srivastava, 1999a).

ANALYSIS AND RECOMMENDATIONS

Many of the South Asian countries have a long way to go to achieve sound forest fire management, as in the case of Bhutan, Nepal and Sri Lanka. India, on the other hand, seems to be realizing some improvements.

The destruction caused by forest fires is recognized to a limited extent by the people and by decision-makers in all countries, and some knowledge exists on how to address the problem of fires. The question is how countries decide to tackle these issues and what support and incentives may be available from outside.

The following recommendations aim to establish a sound, basic forest fire management system:

- In most South Asian countries, governments should first be more aware of and committed to fire prevention and fire suppression. As long as governments refuse to take into account the negative effects of fires, it is very unlikely that changes will be accomplished.
- The definition of responsibilities and the creation of internal structures in charge of fire-related matters within Forestry Departments are still lacking in several South Asian countries. These bodies should be responsible for, *inter alia*, developing fire management concepts, building up capacities at all levels and initiating awareness-raising campaigns.
- A legal framework is essential to fire prevention and control, since it can remove incentives that encourage people to start harmful fires.

- Development of fire management plans and programmes is an important parallel step.
- Awareness-raising and the creation of a sense of responsibility among rural people can be pursued by campaigns using the media, meetings and the enrolment of villagers in forestry programmes.
- Community-based approaches should be given priority in forest fire management by empowering local people and institutions and engaging them actively in management issues, including giving them user rights.
- Fire management capacities should be built at local and national levels.
- Basic tools must be provided for preventing and combating fires.
- National science bodies should be involved in data collection on forest fires and in collaboration with forest departments to support fire prevention, suppression, and mitigation.
- Stronger collaboration among South Asian countries is advisable for the purpose of information exchange.
- Cooperation with international organizations and NGOs should be intensified.

Once the basic needs for a working fire management system are met, other technologies, such as remote sensing and satellite imageries for fire detection, should be introduced to improve the efficiency of fire management.

12. Southeast Asia

The regional paper for Southeast Asia reviewed the countries of insular and continental Southeast Asia – members of ASEAN. Through the ASEAN Agreement on Transboundary Haze Pollution, member states are forming a network that will serve as the UN-ISDR Regional South East Asia Wildland Fire Network (details are given in FAO Fire Management Working Paper FM/10/E).

EXTENT AND TYPES OF FIRE

There has been almost no data on fire occurrence for the region since 1997/98. Thailand offered the only source of fire-related data for this study, including fire numbers and extent. Data for the post 1997/98 period were difficult to obtain, other than the limited data reported for FRA 2005 for six countries, or extracted from publications, such as Ganz (2003). Most available statistics dealt only with area burned and frequently there were no data at all relating to numbers of fires or causes.

In the past two decades, severe fire events in the region have been notable for the level of intraregional and global concern, but between these occurrences, there was little data collated to enable monitoring or evaluation at national or regional levels. Despite the level of inputs, including donor projects, almost no data were routinely collected and thus there were no time series against which routine performance and progress might be measured, other than the series of spikes at irregular intervals at the upper end of the spectrum.

CAUSES

Past analysis of the underlying causes of wildfires – by groups such as Project Firefight South East Asia (Ganz, 2003) and CIFOR (Murdiyaso and Lebel, 2006) – is still relevant and valid. Some reasons for fire use included:

- land-use change/conflict;
- increasing land-use pressure;
- inconsistent land-tenure policies;
- perverse economic incentives;
- direct economic incentives.

The most direct reason for fire use in the region was the search for subsistence and income, i.e. using fire as part of an agricultural cycle for either food or plantation crops.

The Integrated Forest Fire Management (IFFM) Project of the German Agency for Technical Cooperation (GTZ) drew together the elements of fire management and coherently structured them into a tropical fire management framework. IFFM included a clear basis for the underpinning information required (e.g. cause, impact,

behavior) to create an understanding of fire at management levels and to define the linkage between understanding the causes of fire and achieving effective fire prevention (Shields, 2004). Prevention campaigns were often aimed at sections of the community that did not cause a significant number of fires, e.g. school-aged children, while those that use and cause the most fires, the farming and plantation management communities, were ignored.

EFFECTS

Forest and other land fires in 1997/98 caused significant ecological and human impacts that focused world attention on the underlying nature of fire problems and their causes within the region. International attention had been directed to this region following severe drought and fire in 1982/83, 1991 and 1994. As might be expected, with the increasing ability to remotely monitor fire occurrence and extent, albeit very coarsely, the 1997/98 episode drew far more global attention than prior events, and future events will attract at least similar levels of scrutiny, driven heavily by neighbours that cause little fire but are impacted by the outputs from it.

Since 2000, there has been no new reported country-level information on specific social, economic and environmental impacts. Smoke haze episodes generated by wildfires and land-use fires have occurred repeatedly, such as in August 2000 and August 2005.

The fires in peat soils were burning in deep strata and thus it was not possible to suppress them by conventional techniques. Numerous slash-and-burn agricultural or land-clearing fires burned out of control as well, because of very dry weather conditions.

PREVENTION

The use of satellites for detection of active fires peaked following the 1997/98 fires, following recognition of the technology's limitations. 'Hotspot' identification using NOAA's AVHRR is increasingly recognized as offering no practical value for strategic and tactical suppression purposes. The use of fire location maps generated by AVHRR is limited owing to coarse resolution, cloudiness, time delays in information relay to field sites, and accuracy. Given the general development status of fire management capabilities and systems in Southeast Asia, the application of spaceborne information other than for monitoring purposes is difficult to justify at this stage.

The availability of fire-related weather information has improved in the period 2000–2004. The ASEAN Specialized Meteorological Center and the Southeast Asian Fire Danger Rating System now provide relevant fire danger and meteorological information via their websites. These tools are valuable to the fire manager, although difficulty in accessing and interpreting the information remains in some rural and semi-rural locations.

Viet Nam is operating a National Fire Danger Rating system. Fire-related weather data are collected in the field, analysed centrally and distributed as a fire danger warning across the country. The fire danger rating is made available in rural areas via various media, including facsimile, radio and roadside signboards.

An ASEAN zero-burning policy was ratified in 1999. It is apparent that the prohibition on burning is proving ineffective in reducing fire in the region. It is now more widely recognized that fire has a deeper role in society and in livelihood creation than a policy can prohibit. Some potential modification of this policy is now beginning to affect national fire considerations, including recently developed guidelines for prescribed burning aimed at small landholders, farmers and shifting cultivators.

SUPPRESSION

Fire suppression resources are available but are insufficient in most countries. Thailand, for example, has a nationally organized fire suppression capability, but it recognized in 2000 that it could offer coverage of only 20–30 percent of forested lands. No other national coverage estimates are presently available. Indonesia has begun a programme to develop fire brigades with trained and equipped staff in localities considered highly fire-prone.

The equipment and resources available in the region comprise a range of locally developed and imported technologies. Fire suppression field crews, equipped with standardized levels of manual and mechanized equipment, are being developed. Crew sizes vary from 3 to 15 people and have designated leaders and specialists capable of operating and repairing firefighting equipment. These suppression crews are the backbone of firefighting operations, and their continued development and increasing numbers across the region will mark significant changes in fire suppression in the future, provided they are supported by effective management systems.

Vehicles fitted with water tanks and pumps of varying capacities continue to be used. Their utility is limited by road access. Heavy equipment (bulldozers and excavators) is utilized more widely by plantation owners, particularly in peat soil fires.

The use of aircraft for fire suppression is just beginning in the region. One of the most successful aircraft uses in recent times is of light and medium helicopters for remote and rapid access to fires, with self-contained and well-equipped field crews, and for their support. Fixed-wing aircraft have not yet been widely engaged for rapid fire detection or work such as infrared scanning.

COMMUNITY PARTICIPATION

Significant evolution in understanding of CBFiM has taken place in the region since 2000. The first international workshop on this topic took place in 2001 in Bangkok, Thailand, and was jointly managed by the Regional Community Forestry Training Centre for Asia and the Pacific (RECOFTC) and Project FireFight South East Asia (operated by WWF and IUCN). The workshop was followed by an international conference in Balikpapan, Indonesia. Concurrently, several higher order reports and collations of case studies on CBFiM have been published, placing CBFiM firmly in a field of study and understanding that is now increasingly appreciated as a more socially adaptive and capable management method. For further information, see the regional paper.

Continued attention to CBFiM as a practical and suitable form of fire management in the region will increasingly enhance the overall fire management outcomes.

COLLABORATION

A significant policy development over the period 2000–2004 was the ASEAN Agreement on Transboundary Haze Pollution, which was signed by all ASEAN member countries in June 2002 and entered into force on 25 November 2003. This was the culmination of concerted and intensive regional efforts over several years to address transboundary haze pollution since the 1994 and 1997/98 severe haze episodes. The agreement is the first legally binding ASEAN regional environmental accord, although not all ASEAN member countries have yet ratified it, and until this occurs, questions about its potential effectiveness will remain.

NEEDS AND LIMITATIONS

First, while international action and input are seen as necessary to assist the region in guiding fire management along a path that will achieve a level of self-sufficiency, the ultimate goal is to achieve a state in which effective and practicable fire management can be sustained within the region, indeed within individual countries, without significant external input. In essence, the solution is for individual countries to develop their own or collective fire management solutions matched to their specific cultural, physical and financial constraints, rather than adopting fire management solutions developed for different circumstances. To achieve this, however, the region needs support and assistance from the wider global fire management community.

Second, there is apparently an increasing willingness for governments to cooperate on regional action on fire management issues. This willingness needs to be harnessed through the development of appropriate fire management capabilities at national, provincial and local levels.

Third, the routine collection and collation of fire information at local, provincial and national levels is essential to sound fire management decisions, policies and plans. Each country needs to direct efforts towards the collection of fire-related data such as the number of fires, area burned, vegetation types within which they occurred and, if possible, measures of impact. This will assist in identifying fire management needs and suitable programmes of management appropriately targeted and scaled to the circumstances.

Fourth, fire in the region is an annual event, not something that occurs without warning or understanding. The management of fire is a balance between livelihood creation and health and environmental concerns. The adverse livelihood, economic, health and environment impacts are all appreciated. For example, the heightened international awareness and pressure that result from haze events must be directed into longer-term management efforts, not simply immediate suppression and restoration. The majority of fire management efforts must be directed to long-term prevention.

ANALYSIS AND RECOMMENDATIONS

The management and impact of fire within the Southeast Asian region is a matter that requires a combined multinational and regional approach. The ASEAN Agreement on Transboundary Haze Pollution was one of the events of greatest significance in the region. Although this agreement has been accepted in principle and serves as a model for other regions to follow, not all member countries have yet ratified it or given it their full endorsement. Until all member countries have ratified the agreement, it will not become legally binding and its effectiveness will remain open to question. The August 2005 fires, although brief in nature, could serve as a trigger to ensure that this agreement is fully adopted and implemented.

CBFiM has emerged as a new and increasingly adaptive mechanism for working with and managing fire. The region has embraced the early development of CBFiM through donor projects, international workshops and the hosting of international conferences. The future of CBFiM and the benefits it can bring to communities will only be ensured if regional and international efforts for its development continue.

Although the underlying motivations for the use of fire are increasingly understood, whenever adverse fire weather conditions persist, it is almost a foregone conclusion that a severe air pollution/haze event will ensue, induced by fire-associated smoke. The lack of baseline annual fire data will continue to hamper well-structured fire management efforts in the region.

Without identifying action to sever the linkages between fire causes and fire prevention actions, and more particularly, to identify who sets fires and why, the effective targeting of sound fire management practices, particularly fire prevention, will remain a difficult task.

There is a strong need for fundamental analyses of fire situations on an ongoing basis – and not only when disaster strikes. If it is to be effective, fire management must be a daily, weekly and monthly programme of systematic management in any region of the globe. The attention to and effort in fire management in this region must achieve such time regimes if it is to have any effect in the long term.

Fire is an inescapable part of the environment in this region. As is the case elsewhere on the globe, a box of matches remains the simplest and least expensive tool available to fire users. Put simply, fire will remain a crucial part of the ASEAN environment for the foreseeable future.

13. Australasia

The regional paper for Australasia covered Australia and New Zealand (details are provided in FAO Fire Management Working Paper FM/13/E).

EXTENT AND TYPES OF FIRE

In the period from 2000 to 2005, the 2003 fire season in Australia was one of the most dramatic since European settlement in terms of its impact on people and homes, although the most extensive area was burned in 2001 (Table 8). Very large areas of southeastern Australia experienced fires under severe weather conditions, following a long and harsh drought. The damage to assets and the nature of the fire season led to a number of inquiries and reviews of fire management for Australian states and the nation as a whole.

In northern Australia, tropical savannah and grasslands are ‘easy’ to burn. Many living on the land, and relying on it for their livelihood, do not fear fire – they use it. In southern Australia, where settlement is denser, the landscape is highly fragmented and there are high-value fire-vulnerable assets. In addition, coastal communities are overwhelmingly urbanized and the majority of civil society and those that influence it see fire as ‘bad’.

The area subject to yearly fires has declined significantly since European settlement, due to changed land-use patterns, fire suppression and the cessation of burning by aboriginal populations. These changes are leading to altered forest structures, emerging forest health problems such as dieback, and an increase in landscape-scale, high-intensity fires. Prescribed burning in southeastern Australia has been under pressure from public opinion, and the area undergoing such burning has been shrinking.

In New Zealand the average number of fires per season and the average area burned per fire, while indicative rather than definitive, suggest that the fire management

TABLE 8
Approximate fire-affected areas across Australia 1997–2003

Calendar year	Area (million ha)	% of total land area fire affected	% of fire-affected area consisting of tropical savannah
1997	48.3	6.3	86
1998	26.3	3.4	92
1999	60.0	7.8	86
2000	71.5	9.3	65
2001	80.1	10.4	84
2002	63.8	8.3	63
2003	31.6	4.1	85

Source: Western Australian Department of Land Information, cited in Ellis, Kanowski and Whelan, 2004.

system is working well. An average fire size of 2.4 ha is small for an annual average of 2 669 fires. While small fires can be significant in losses for plantations or natural ecosystems, particularly small-scale or localized habitats, the figures reflect effective arrangements for preventing, preparing for and responding to fires.

CAUSES

In addition to lightning, people cause the overwhelming number of fires in Australia. Human-caused ignitions are generally unintentional, although there has been an increase in arson. This recent increase is not reflected in the number of people convicted of offences following the 2002/03 fire season, where, out of a national total of over 10 000 fires identified as deliberately lit or as potentially arson, there were 43 convictions.

In New Zealand, also, fires are mainly caused by people. Lightning fires occur, but represent a very small percentage of ignitions.

EFFECTS

In Australia, generally, all fires are assumed by the public and the media to be bad. Research, experience and history generally demonstrate that this is not the case, but, except in the north, this overriding impression is widely held. As a result, questions are not asked about which fires, or parts of fires, were detrimental and which were beneficial.

There is generally very little information available on the economic impact of unwanted fires. Historically, the recording of losses has been limited nor are the details of the type of loss considered. Possible types of loss might include: reduced productivity, impact on tourism, infrastructure damage, loss of sales and loss of employment.

It is possible to extract indications of firefighting costs from annual reports and other sources. These are not necessarily clear or simple to calculate. In the recent past, the strong impression has been of increasing budgets for fire agencies and perhaps decreasing budgets for the management of land, including fire prevention.

There have been no assessments of ecological or environmental impacts. This information is essential to explain changes in land management practice and to support the evolution of policy, a need emphasized by persistent media descriptions of large and damaging fires as “environmental disasters”.

Development controls require the assessment of significant environmental impacts, for which there are sophisticated and highly regulated schemes and systems. Major wildfire events, on the other hand, attract no such assessment or evaluation of their environmental impact or the chances for recovery. Consequently, there is no information to support or prioritize efforts for restoration of landscapes and ecosystems, despite the availability of the skills and technical capacity to undertake restoration.

As in many countries, the costs of combating fires and the value of losses are not comprehensively measured in New Zealand.

PREVENTION

The three elements of prevention are prevention of ignition, of the movement of fires across landscapes and of damage. The measures and management needed to address these elements are most easily applied to preventing ignition and damage. Ignition-reduction strategies are quite well developed in Australia and are evolving as civil society evolves. The places where people choose to live are changing, shifting the rural/urban interface into natural areas, including protected areas and rural lands. At this interface, education about fire and systems to reduce fire damage (engineering and managing human behaviour) are applied in all Australian states.

The prevention of fires moving across the landscape involves managing or reducing fuels, and there have been increasing efforts in this area as well.

The difference between the tropical and non-tropical areas of Australia highlights the variation across the nation with respect to fire. In tropical areas, there is no real fire prevention focus at all. The emphasis is more on education as to when the community should use fire, rather than on not using fire at all; the issue is timing, not prohibition. There are also differences in land use, in some cases historically based, which influence the role fire plays. Some landscapes have a strong prevention culture and there are no random fires. In other landscapes, rural landowners use fire in a very unstructured way, “throwing around matches” as they move across their properties.

SUPPRESSION

There is a high level of fire suppression taking place. The majority of fires are contained and controlled, with the uncontained 5 percent of fires responsible for 95 percent of the damage suffered. Fires are put out mainly by ground firefighting techniques, but the use of aerial firefighting resources is increasing.

Air support to fire suppression operations was significant during the 2002/03 fire season. States and territories incurred a total cost of over \$A 110 million. On the busiest day, over 100 aircraft were used. Helicopters and fixed-wing aircraft have consistently gained extensive public exposure, especially through the media, but the costs of aircraft are considerable and weigh heavily in overall fire management costs.

The International Wildland Fire Summit was held following the 3rd International Wildland Fire Conference in Sydney, Australia, in October 2003. One of its outcomes was an international agreement for the exchange of fire management personnel among Australia, New Zealand and the United States that is a model for other international agreements on cooperation in fire management.

COMMUNITY PARTICIPATION

Fire management in Australia has largely shifted from the community to government agencies. There is little input expected from communities and few significant opportunities for them to have substantial involvement in decision-making. The volunteer bushfire movement, which does not strictly meet the accepted definition of CBFiM, is, however, still heavily relied on for fire suppression.

NEEDS AND LIMITATIONS

In vegetation-fire risk assessment in Australia – also called bushfire and wildfire – Handmer (2003) identified three categories of actors and stakeholders to consider:

1. *those that create the risk* – these are the formal planning and land development systems and the informal attitudes and actions of people at risk;
2. *those dealing with the results of the activities that create the risk* – the key groups are the fire and emergency services, insurers and groups that work with them, such as forest and land managers. In an informal way, the media and the behaviour of volunteers, individuals and groups are all part of dealing with the risk;
3. *those that create the future risk* – these are factors such as urban expansion, governance, changes in lifestyle or values, possibly emergency management trends and climate change. Except for the last, these influences arise both from institutions and from individual choices and behaviour.

One aspect that is clear from Handmer's discussion is that these three groups of actors and stakeholders operate separately from each other: "Those creating the risk historically have no direct interaction with those dealing with the results, the fires. Worse perhaps is the absence of any useful engagement with those creating the future risk – the risk that fire and emergency services, insurers and society, will be dealing with in the future." This may well be a characteristic that is experienced more widely even outside Australia in the future.

In New Zealand there may be another future change. There is a trend towards an increase in biomass and the quantity of available fuels. Native forest, tussock land, wetland and scrubland areas that had been converted to pasture are becoming uneconomical or non-viable. They are reverting to scrubland or being converted to plantations, which contribute to a dynamic export industry. There have also been attempts to stabilize and vegetate steep landscapes hosting introduced exotic animals, in particular deer.

Thus some parts of the New Zealand landscape are moving from less complex systems with low fuel loads to increasingly complex systems with higher loads. Fuels are also physically more continuous, meaning that fires have a greater chance to spread across the landscape once they start. Fires will become more difficult to control, may occur in more remote areas and are likely to be much larger in size when fire weather conditions are severe. Severe conditions in New Zealand may recur every 15 to 25 years. The expansion of the plantation estate also suggests that losses will be higher.

ANALYSIS AND RECOMMENDATIONS

In Australia, fire management has largely shifted away from the community to government agencies. The country needs to develop an agreed, consistent data-collection process on all aspects of fires. The lack of such data will hinder research, operational planning and evidence-based funding of bushfire response capability. The legal framework may also require review because of the declining use of prescribed fire (because of inadequate recognition of the role and benefits of deliberate fire

use), and failure to support individuals and agencies engaged in applying fire to landscapes.

In New Zealand, changes in the composition and complexity of the vegetation in rural areas, and the implications of these changes for fuel loads in particular, will require adjustments to the way fire management is practised. The National Rural Fire Authority has recognized this and has started to identify changing needs and altered circumstances.

The first important step in both Australia and New Zealand is the development of research projects: to support and enhance fire danger rating; increase the understanding of fuel characteristics and dynamics; predict fire behaviour; and create a decision-support tool or system to assist rural fire managers in their planning and decision-making. In parallel, the management of resources, people and information is evolving to meet the expected needs of fire prevention, suppression and incident management.

Australia has noted the historic absence of interaction and engagement between those creating the risk of fire and those dealing with the results. It is an increasing threat in Australia, and one that is likely to be experienced elsewhere in the future.

14. Southeast Europe/Caucasus

This region comprises the Balkans and includes Greece and Turkey, which are also part of the Mediterranean region (details are given in FAO Fire Management Working Paper FM/11/E).

EXTENT AND TYPES OF FIRES

The number of forest fires per year in the Balkan region varied greatly from 1988 to 2004. Over this period, the smallest number of forest fires was recorded in 1991 (2 765) and the largest in 2000 (16 922). With the exception of 2000, the trend in forest fire occurrence increased steadily.

Over this period, the total burned forest area was 1 250 892 ha, and the annual average area burned amounted to 156 361 ha.

The countries most threatened were Bulgaria, Croatia, Greece, The former Yugoslav Republic of Macedonia and Turkey.

CAUSES

The changing land uses and rural exodus in some parts of the region are resulting in increased wildfire hazards and vulnerability of ecosystems. Conversely, urban encroachment into wildlands means increased vulnerability of human populations to fire, particularly at WUIs. During the last 15 years, wars and economic and political disorders have had a significant role in forest fire occurrence, behaviour and suppression.

TABLE 9
Causes of forest fires in the Balkan region

Country	Causes (%)		
	Human	Natural	Unknown
Albania	63.7	0.8	35.5
Bulgaria	30.4	1.7	67.9
Croatia	75.3	0.8	23.9
Greece	55.5	3.0	41.5
Serbia and Montenegro (Serbia) ^a	66.0	3.0	31.0
Slovenia	45.9	8.3	45.8
The former Yugoslav Republic of Macedonia	72.5	2.0	25.5
Turkey	60.9	6.7	32.4
Average	58.8	3.3	37.9

Source: Macedonia, 2005.

^a Now Serbia, but the statistics for Serbia and Montenegro refer to the Serbian Republic of the commonwealth (State Union) before the independence of Montenegro in 2006.

On average, 58.8 percent of total forest fires have a human origin, 3.3 percent a natural one and 37.9 percent arise from unknown causes (Table 9). The human causes are often arson and negligence (including the negligence of tourists). Even those fires of ‘unknown’ origin are often caused by people.

EFFECTS

There are no international standards to define economic and ecological damages caused by fire, but according to available evidence, there is no significant social impact of forest fires in the region. The economic and environmental damages are much more important.

The environmental damages include soil erosion, which is observed in all countries with large burned areas. The mass outbreaks of bark beetles (*Ips* spp.) are a very significant problem in the pine forests of The former Yugoslav Republic of Macedonia. The effect of forest degradation on tourism in the region is significant, especially in Albania, Croatia, Greece, The former Yugoslav Republic of Macedonia and Turkey.

PREVENTION AND SUPPRESSION

Legal regulations regarding fire prevention exist in each country in the region. Other measures, such as awareness-raising and education, have also been used in most countries. Their quantity and quality depend on the economic situation and organizational potential of each country and they are usually carried out by the Ministries of Interior or Forestry, voluntary protection unions or some NGOs.

Human intervention is the most important means of extinguishing fires, given that the number of naturally extinguished forest fires is very low (no more than 3 percent) – usually when the cause of forest fire is lightning accompanied by rainfall. Regional exercises in the suppression of forest fires have been held in the interests of increased efficiency.

INSTITUTIONS, ROLES AND RESPONSIBILITIES, AND COMMUNITY PARTICIPATION

Institutional roles and responsibilities for wildfire management are different in each country in the region, but there are also similarities. In several countries, the forest services at federal or regional levels are responsible. In others, all fires are the responsibility of a fire department. Serious fires may require the assistance of other bodies through an interagency agreement.

Turkey reported that, since 1997, there have been substantial improvements in handling forest fires through the Fire Command Center, which is responsible for all fire management issues. A more comprehensive national database on forest fires is being created.

The Pact on Stability for South Europe developed an initiative to form the Regional Disaster Management Center in Croatia. It covers Albania, Bosnia and Herzegovina, Greece, Italy, Montenegro, Serbia, Slovenia and The former Yugoslav Republic of Macedonia. The aim of the centre, which is in the organizational phase,

is to facilitate cooperation in planning, preparation, prevention and reaction, and in reducing disaster consequences, including forest fire suppression in the area of southeastern Europe.

Turkey reported that local people are required by law to respond to a fire situation if and when requested. The positive response of local people and communities in combating fires has increased considerably in recent years – mostly as a result of public awareness campaigns and a change in attitudes towards forest resources.

Croatia has signed agreements on multilateral assistance with a number of countries. Bulgaria has received targeted support to improve forest fire management capabilities from Germany, Switzerland, the United States, FAO, UNDP and the World Bank. In 2006 a European Union Twinning Project is supporting the country in harmonizing legislative, reporting and preventive measures with European Union standards. GFMC has supported the Bulgarian-Swiss Forestry Programme in developing a national fire management strategy and the European Union in implementing the Twinning Project. The former Yugoslav Republic of Macedonia has international agreements with Bulgaria and Greece. Turkey reported that the Fire Command Center participates in interregional cooperation – firefighting assistance was provided to Georgia and Syria in 2005.

Universities have a role in fire ecology and management research in The former Yugoslav Republic of Macedonia and Turkey.

NEEDS AND LIMITATIONS

In April 2005, The former Yugoslav Republic of Macedonia hosted the International Technical and Scientific Consultation “Forest Fire Management in the Balkan Region” under the auspices of the Regional Balkan [now Southeast Europe/Caucasus] Wildland Fire Network of GWFN (Macedonia, 2005; GFMC, 2005b). The following gaps in fire management were noted during the consultation:

- consistent information and statistics on fires, their causes and their effects;
- applied research in social sciences and humanities, including financing of research;
- integration of social, economic, environmental considerations and institutions in developing tangible policies and practices related to fire;
- integration of fire as a component of land, resource and forest management;
- community-based approaches to fire management;
- training in the appropriate use of fire (prescribed burning for fuel reduction and nature conservation);
- training in the safe and efficient use of resources for fire suppression (and appropriate equipment);
- compatible approaches, e.g. global implementation of the Incident Command System and the International Wildland Fire Agreements template.

The consultation was followed by the “Eastern European, Near East and Central Asian States Exercise on Wildland Fire Information and Resources Exchange – EASTEX FIRE 2004”, a regional forest fire exercise organized by the host country, Bulgaria, the UN-ISDR regional network and GFMC. Fire and forest services from

Albania, Bosnia and Herzegovina, Bulgaria, Greece, Romania, Serbia and Montenegro, The former Yugoslav Republic of Macedonia and Turkey participated in the exercise (www.fire.uni-freiburg.de/GlobalNetworks/SEEurope/SEEurope_4.html).

ANALYSIS AND RECOMMENDATIONS

The consultation recommended the following plan of action to governments, international organizations and NGOs for cooperation on vegetation fire research and management in the Southeast European/Caucasus region:

- secure financing of a regional fire research programme;
- strengthen fire research cooperation between neighbouring countries;
- develop standardization of terminology and procedures;
- develop standardized data collection, including further development of global fire data collection;
- encourage increased involvement of the science community in fire-related, interdisciplinary research programmes;
- support the establishment of national or regional fire research centres;
- establish a regional fire weather network;
- approach the Erasmus/Sokrates programme of the European Union about developing a dedicated programme for fire information exchange.

It is evident that the majority of countries in the region are ready to establish and strengthen a regional dialogue on cooperation, exchange of information, research and fire management as a contribution to forest and environmental protection, stability and peace.

In May 2006, the Regional Southeast Europe/Caucasus (formerly Balkan) Wildland Fire Network presented a proposal for “Development of a Strategy for International Cooperation in Wildland Fire Management in Southeast Europe” to the 33rd Session of the FAO European Forestry Commission (Zvolen, Slovakia, 25 May 2006). The proposal aimed to enhance international cooperation in the region, including the development of standards and bilateral and multilateral agreements.

15. Baltic and adjacent countries

The working paper for this region covered Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Luxembourg, the Netherlands, Poland, the Russian Federation (Karelia), Slovakia, Sweden, Switzerland and the United Kingdom (details are provided in FAO Fire Management Working Paper FM/7/E).

The Central European countries, the Alps and non-Mediterranean southeastern Europe belong to the temperate vegetation zone, where mesic and more fertile forests are generally dominated by broadleaved trees. The most fire-prone forest ecosystems in this area are often dominated by pine (predominantly *Pinus sylvestris* L.) in dry and dryish site types, primarily plantations.

The Nordic countries largely belong to the boreal and hemi-boreal vegetation zones. In this region, also, the most fire-prone ecosystems are pine-dominated forests (predominantly *P. sylvestris*) in dry and dryish site types. In the United Kingdom, especially in Scotland, the most fire-prone ecosystems are the heathlands, dominated by *Calluna vulgaris*.

Fires have always had social, economic and environmental effects that have generally been regarded as negative – especially in fire-prone ecosystems. But in Europe, especially in boreal ecosystems, fire has been reintroduced to forest ecosystems after a long period of no-burn policies. It is now used as a restoration and management tool for forest regeneration and biodiversity management.

EXTENT AND TYPES OF FIRES

In the southern part of the region, most fires occur in the spring, from February to April. Towards the north, where spring starts later, the highest fire frequency is in May and June. Another peak in the number of fires and area burned occurs in most countries in August.

In this region, the number of fires and the area burned annually vary mostly with the weather conditions. In general, the average size of a fire in the region is very small, often below 1 ha and not above 5 ha. Exceptions can be found in some countries, such as Poland, where a clear increase in the number of fires and area burned has been observed.

CAUSES

Arson is an important and increasing cause of forest fires; in Poland it is the reported cause in 44 percent of fires. The reason seems to be the high unemployment rate, which has led to fires being deliberately set to produce at least temporary jobs in firefighting and forestry. Arson has also been reported as a rather common cause of fires in Lithuania (16 percent) and Estonia (13 percent).

In both the southern part of the region and the Baltic countries, burning of grass in the context of agriculture is often carried out in the spring and is a common factor in the spread of fires. This seems to be a particular problem in many eastern countries of the region. The practice has ceased in Fennoscandia.

Changes in land tenure and ownership have led to omission of the necessary precautionary measures, especially in the Baltic countries, where a high number of new, small-scale forest owners have emerged. In addition, migration from the country and abandonment of rural lands have resulted in increased fuel loads and changes in vegetation composition and succession, leading to a higher fire hazard. Abandoned agricultural land has significantly increased in many countries of the region since the transition towards a market economy began. This has resulted in an enormous increase in the number of fires observed on such land. In Poland, for example, the number of fires increased from approximately 5 000 in 1994 to 53 000 in 2003. The extent of burned area in Poland has also increased – from about 13 000 ha in 1995 to 95 000 ha in 2003.

Regionally, large plantations of exotic species, particularly those of coniferous trees such as *Pinus contorta*, have led to an increased fire risk. Preventive actions to reduce fire risk, such as changing tree species composition from coniferous to deciduous species, are being carried out in some countries, for example Poland.

Uncontrolled fire use, especially in agriculture, and, infrequently, prescribed burning in forestry have been a cause of fires escaping into wildlands and occasionally into forests. But the use of fire for prescribed burning depends on the level of local public awareness and knowledge of the principles of fire ecology and management. In some countries, for example in Estonia, the attitude of the public and the national authorities is opposed to prescribed burning. This opposition, together with an effective fire suppression policy, has led to fuel accumulation, especially in conservation areas, and thus to an increased fire risk.

The use of prescribed fire in nature conservation and landscape management is increasing, including the use of fire in forestry and forest certification. The European Fire in Nature Conservation Network, an initiative of GFMC and the FAO/UNECE/ILO Team of Specialists on Forest Fire, reflects the broad variety of prescribed burning objectives and the increasing number of projects throughout the region (www.fire.uni-freiburg.de/programmes/natcon/natcon.htm).

EFFECTS

The economic costs of fire vary greatly within the region and among countries. However, the economic losses are generally quite low compared with other regions in which fires are more common and have more drastic consequences. Ecological damage is rare, but avalanches occasionally occur after fires, especially in the Alps. Health effects of fire are also rare, as the average size of fires in the region is small. However, the impact of smoke pollution from wildfires and land-use fires burning in neighbouring Russia has severely affected the Baltic region, notably in 2001 and 2006.¹⁰

¹⁰ Results for 2002 are available at www.fire.unifreiburg.de/iffn/country/rus/IFFN%20Russia%202002%20Fire%20Report.pdf, and for 2006 at www.fire.uni-freiburg.de/media/2006/GFMC-Bulletin-01-2006.doc and www.fire.uni-freiburg.de/media/2006/05/news_20060518_uk.htm.

PREVENTION

Financial support for fire management varies within the region, and lack of resources causes difficulties in fire management, especially in the Baltic countries. Aerial control may not be available due to competing demands.

SUPPRESSION

Training in wildland and forest fire management and suppression and even in the use of prescribed burning is inadequate in most countries of the region, especially concerning the ability to respond to large and lengthy forest fires. Decision-support systems need further development for these situations, as well as for specialized training in fire management.

Bilateral and multilateral agreements on cooperation in fire management are also needed. The ICS, as an international standard for all incident management, should be introduced into interested countries.

INSTITUTIONS, RESPONSIBILITIES AND ROLES

Increasingly, fire management is no longer the responsibility of forestry staff, but of national fire and rescue services (F&RS). More often than not, these F&RS lack training in fire management and specifically in aspects of fire behaviour, including techniques in backfiring. Responsibilities shared between the authorities and organizations, as in Germany, can occasionally cause problems as well.

There appears to be no community involvement in fire management. Some regional bilateral and multilateral fire emergency exercises have been carried out, e.g. among Baltic countries, but more need to be arranged. Exchange visits and programmes should be promoted regionally. Specific attention should be paid to developing online information systems through Web sites.

During the last five-year period, fire research in the region has increased and northern countries have begun participating in European Union-funded fire research projects. Regional cooperation in the field of fire research has been initiated between the Baltic and Nordic countries. Finland, Germany, Poland and the United Kingdom are participating in the research programme Fire Paradox (www.fireparadox.org/). The emphasis is on the use of prescribed burning and fire suppression.

COLLABORATION

In May 2004, a Regional Baltic Wildland Fire Meeting was held in Helsinki, Finland, followed by a side meeting to promote Baltic cooperation in fire research.

At the meeting, trends in fire management in the Baltic region were studied and the *Helsinki Declaration on Cooperation in Wildland Fire Management in the Baltic Region* was issued. It included proposals to harmonize and strengthen efforts by UN-ISDR, WFAG and United Nations agencies and programmes to reduce the negative impacts of fires on the environment, but also to support and promote the knowledge and techniques to utilize the beneficial role of fire in ecosystem management, including the application of prescribed burning for the benefit of ecosystem stability and sustainability, with special emphasis on biodiversity.

The Helsinki Declaration aimed to promote international cooperation in fire management, strengthen multilateral and bilateral agreements for such cooperation and follow and support the recommendations made in a number of international fora (details can be found in the regional paper).

Those countries that are members of the European Union participate in the informal Forest Fire Expert Group, which meets twice a year. Most of the work on cooperation is based on Regulation (EC) No. 2152/2003, Forest Focus (<http://europa.eu/scadplus/leg/en/lvb/l28125.htm>), a European Community plan for harmonized, broadbased, long-term monitoring of European forest ecosystems. The plan focuses on protecting forests against air pollution and fire. To supplement the monitoring system, new instruments are to be developed for soil monitoring, carbon sequestration, biodiversity, climate change and protective functions of forests. The European Commission serves member states through the European Forest Fire Information System (EFFIS – <http://effis.jrc.it/Home/>), which provides information for the protection of forests against fire in Europe, addressing both pre-fire and post-fire conditions.

ANALYSIS AND RECOMMENDATIONS

Most countries in the region are not facing major problems with fires in forests and are able to establish and strengthen regional dialogue on cooperation in vegetation fire management. Preventive measures can clearly be improved, as in the case of grass burning in the spring. Financial restrictions, especially in the Baltic region, are one of the main problems.

Within the region, the following fields need to be strengthened:

- collection and standardization of data on fire occurrences;
- fire prevention measures, including improved public awareness;
- fire management, including training and fire research; and
- international cooperation.

Collection of fire statistics and reporting vary among the countries of the region, making comparisons over time and space difficult. There are clear differences in classification, for example of fire causes such as arson, which can lead to misleading conclusions. A common database on forest fires is required.

Fire management could be improved in many countries by preparing strategic fire-suppression plans at local and regional levels, while recognizing that the role of fire varies among the countries in the region. Increased public awareness of fire risks and benefits and a more careful attitude towards fire use should be promoted. Regional mobile, airborne fire-response units should be created.

Training for fire management, which is done mainly by the F&RS, is inadequate in most countries, especially regarding aspects of fire behaviour and the ability to respond to large, prolonged fires. Thus exchanges in training programmes and international training courses should be promoted. Decision-support systems need further development for situations involving large fires.

Current research projects are developing fuel-type maps covering the whole of Europe. This could help estimate fire risk in various European regions, in relation

to diverse vegetation types in diverse climatic conditions, and thus help develop fire management methods and prevention strategies. Further development is also needed in fire danger rating systems and in the fire weather index. Research at the European level in this region is continuing in the Fire Paradox programme.

Efforts towards international collaboration should build on the start made by the Baltic countries.

16. Mediterranean

The working paper for this region covered ten countries: Algeria, Cyprus, France, Greece, Israel, Italy, Morocco, Portugal, Spain and Turkey (details are provided in FAO Fire Management Working Paper FM/8/E). Greece and Turkey are also part of the South-East European/Caucasus region.

EXTENT AND TYPES OF FIRES

Fire is the main cause of forest destruction in the countries of the Mediterranean basin. About 50 000 fires sweep through 700 000 to 1 million hectares of Mediterranean forest, other wooded land and other land each year, causing enormous economic and ecological damage as well as loss of human life. For detailed information in addition to that of the working paper, see the annual regional European forest fire analyses published by EFFIS and the Joint Research Centre of the European Commission (<http://effis.jrc.it/Home/>).

Reflecting the prevailing climate, with its long summer droughts, Mediterranean forests are frequently characterized by fire climax species, i.e. those dependent on the presence of fire in the reproductive cycle. Pines form the largest forest stands on both the northern and the southern shores of the Mediterranean. These species also tend to have a particularly high content of resin or essential oils, making them extremely inflammable.

Socio-economic development in the region has led to a general decrease in grazing and in the collection of fuelwood and fodder. As a result, there has been a build-up of highly inflammable forest litter.

Another cause of increases in forest fuels, especially on the European side of the Mediterranean, has been the migration of populations from rural areas to cities. This population shift does not imply the total elimination of activities in the forest area. The remaining, often elderly, rural population continues to use fire to eliminate stubble and renew pastures and fields. However, the accumulation of fuel often allows fires set for agricultural purposes to spread out of control. Moreover, the sparse rural population makes fire suppression more difficult.

CAUSES AND EFFECTS

The forest fire situation in the Mediterranean basin is largely determined by climatic conditions. Prolonged summers with virtually no rain and average daytime temperatures well in excess of 30°C reduce the moisture content of forest litter to below 5 percent. Under these conditions, even a small addition of heat (lightning, a spark, a match, a cigarette) can be enough to start a violent conflagration.

Wind is another climatic factor influencing fire hazard. The inland summer winds are highly desiccating, characterized by high speeds and low humidity. The dry, cold winds of Mediterranean winters can also increase fire danger.

Statistics on the causes of forest fire in the Mediterranean region are far from complete, but it is evident that people set most fires. Natural agents such as lightning also cause forest fires, but the number of naturally occurring fires is small in comparison with those caused by people.

An important source of fires is shepherds, who ignite forest and grassland to promote new flushes of growth for grazing animals. Farmers also use fire to eliminate crop stubble and invasive thorn plants and to push back the forest to make room for agricultural expansion.

Urban populations in the Mediterranean region show a particularly poor understanding of the danger of fires and of their potentially negative consequences. Despite continuous, preventive propaganda campaigns, many city dwellers do not consider a forest fire to be a threat, even in the middle of summer. An increasingly important cause of fires is the burning of large quantities of solid waste by tourists and other recreational users of forest areas.

Finally, there are a growing number of fires ignited not for utilitarian purposes but with destruction as their sole aim, especially in the western Mediterranean. These fires may be lit for a variety of reasons, including private vengeance and conflicts related to ownership or hunting rights. Another important motivation for destructive fires, particularly in the European part of the Mediterranean, is an attempt to change land-use classification.

Ironically, there also seem to be a growing number of fires set by the auxiliary workers retained by national forest fire services, to generate employment during the critical summer months.

Land-use change and climate change are the main factors expected to play the most significant part in fire regimes of the Mediterranean basin during the twenty-first century.

PREVENTION

Prevention activities can be divided into two broad areas: those directed at the primary cause of fire, i.e. people, and those aimed at mitigating the flammability of forest resources.

Public information campaigns are carried out in most Mediterranean countries, with the intensive use of mass communications media, mainly television, radio and the press. In most cases, these campaigns are aimed almost exclusively at urban dwellers during the summer and stress the risk of fire caused by negligence and its potential consequences.

The situation regarding the rural population, however, requires a different approach. It is apparent that the rural population needs to be aware of the cost. Sociological studies to determine the behaviour and knowledge of rural people may be one key to developing effective information campaigns aimed at this population.

Information campaigns must be complemented by preventive silviculture, i.e. forest management techniques designed to minimize the risk of and damage resulting from fire. Fuel management involves such highly diverse techniques as tree thinning, brushwood crushing, prescribed burning, controlled grazing and species selection.

Protective techniques need to be integrated into overall silvicultural practices, which have generally concentrated on regeneration and production. The major problems in applying efficient preventive silviculture are the large area to be treated and the cost of the labour required.

National detection and monitoring networks based on fixed and mobile stations have been established in all Mediterranean countries. Aerial monitoring has also been experimented, primarily in Italy and Spain. But hi-tech systems cannot replace ground-based personnel with a good working knowledge of the terrain.

Danger rating systems are another essential element of fire control. Some countries, e.g. Greece, Portugal and Spain, are operating national fire danger rating systems. The pan-European EFFIS provides a daily fire danger forecast for member countries of the European Union and adjoining regions.

SUPPRESSION

Approximately 30 000 workers are mobilized for firefighting activities each summer in the Mediterranean region; in particularly hazardous years, the number may swell to 50 000, including the participation of members of the armed forces.

Having trained personnel available in sufficient numbers is a basic condition for successful suppression work. The organizational scheme providing the best level of protection is one consisting of a general, permanent fire service, which is reinforced with additional resources and personnel during critical periods. The dimensions of the basic service will be determined by the overall risk of fire.

The efforts of land-based suppression forces are reinforced in many Mediterranean countries by fleets of aircraft (mostly amphibious) and helicopters. Approximately 300 government-owned and contracted aircraft are used each summer for firefighting operations in the Mediterranean basin. The use of helicopters is assuming increasing importance, particularly in the transport of fire crews to difficult locations.

However, airborne suppression activities must not be viewed as a substitute for land-based efforts, particularly in view of the high costs involved. If land-based forces are not sufficient, the introduction of additional airborne forces will not improve overall efficiency, and may even retard future development as resources that could have been better invested in the formation of land-based brigades are diverted. Apart from their direct costs, airborne forces require an additional infrastructure of personnel and facilities.

INSTITUTIONS, RESPONSIBILITIES AND ROLES

Different countries have different ways of organizing their fight against forest fires. There is no up-to-date comparative information for the countries of the study. Most descriptions given to FAO or the European Union are lists of suppression means, especially airplanes, vehicles and firefighters. There is no critical description of the weaknesses and advantages of the systems applied.

The philosophy of forest fire prevention is similar throughout the Mediterranean basin. It is based on the creation of tracks, firebreaks and water reserves. This work is often designed within the framework of traditional management projects (e.g. in

Algeria and Tunisia). Maintenance of these networks is an important issue, especially as the authorities responsible for creating the systems are often not the same as those who are responsible for maintaining them.

Two general trends can be described within the countries of the Mediterranean, as far as protection from forest fires is concerned:

- a system in which the forest service is responsible for forest fire prevention and control;
- a mixed system, in which the forest service is responsible for forest fire prevention and the fire brigade takes over presuppression and suppression activities.

In some countries, the mixed system is more complex and local and national authorities are involved as well.

European Union countries apply the mixed fire protection system, with various players involved, strengthened through expensive fire suppression tools (mostly aerial). In the other Mediterranean countries, forest authorities have full responsibility for fighting fires in the forest. There are three main trends observed in relation to forest fire protection, moving from south to north of the Mediterranean:

- from a central agency towards a more peripheral system;
- towards increased participation of private bodies in fire protection; and
- from fire suppression by the forest services towards professional firefighters.

The third trend is actually a shift from a managerial approach to a more operational one. As the means for spending on firefighting increase, governments decide to invest their resources in a more complex system, where diverse groups of professionals work together. While this is, in principle, correct, it involves a reduction of the participation of forest management authorities in the fire protection scheme, giving it more of a crisis-response character.

Another reason for this development is that most people in European Union countries live in urban environments and do not understand the managerial approach. For them, fire is a bad thing and should be eliminated by all the means a modern society may have at its disposal.

As the problem of forest fires becomes more and more severe in the countries with the mixed system, a change in the policies and decision mechanisms is necessary. The players involved in fire management are not the crucial question. What is important is the policy under which these players operate and their coordination. The data so far show that the current policy is not efficient.

COLLABORATION

Various Mediterranean countries have established cooperative relationships to address specific forestry issues in the region.

The problem of forest fire is too large to be controlled at a single government level. It is a Mediterranean problem, but most international associations include forest fires as a small part of their activities, as a geographical or thematic subunit. There is a lack of a common perception of forest fires in the Mediterranean.

Since 2002, the Forest Fire Network of *Silva Mediterranea* – chaired by Spain – has become increasingly active in promoting and developing international

cooperation in forest fire emergencies. Two workshops on Multilateral Assistance against Forest Fires in the Mediterranean Basin (held in Zaragoza, Spain, in 2003 and 2004) addressed procedures for coordinating existing mutual assistance agreements and common legal and logistical tools. The ultimate aim is to share resources and improve multilateral assistance in extreme forest fire situations within the Mediterranean basin. The Forest Fire Network constitutes the Regional Mediterranean Wildland Fire Network within the UN-ISDR GWFN.

Data availability is a major problem in the countries of the region. Even where available, it is not comparable, due to different methodologies, definitions, perception and mentalities. Analysis of the causes of forest fires is also problematic. In many countries, there are too many fires attributed to unknown causes, due to lack of investigation after the fire or political and social reasons. Another phenomenon observed is an intense discussion on arson, especially in countries where the state tries to cover its own ineffectiveness in firefighting.

Lack of data on forest fires and their causes is a major obstacle in understanding the nature of forest fires and in designing strategies and measures at national and international levels. The differences in definitions concerning forest fires are also a major obstacle to the implementation of any international strategy.

The European Union policies related directly or indirectly to forest fires do not appear to be suitable to addressing the issue in the Mediterranean, additionally because they are strongly influenced by the timber-producing northern countries of the continent. As a result, forest fire management has often become a low priority and receives little attention and financial assistance.

However, the activities of *Silva Mediterranea* may be instrumental in facilitating intra- and interregional cooperation in forest fire management.

COMMUNITY PARTICIPATION

In non-European Union countries, the forest has lost value in comparison with other land uses, and people depend on those other land uses for primary production. This has led to overexploitation and degradation of the forest resource, both in terms of quality and quantity.

A major element emerging from the analysis is that local communities have become less involved in forest fire management over the years, in all countries. This lack of local involvement has caused fuel accumulation, making forest fires uncontrollable when they are not suppressed at the start. It has also changed forest fire management dramatically.

There is a clear trend away from a low-profile management approach (at subnational and local levels), in which fire protection measures are part of forest management, towards a high-profile operational model, in which high-technology equipment and professional, specialized units are involved after the fire breaks out. In the latter case, prevention and suppression are assigned to different players and coordination is often very poor.

Local populations are not very aware of the need for forest fire protection. They often burn forests by mistake, using fire as a tool at the wrong time and in the wrong

place. People also burn forests deliberately in order to replace them with other land uses that may bring short-term profits. A major factor that contributes to lack of awareness is the inability of Mediterranean countries to estimate and describe the impacts of forest fires on society and on people.

Government policies do not seem to contribute to the control of forest fires. Many have not established and applied simple management regulations for agriculture and pasture to prevent accidental fires (such as the season for burning or the method). In areas in which a central forestry body is responsible for the whole range of forest activities (mainly North Africa and Turkey), the state often fails to control and coordinate prevention and suppression measures. During years of extreme drought, with many fire outbreaks daily, the state mechanism is unable to respond successfully to all cases and the local populations are not part of the firefighting mechanism. In cases where the mixed system is applied, coordination before and during fires is a major problem. More importantly, different actors perform different tasks, usually following different mentalities and implementing different policies.

Governments, apparently, also fail to recognize and report problems. Almost all official reports present a very flattering picture of the organization of fire management in the country, although the numbers show that the problem has deteriorated. By employing a purely operational approach, governments may fail to recognize the nature of the phenomenon and may consider the accumulation of aerial suppression means the equivalent of the expected success of the mechanism.

NEEDS AND LIMITATIONS

From an analysis of forest fires in the Mediterranean basin, the following needs and limitations can be identified:

- Mediterranean countries share common characteristics concerning forest fires and their ecological and socio-economic features. An integrated approach is needed, both in forest planning and management of forest fires.
- Unfortunately, collaboration among Mediterranean countries on forest fire issues is very limited.
- Although the Joint Research Centre of the European Union maintains a standardized forest database for member countries, a common database for all Mediterranean countries is still lacking. Data from outside the Union are scattered, inconsistent and difficult to process.
- As a result, analysis of the direct and indirect effects of forest fires is at a very preliminary level, failing to identify and estimate the real burden posed to the economy and society from forest fires.
- Research on forest fires is carried out in some countries, but the results are not communicated through expert meetings and the exchange of information.
- Forests are not viewed as a common good having vital links with local economies. Communities do not feel part of forest management.
- Public awareness of the values of forests, other than direct timber production, is not adequately promoted.

- A management approach on forest fire issues is lacking. Fighting forest fires is in most cases seen as a reaction to a natural catastrophe, independent of the actual root causes and of forest management policies and practice.
- The policies of others sectors (e.g. agriculture, tourism development, urban development) often contribute to fires and may increase the sense of disconnection of communities towards forests.
- Forest policy at a national or European Union level is in most cases focused on production, and forest fires constitute only a minor part, despite their importance for the forests of the region. In most countries, forests and forestry are the lesser part of broader agricultural policy.

Mediterranean landscapes have been shaped through intensive human intervention over millennia, due to burning, cutting and grazing on non-arable lands, and the clearing, terracing, cultivating – and later abandonment – of arable land. Human intervention is still making a significant impact on current vegetation patterns and is expected to do so in the foreseeable future.

Although the main reason for the increase in fires in recent decades is most likely changes in land use, climatic factors should also be considered as a contributing factor. Predictions of climate change in the Mediterranean basin indicate an increase in air temperature and a reduction in summer rainfall. These changes, predicted for the near future, are likely to lead to increased fire risk not only in the Mediterranean area, but also in the other fire-prone regions of the world.

