Activities of the Global Wildland Fire Network (GWFN) mirrored by GWFN Publications in following up the 6th International Wildland Fire Conference

Compiled by the Global Fire Monitoring Center (GFMC) for the Meeting of the International Liaison Committee (ILC) of the International Wildland Fire Conferences

U.S. Forest Service, Washington, D.C., 1-2 February 2017

UNISDR IWPM
International Wildfire Preparedness Mechanism

Contents

LOCAL FIRES, GLOBAL WORRIES

At the 6th International Wildland Fire Conference this past October, the talk focused on a year of devastating fires (even as Indonesia burned) and on local, regional and global actions for managing fire in the Pyrocene. Writer Lindon Pronto and a range of experts offer insights on how this key global conference helped to influence the Paris climate talks and may guide us into an era of integrated fire management.

An example of integrated fire management: prescribed burning with the Xerente on indigenous land in Brazil. Photo: GFMC.

By Lindon Pronto

1. Welcome to the Pyrocene

The old proverb—fire makes a good servant but a bad master—has become too literal a guiding doctrine, for too long. This understanding characterizes fire entirely within the context of how humans relate to fire, while neglecting fires' innate role within the natural environment, as an ancient earthly element, much older and perhaps much wiser than we human stewards, users, and fighters of fire. With or without us, fire will continue to shape our landscapes.

Historian Stephen Pyne captures this truth well, casting fire as a shape shifter, a creature of its context. Fire may share a singular chemical process, but exists as pluralistic phenomena varying greatly in ecological and cultural contexts throughout the world. Pyne conjures up politics to describe fire: while we may acknowledge fire as having global implications, ultimately all fires are local.

Similarly, all fire "managers" are local. Viewing fire management as an international undertaking may raise some questions. Be this especially true if the words *concerted, international, fire management,* and *efforts* appear in the same sentence. However, as we know from

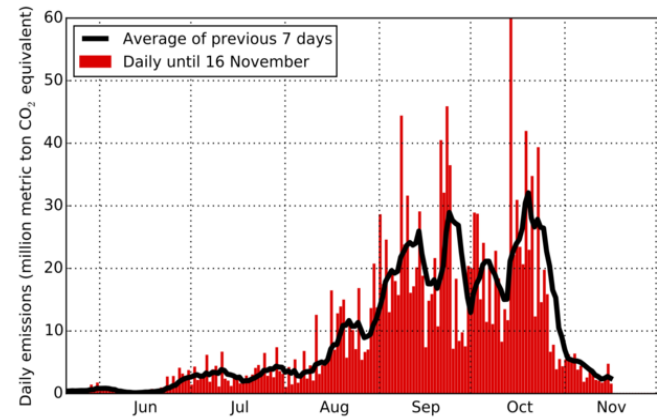
our efforts locally, fire does not observe jurisdictions or national borders. To preface a discussion on international fire management politics and concerted action, a few of the contemporary impacts vegetation fires have across the globe, should be highlighted.

This past year wasn't just a "bad" fire season for the Northwestern and Western United States and Canada, but devastating fire episodes hit the Mediterranean states, Russia, Northeastern China, and many Eurasian states as well; in Mongolia a handful of fires devoured nearly 13.6 million acres in the second half of April. Fires burned hot on the African continent, bringing devastation to Zimbabwe and the Democratic Republic of Congo, among others. Later, Indonesia caught the world's attention with local fire conditions escalating to a global dimension. Australia is suffering a deadly fire season. It is remarkable that such an enormous fire presence is experienced in all parts of the globe, virtually all at once.

Historically, an average of about 600 million hectares of vegetated lands burn—that's over 1.5 billion acres, or roughly the amount of combined forest, grasslands and managed parklands in the United States (1). Worldwide, fires are trending toward longer burning periods, heightened fire severity, greater area burned and increased (mostly human-caused) frequency. These factors contribute to more damaging environmental impacts, increasing socio-economic costs including greater threats to human health and security, and higher shares of emissions into the atmosphere.

As Pyne notes, since the major evolutionary advancement of the Industrial Revolution, humans have induced irreversible climatic changes by "burning the lithic landscape"— fossil fuels. He claims we have entered into the Pyrocene—an era characterized by burning matter both above and below the earth's surface. His theory is supported by one of the world's leading climate scientists Schellnhuber –principle advocate of the 2 Degrees Celsius Limit theory – and who in his latest global analysis "Self-Immolation" draws a blunt scenario of the Weltenbrand (planetary blaze) as a consequence of burning-driven climate change (2).

Every year, global vegetation fire emissions typically constitute one-third of total releases of carbon dioxide, the main heat-trapping emission contributing to climate change (3). For example, fires burning in Indonesia alone, during the El Niño dry season in I997 and 1998 produced an equivalent of up to 40% of the global gross carbon dioxide (CO_2) emissions from fossil fuels for that year (4).



Daily fire emissions from Indonesia (estimated) for 2015, show that on many days the rate exceeds that of fossil fuel emissions in the US (roughly 15 million ton CO2 per day).

Source: Global Fire Emissions Database. http://www.globalfiredata.org/updates.html.

According to the Global Fire Emissions Database (GFED), the recurrent Indonesian crisis of 2015 often put up daily CO_2 amounts higher than the entire U.S. industrial economy, and two months of burning nearly doubled Germany's yearly carbon output from fossil fuels. These emissions do more than just contribute to climate change, they are literally killing people.

Some models indicate that the annual average number of premature deaths resulting from vegetation fire smoke exposure, range between 180,000 and 339,000 (5, 6). During previous severe El Niño years like this one, that global average spiked to some 530,000 deaths (6). Documented this year alone, there have already been over 600,000 hospitalizations according to Indonesia's National Disaster Mitigation Agency (BNPB).

Evidently, although we are just beginning to understand the consequences of fire and smoke on human health, we have been impacted since human-harnessed fire was first used for heating and cooking. This is still the case for much of the earth's population. Sustainable Energy For All (a United Nations initiative) reports that over 1 billion people live without electricity and 4.3 million people die from diseases caused by indoor smoke from fires to cook and heat, and oil lamps and candles to light.

Today, most "keepers" of fire are land management agencies, forest and fire managers, and tangibly the boots on the ground: a line of sweat-stained yellow shirts pounding out a break in mineral soil or taking a stand with a leaky drip-torch. Men and women of the fire management community,

whether they know it or not, are on the front lines of climate change—if only the solution was as straightforward as anchor and flank, or going direct.

Comparing the human and ecological balance of past fires is important for remembering we have coexisted in an ecologically "sustainable" way. However, these understandings have limited usefulness as doctrine for understanding and managing fire in the future. By nature's perfect design, fire does not degrade the landscape; yet human wants and needs have altered and degraded the global ecology extensively, so that the long-term consequences of both our actions and inactions leave us questioning whether Nature or Man masters fire. There was a time in American history, when either by arrogance or ignorance Man thought he controlled fire—evidently Man was wrong, and this human-fire relationship was little more complex.

The big question then, is how to manage fire to support the long-term biological integrity of a particular landscape, while still meeting diverse human needs? Our big challenge is answering this question while considering that in just a handful of generations humans have completely altered fire's natural habitat. We have fragmented and degraded ecosystems, drained or dried out the land, excluded fire from its native spaces, or introduced it to where it doesn't belong. If fire were an animal, it would be cornered, angry, and trying to find new habitat.

The fire we face today is undeniably fierce and destructive. It spreads in patterns and at rates never seen before. Most alarmingly, through human ambivalence, fire is colonizing new habitats through amplifying positive feedback cycles in sensitive areas. These sensitive ecosystems, primarily the Arctic tundra (7), peatlands (3), and tropical rain forests (8, 9, 10), harbor ancient highly concentrated carbon stocks, which are rapidly released during fire events (like in Indonesia). Fire is not a natural process here, and it has devastating effects, locally and globally.

Expanding infrastructure, industrial activities, human exclusion and suppression of fire among other factors, have hindered fire—preventing it from fulfilling its ecological function. Clearly, fire has become an obstacle to humans too. We see this clash—this human environmental conflict—most poignantly in the wildland urban interface (WUI) or where other human values become threatened. Enter politics.

2. A New Fire Management Paradigm

While fire has been a part of culture for thousands of years, it has only been a century that we have attempted to mix fire with politics. Any fire manager who must reconcile these two in say—the Southern California WUI or in border crossing fires between hostile countries—understands this nightmare. These present-day complexities suggest that a multi-level governance approach is necessary to ensure that fire management policies and practices are appropriately fitted to address everything from local firefighter and public safety, regional border-crossing fires, large-scale smoke episodes, radioactive fallout from contaminated areas scorched by fire, to impacts of fire emissions on the global atmosphere.

A management structure must be at least as complex as the system it seeks to manage. Yet bureaucracy tends to compartmentalize crosscutting issues, like the common disconnect between prevention and suppression. Communication and collaboration between multiple sectors, stakeholders, and agency departments is precisely what is needed to holistically address fire management. In broader terms, a horizontal cross-sectorial and multi-level approach, which includes top-down structures as well as local-level (bottom-up) participation, is the aim of an evolving new paradigm of fire management. Integrated Fire Management (IFM), as it has become known, is a top priority identified by the international community. An important component of IFM is community participation, which applies equally to the Californian WUI as it does to remote savanna communities in Sub-Sahara Africa, Central Brazil, Mongolia or Northern Australia.

Community-led fire management decentralizes authority in areas were centralized management structures would be ineffectual, inefficient, or both. It is also social by nature by being rooted in the cultural interaction and use of fire; it incorporates indigenous knowledge and thousands of years of human experience—the most time-tested form of fire management. Civilizations evolved with fire, learning its benign use, balanced application and continuous management.

Volunteer fire groups, such as in Community Asunsu No.1 (Dormaa Ahenkrom), have significantly contributed to the reduction of wildfires in the country. Photo: GFMC.

According to Val Charlton, managing director of Kishugu, South Africa's largest fire organization, "we should be paying serious attention to indigenous peoples, indigenous needs in the landscape and fire in the context of ecosystem integrity and long term functioning." This approach of IFM, inclusive of participatory methods represents technical fire management principles of the future, joined with intuitive and sustainable fire management principles of the past.

Integrated Fire Management must address challenges not only rooted in current and previous management structures, but also particularly in well-established cultural norms. The most problematic practice is the use of fire as a land conversion tool. Two more 21st century buzz-concepts are aimed at addressing another level of complexity for socio-economic, cultural, and political drivers of fire problems: knowledge transfer and capacity building.

Johann Georg Goldammer, Director of the Global Fire Monitoring Center and coordinator of the UNISDR Global Wildland Fire Network, cites Nepal and Ghana as notable examples of capacity building and knowledge transfer in fire management. In what he terms effective horizontal fire management, communities learn from and help each other address local wildfire challenges, sometimes independent of state or national government help.

Lucy Amissah, a Research Scientist at the CSIR-Forestry Research Institute of Ghana, explains further how this looks at the community level:

> *[In Ghana] there is currently a network of village fire volunteer groups in fire-prone areas that focus on early fire detection, fire suppression activities and the enforcement of burning bans during the fire season; they also supervise burning of slash during the farming season to prevent agricultural fires from getting out of control.*

Community fire management training in Mozambique. Photo: GFMC.

Amissah notes that skills are transferred from one community to another, especially from neighboring communities whose good fire management practices have yielded benefits, such as a marked reduction in the occurrence of damaging wildfires. During skill-transfer training meetings, young people are encouraged to join the aging fire volunteer groups to sustain fire management at the community level.

In Nepal, one of the least developed and economically most disadvantaged nations in the world, Sundar Sharma, leader of the South Asia Wildland Fire Network, has demonstrated that even the poorest of all—the remote mountain communities—are among the most efficient keepers of fire:

> *Our local communities have fully understood the benefit of effective fire prevention within and around the community forests. In the Himalayas, forest resources are becoming scarce, and the impacts of climate change can already be seen. Increasing temperatures, more frequent droughts, dwindling glaciers and snow cover make our mountain ecosystems more vulnerable to wildfires—and this is why the local communities are taking responsibility.*

In Nepal, a student of fire demonstrates firefighting techniques with a backpack water pump. Photo: GFMC.

Lara Steil, Interagency Fire Management Coordinator for Prevfogo, the fire management arm of the Brazilian Ministry for Environment (IBAMA), offers a different

Fire managers gather traditional indigenous knowledge of fire use from villagers in Brazil. Photo: GFMC.

example of IFM functioning at the intersection of top-down and community-led fire management for protected areas in Brazil. These include conservation units, indigenous lands, and territories of traditional people. As Steil observes:

> *We have adopted a participatory approach to study indigenous traditional knowledge on fire use and develop a prescribed-burning plan. The aim was to meet local land management objectives, promote flowering and fruiting and pasture management, reduce fuel loads, establish vegetation mosaics, and minimize the incidence of high-intensity wildfires in the late dry season, thereby decreasing excessive greenhouse gas emissions.*

From Ghana to Brazil, IFM promotes the benign use of fire for meeting ecological and human needs, while in turn creating awareness for dangerous burning conditions and enhancing capacity to contain escaped burns. The results include a reduction in livestock and human casualties, fewer dwellings and agricultural crops lost to fire; and success in limiting the occurrence and impact of large uncontrolled fires that release excessive amounts of emissions. As many traditional uses of fire are ecologically appropriate and beneficial, returning trust and responsibility [back] to communities to manage their landscapes accordingly, is (ironically) being hailed as a new effective way forward.

Charlton adds, "If we are to tackle this messy area head-on and make a real difference in mitigating unwanted damaging fire, we have a serious need for fuel reduction and prescribed burning at landscape level, globally." After all, maintaining an ecologically appropriate balance of fire within the landscape is a task most suited for local fire managers and indigenous communities intimately familiar with sustainably managing their land over the long-term. It will take a well-crafted combination of IFM principles, educational efforts, and trained, capable communities to address contemporary challenges, like developing alternatives to fire as a land-use change method.

3. The 6th International Wildland Fire Conference

Broadly speaking, fire now poses a common threat to environmental stability, economic security, human health

A former Soviet tank has been retrofitted with various firing devices and suppression capabilities, including a 600 gallon water tank to safely carry out prescribed burning on former military terrain contaminated by unexploded ordnance in Teltow-Flaeming County, Germany. The use of fire has contributed to shape landscape patterns of high ecological and cultural diversity in Germany and elsewhere. Armored fire suppression technology, with offsite incident management via drone, help to decontaminate dangerous areas. Photo: GFMC

and safety—but internationally it still lacks effective political recognition and legitimization inside and across borders. This is why government officials, professionals and experts have been convening for 25 years as an international fire management community to assess challenges at multiple governance levels and encourage a deeper understanding of contemporary fire management complexities.

At a crossroads of old ways and new approaches in the human experiment with fire, *"Fire of the Past, Fire in Future"* was the banner bringing participants from 73 countries and international organizations together at the *6th International Wildland Fire Conference,* held in South Korea in October 2015. The conference series originated in Boston in 1989 traveled to Canada in 1997, and has since been held every four years in Australia, Spain, South Africa, and finally in Asia this year. Brazil will host next. Evidenced by this ever-expanding series, both acknowledging and acting on the global implications of vegetation fires has become an important contribution to understanding fire outside of its local-only context.

The international wildland fire community recognizes the sense in establishing a coherent global fire strategy. The envisaged approach is a flexible, scientifically-informed, cooperative, concerted one that combines regulatory, informational, economic and organizational instruments, to consider local to global arrangements in managing vegetation fires with both ecological and human needs in mind.

The Pyeongchang Declaration produced by the Conference acknowledges a handful of contemporary challenges. It cites strong concerns over the contribution of vegetation fire emissions to climate change, the application of fire in land-use change, accumulating effects of global change on fire regimes, and increasing impacts of fire on society, notably on human health and security. Several additional concerns that were explicitly recognized included the role of vegetation fires on

- Positive feedback loops and disturbances in the global system
- Ecologically sensitive and carbon-rich environments like tropical rainforests, peatlands, and arctic tundra
- Agricultural systems and beyond (trans-boundary impact of agricultural fires such as long-range transport and deposits on of black carbon on the Arctic ice)
- Environment and humans, stemming from collateral damages of armed conflicts
- Contaminated terrain including industrial, unexploded ordnance and radioactivity
- Fire-induced immediate threats to human health and pre-mature mortality through fire-smoke pollution

Clearly, the above concerns cannot be considered in a local-only context; fire and smoke cross borders and create regional or global challenges. The conference participants, citing the collective interest, therefore recommend a two-tier response for addressing local to global fire management challenges. Summarized from the Conference Declaration these are:

- **International politics:** Collective international action is needed to address impacts of vegetation fires that are of trans-boundary nature. Applying principles of Integrated Fire Management (IFM), based on the wealth of traditional expertise and advanced fire science, contributes to sustainable land management, ecosystem stability and productivity, maintenance and increase of terrestrial carbon stocks, while reducing unnecessary emissions and pollutants that affect human health and contribute to climate change.

- **To capacitate nations in addressing fire management challenges:** To implement IFM, capacity building, investments and outreach work is needed globally. As traditional and advanced knowledge of IFM principles is available for all vegetation types, the systematic application of IFM, notably community-led fire management approaches, should be promoted by exchange of expertise between countries. Countries and international organizations should support these objectives by establishing regional training programmes and resource centres. Bilateral agreements and multilateral voluntary exchange instruments should also be supported.

To engage leaders to act on these recommendations, the Conference Statement (annex to the Declaration) elaborated a three-level approach and recommended nations support the following goals:

Goal 1. To help those most vulnerable, to address fundamental threats posed by fires on human health and security; to lend financial, technical, or operational support; and to offer expertise, basic training, strengthen local education efforts, support capacity building and community-led initiatives.

Goal 2. In "transitioning" fire management settings where basic needs are met or institutional capacity are established,

Regional fire management field training for Mongolia and Central Asia: Fireline construction in preparation for a prescribed burn. Photo: RCAFMRC

the fire management community is encouraged to continue supporting efforts under Goal 1; establish regional programs and resource centers where needed; advance technical efforts such as fire detection, early warning and monitoring; enhance cross-border cooperation; promote practical measures like standard operating procedures and the Incident Command System (ICS); and to strengthen participatory fire management approaches (community-led, volunteer).

Goal 3. In "advanced" fire management settings, Goals 1 and 2 shall be continually evaluated and improved as appropriate; nations shall further develop legal frameworks where desired; enhance bi- and multi-lateral mechanisms for fire management expertise and resource sharing; share and advance science and technology.

A clear outcome of the Conference was emphasis on expanding international cooperation and response mechanisms, and exchanges of information and technical and scientific expertise. A key recommendation to facilitate this process was to make better use of existing institutions and to create new ones where needed. In particular, establishing more training programs and national and regional resource centers are a top priority.

The Global Fire Monitoring Center (GFMC) has played the lead role in facilitating cross-border cooperation and exchanges, and serves as coordinating secretariat of the UNISDR Global Wildland Fire Network. For instance, the Central Asia Regional Network has undertaken initiatives and activities, like an agreement on transboundary fire cooperation between Mongolia and Russia, regional fire management conferences, consultations and trainings in different countries of the region.

Oyunsanaa Byambasuren, Director of the newly established Regional Central Asia Fire Management Resource Center in Ulaanbaatar, Mongolia, further explains the function of his Center:

> *Like other Centers, we are playing a critical role to make the Network activities more efficient. It is addressing increasing demand for collection and distribution of data and information relevant to fire management among local stakeholders and regional neighborhoods, facilitation in capacity building at regional level, and the exchange of human and technical resources. To enhance capacity and participation in fire management of civil society, notably local rural communities, the Center is also conducting fire management training at local community level.*

Two sister centers, which were established in 2010 in Skopje, Former Yugoslav Republic of Macedonia, and in 2012 in Kiev, Ukraine, are coordinating the activities of the Southeast Europe/Caucasus and the Eurasia Wildland Fire Networks. As of 2015, Brazil intends to support the establishment of another resource center for coordinating the Regional South America Wildland Fire Management Network activities.

An outcome of the Conference was vibrant commitment by the Republic of Korea to establish themselves as a major player in the region by consolidating four current regions into a Pan-Asia Network to better facilitate cross-border cooperation and training exchanges (see previous Wildfire issue). The country's intention, supported by the Korea Forest Service, is to greatly expand the ASEAN-ROK Forest Cooperation (AFoCo) training program, establish a Regional Resource Center and to invest in areas such as knowledge transfer and community-led fire management. Similarly, the GFMC has urged the International Tropical Timber Organization (ITTO) to consider supporting the establishment of such centers of excellence in South America, Southeast Asia and West Africa.

In total, endorsed by the United Nations International Strategy for Disaster Reduction (UNISDR), the GFMC assists in coordinating international cooperation between 14 Regional Networks with varying levels of activity. At the Conference, there was a strong showing of representatives from these networks, who reported on the accomplishments, challenges, and intended future activities of their regions. Both the Conference Declaration and the more extensive Conference Statement are based on the Regional Network reports.

4. Fire, Climate Change, and International Politics

As adept as our scientific and applied fire expertise has become, we remain amateurs in our understanding of the aggregate effects of fire on humans and the earth's system. Our knowledge hinges largely on our very recent and still limited ability to monitor global fire activity from space, calculate fire's share in emissions, or model the smoke impacts on premature mortality rates. We lack accurate and comprehensive data for today and we have limited historical data for these issues, making it difficult to grasp the complete context of our current fire situation.

Such uncertainties often beget political inaction. Managing the fire challenge is analogous to action (and inaction) on climate change. To face the magnitude of challenges posed by fires, it is imperative that the global community initiate action, despite lingering uncertainties. Oddly, fire has been largely excluded from climate change discussions – if only mentioned as a symptom of deforestation. This is changing, as fire is being increasingly understood as both a consequence of and a driver for climate change.

During the United Nations Framework Convention on Climate Change (UNFCCC) 20th Conference of the Parties (COP 20), in 2014, the world's political community was warned by the world's scientific and professional fire management community. A statement issued by the GFMC underscored the need to address global vegetation fires in the context of climate change, largely referring to a 400-page White Paper commissioned by the United Nations International Strategy for Disaster Reduction (UNISDR) to evaluate the global state of vegetation fires and global change between 1993 and 2013. The White Paper was a comprehensive effort by 58 lead scientists and experts in fire science, ecology, atmospheric chemistry, climate change modeling, and remote sensing (11). Some of those authors for many years belonged to the Team of Specialists on Forest Fire that was tasked by the United Nations Economic Commission for Europe (UNECE) to:

> *… Provide a critical link in communication and cooperation between fire scientists, managers and policy makers. … organize seminars; and promote of synergistic collaboration between governments, non-government institutions, and individuals, with emphasis on science and technology transfer, and support in developing fire management policies. (12).*

Convincing upper-level policy makers to legitimize global vegetation fire may be logical, but is certainly a challenging step. Fortunately, the organizational skeleton of a globally concerted fire management strategy is already present, but needs to be stitched together into a more comprehensive program. Identifying actors who are already rigorously engaged, and providing the appropriate support, would be a relatively low investment. According to one of these actors—Goldammer—he emphasizes an additional need for shared principles:

> *It is necessary that humans—policy makers—develop consent on how to deal with fire in a changing global environment. We have altered our landscapes to such an extent that no longer is anything really 'natural' anymore. With our many [human] influences, nature does not just function separately from humans. In reality, we are talking about nothing short of planetary management.*

Now, for the first time in the history of the conference series, climate change has been given priority recognition. In fact, the Conference Declaration is explicitly directed at the UNFCCC COP 21 climate treaty negotiations. It reads:

> "The COP 21 is encouraged to acknowledge the role and endorse the support of Integrated Fire Management as an accountable contribution to reduce greenhouse gas emissions, maintain or increase terrestrial carbon pools in all vegetation types and ensure ecosystem functioning."

Compared to 2014, when the GFMC—an NGO—delivered a message, now in 2015 a nation state—the Republic of Korea, as host nation of the IWFC—issued an unprecedented Ministerial Decree to the COP as a vehicle for delivering the Conference Statement. Also at the climate summit, Indonesia's Presidential Address recognized its fire problems and reinforced concerns on the issue. Singapore explicitly focused on fire-induced ecosystem

Brazilian and international specialists work together on a fire management field campaign in the State of Tocantins, Brazil. Photo: GFMC.

degradation and emissions contributions, while Malaysia re-emphasized mitigating these impacts through restoration and reforestation projects.

Indeed, the Paris Agreement of December 12th 2015, in Item 55, recognizes this request and in Article 5 encourages the [signatory] parties to pursue "…policy approaches and positive incentives for activities relating to reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks…"

The next IWFC host, Brazil, seemingly has a grasp on the interconnectedness of climate-change, forest degradation and destruction, and fire use. These important political moves are a critical step in legitimizing an internationally shared understanding of fire management imperatives.

Considering how intricately fire is integrated into various aspects of culture and peoples livelihoods, and how important a tool it is for communities globally, a political approach to fire management must ultimately be integrated, and community driven. Pyne's fundamental understanding of "local fire" may turn out to be the best point of reference we can follow, even while addressing fire at a global scale. When asked about actions local fire management officials should take in light of contemporary challenges, Stuart Ellis, CEO of the Australasian Fire and Emergency Service Authorities Council (AFAC), responded with:

> *[It is important] to ensure our [local] efforts in fire management align and can be measured with the (UNISDR) Sendai Outcomes for Disaster Reduction. [We] must take a global view and be aware of initiatives and activities outside of Australia, in order to better manage fire inside Australia. You can always learn from others.*

A humble yet stalwart supporter of cross-border cooperation in fire management is Tom Harbour, the outgoing U.S. Forest Service Fire and Aviation Director. As much as anyone, his keynote in Korea summarized the issues we face. In digested form, his key points frame our fire future as one that demands a global strategy and a shared set of fire values:

> *A cohesive strategy will honor the past, but focus us into the future. While our systems have been developed to cope with what we have experienced, we must be challenged to better prepare for what WILL come. International exchange is crucial in developing a new doctrine—and symbiotic mutualism must be at the base of a new cohesive strategy; holistic and unified is the future trajectory of fire management. To continue in concert with one another, we must have agreed-upon values. We must work between the servant and master [of fire] roles.*

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CFA Newsletter

No.74 September 2016 ISSN 1750-6417

Forest Scenes

Global Vegetation Fire Challenges and Outlook

In many parts of the world areas at high wildfire risk are contaminated by the heritage of armed conflicts and industrial or nuclear accidents. In Europe large tracts of lands are contaminated by unexploded ordnance stemming from the World Wars and other more recent armed conflicts. The high risk of injuries and deadly fatalities due to uncontrolled explosions or intake of radioactive smoke or dust particles require specialized equipment to protect fire management personnel. This specialized wildfire suppression tank, operated by a German company on UXO-contaminated lands in Brandenburg State (around Berlin), is a converted T-55 combat tank with unchanged armor. It allows safe application of 11,000 liters of water and water additives for fighting dangerous fires. This kind of technology should be used on radioactively contaminated terrain in places like Russia, Belarus and Ukraine (e.g. in the Chernobyl Exclusion Zone). Photo: GFMC/DiBuKa.

Profile of Global Fire Challenges

Every year, roughly an average of about 600 million hectares of vegetated lands is affected by land-use fires and wildfires (Mouillot and Field 2005). Worldwide, wildfires are trending toward longer burning periods, heightened severity, greater area burned and increased frequency. Consequences include detriment to environment, socio-economic costs including threats to human health and security, and higher shares of emissions into the atmosphere. Conversely, due in large part to human activities such as expanding infrastructure, industrial activities, or mismanagement of fire, fire

regimes are shifting dramatically and creating positive feedback cycles in sensitive ecosystems, notably in the Arctic tundra (Mack *et al.* 2011), in peatlands (Page *et al.* 2002), and in tropical rain forests (Cochrane and Laurance 2002). Sensitive, non-fire-adapted areas can contain highly concentrated carbon stocks, which are rapidly released during fire events with devastating consequences both locally and globally. For example, fires burning in Indonesia alone, during the El Niño dry season in I997 and 1998 produced an equivalent of up to 40% of the *global* gross carbon dioxide (CO_2) emissions from fossil fuels for that year (Spessa, 2013). The Indonesian haze crisis this past year often put up daily CO_2 amounts higher than the entire European Union industrial economy (Huijnen *et al.*, 2016). Globally, emissions resulting from vegetation fire can constitute one-third of total releases of carbon dioxide annually (Page *et al.* 2002). The National Disaster Mitigation Agency (BNPB) of Indonesia, estimated the damages to the national economy caused by fires in 2015 amounted to US$16.5 billion, or around 1.9 percent of the country's GDP; to put a price tag on fires globally is impossible. In addition to the environmental and economic impacts, a humanitarian dimension is growing with some models indicating the annual average number of premature deaths resulting from vegetation fire smoke exposure, range between 180,000 (Lelieveld *et al.* 2015) and 339,000 (Johnston *et al.* 2012). While much emphasis is placed on the negative effects of fire – in many instances more fire is exactly what is needed to reduce some of these consequences. For example, applying "prescribed fire" in fire-adapted environments can contribute to lowering the severity of wildfire events which can wreak havoc on communities in the wildland urban interface (WUI), where measures have not been taken to reduce fuel buildups.

Political Challenges

Political challenges facing fire managers range from the sensationalized affair of protecting celebrity mansions in Hollywood Hills, to coordinating firefighting efforts between two warring countries when border-crossing fires threaten villages. Fire managers and policy-makers from the local to the supranational, are tasked with addressing the contribution of vegetation fire emissions to climate change, the application of fire in land-use change, accumulating effects of global change on fire regimes, and increasing impacts of fire on society, notably on human health and security. Additional challenges include the role of vegetation fires on environment and humans, stemming from collateral damages of armed conflicts and impact on contaminated terrain including industrial, unexploded ordnance and radioactivity; fire-induced immediate threats to human health and pre-mature mortality through fire-smoke pollution, and on and beyond agricultural systems (e.g. trans-boundary impact of agricultural fires causing long-range transport and deposits of black carbon on the Arctic ice) (IWFC, 2015).

Political implementation of these approaches is largely an exercise at the science-policy interface, where actors, activities and institutional arrangements are working to engage in and support the transfer of science and expertise upwards into policy mechanisms and downwards into implementation strategies feasible for practitioners. These mechanisms in large part are voluntary and non-binding. An example is the International Wildfire Preparedness Mechanism, which aims at enhancing national to international fire management capacities by sharing of knowledge and expertise (IWPM, 2016). Another approach is bilateral agreements, several of which have been reached, like between the United States and Canada, or Australia; some have worked quite well, but more on the grounds of exchanges in expertise and political goodwill. The Association of Southeast Asian Nations (ASEAN) Haze Agreement to combat trans-boundary haze from fires is the globe's only multilateral binding agreement to do with fire – yet it remains an example of political progress without problem solving – evident during this past year's repeat of the 1997–98 crisis in Indonesia. Importantly, it goes to show that fire politics and challenges must be addressed at more than one level and (supra)national efforts must also work in concert with actions and activities at the lowest, local level, which include everything from navigating conflicts of interests and corruption, to local law enforcement, building capacity and supporting community-led fire management.

Opportunities and Initiatives

A recent development towards addressing global fire concerns is the effort to establish a number of additional fire management resource centers in regions of the world including South America, Sub-Saharan Africa, South Asia and Southeast Asia. Like the currently operational centers in Southeast Europe (based in FYR Macedonia), Eastern Europe (Ukraine) and Central Asia (Mongolia), these centers are to expand local to international cooperation and response mechanisms, facilitate cross-sectoral communication and exchanges of information and technical and scientific expertise, facilitate training programs and especially enhance local and regional capacity by promoting principles of Integrated Fire Management (IFM). For instance, the Regional Central Asia Fire Management Resource Center in Ulaanbaatar, Mongolia, plays a critical role in addressing increasing demand for collection and distribution of data and information relevant to fire management among local stakeholders and regional neighbourhoods; it is facilitating capacity building at regional level, and supporting the exchange of human and technical resources. To enhance capacity and participation in fire management of civil society, notably local rural communities, the Center is also conducting community-led fire management trainings. Most importantly the center is facilitating national inter-agency coordination in fire management and the cross-boundary cooperation dialogue within the neighbouring countries of Central Asia.

Challenges rooted in cultural norms such as the use of fire as a land conversion tool, are most effectively dealt with locally. Participatory Community-Based Fire Management (CBFiM) incorporates indigenous knowledge and thousands of years of human experience in the benign use and balanced application of fire to support ecological and human needs. CBFiM objectives include creating awareness for dangerous burning conditions, enhancing capacity to contain escaped burns, and thereby reducing the number of livestock and human casualties, instances of lost dwellings and agricultural crops, and lesson the occurrence of large uncontrolled fires that release large amounts of emissions. Regional Fire Management Resource Centres like the one planned for Indonesia (serving SE Asia) will be bridging the science-policy interface to, through principles of good governance, build on success models from other regions, but specifically suited for addressing the high level of stakeholder conflicts (e.g. between smallholders and multinational palm oil and paper pulp corporations), land-use and property rights challenges, and also recognizing the sensitive and globally valuable ecosystem at stake. The Indonesian government, including its newly formulated Peat Restoration Agency stand ready to partner on these critical challenges; an emissions forecasting, early warning, and fire prevention center is also in its formative stages. Working in tandem with these initiatives, a regional

resource center, which functions both horizontally and across the three levels of local, national and regional governance structures – is anticipated to prove as effective and valuable as it's other regional predecessors have.

Globally most emphasis in fire management is given to the empowerment and capacity building of local rural communities. By taking over responsibility for the management of community forests and other lands local communities shall assume a key role in the prevention and suppression of wildfires that may threaten rural assets, including forests, agricultural lands, villages and critical infrastructures. Capacity building in fire management includes the safe application of fire in land-use systems and wildfire hazard reduction. The photograph shows Nepalese villagers training prescribed under-canopy burning and surface fire suppression with hand tools – an example of outreach work of the UNISDR Regional South Asia Wildland Fire Network. Photo: GFMC/Sundar P. Sharma.

Outlook

Mutual gains can be achieved by supporting and participating in current, emerging, and planned initiatives which fall under the scope of IFM, and contribute to realizing Sustainable Development Goal 15[1] and to the challenges of the Sendai Framework for Disaster Risk Reduction[2]. The persistent challenge of fire managers is to manage fire to support the long-term biological integrity of any given landscape, while accounting for the negative consequence of fire and yet meeting diverse human needs. In many instances more ecologically benign fire is both effective and highly constructive; scientists in northern Australia are even showing from an emissions modelling standpoint that applying Aboriginal early-dry-season savanna burning techniques, result in fewer emissions and increased carbon sequestration over time, while simultaneously rejuvenating the ecosystem for plants, animals and human use (e.g. grazing) (Russell-Smith *et al.* 2013). In General, emphasis is needed on prevention over suppression, and in fire-adapted climates, the best approach to prevention is increasing the use of prescribed fire – a less-intensive and less ecologically damaging alternative to mostly human-caused, climate and drought driven out-of-control fires. Aside from better prevention and increased early warning mechanisms, fire management should be better integrated into initiatives like Reducing Emissions from Deforestation and Degradation (REDD+) or those offered by the Global Environment Facility (GEF) and Green Climate Fund; fire management capacity should be bolstered at local, national and regional levels. These institutional arrangements, activities and initiatives can best be supported through regional centers of excellence, where committed individuals, over time, and with the support of governments and organizations, can manage and relate to fire sustainably. Building effective institutional arrangements, networks of people, and integrating best practices and sound science into windows of opportunity in the policy process, while empowering local communities, may be the best steps we can take to ensure that globally fire is fulfilling its ecologically benign role, while limiting its destructive impacts and occurrence in sensitive environments. Ultimately, fire must be understood as much as a social challenge as one that is environmental.

The Global Fire Monitoring Center (GFMC) is an institution of the Max Planck Institute for Chemistry, Max Planck Society for the Advancement of Science, hosted by the Freiburg University, Germany. Since 2005 GFMC is an Associated Institute of the United Nations University (UNU). Since 2001 GFMC is serving as coordinator and facilitator of the UNISDR Wildland Fire Advisory Group and the UNISDR Global Wildland Fire Network, a global voluntary network that is providing policy advice, and science and technology transfer to enable nations to reduce the negative impacts of vegetation fires on the environment and humanity; and to advance the knowledge and application of the ecologically and environmentally benign role of natural fire in fire-dependent ecosystems, and sustainable application of fire in land-use systems.

Johann G. Goldammer and **Lindon N. Pronto**
Global Fire Monitoring Center (GFMC)

[1] SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (UN, 2015b).

[2] By outlining clear targets and priorities, the Sendai Framework for Disaster Risk Reduction 2015–2030 aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years. The Framework was adopted at the Third UN World Conference on Disaster Risk Reduction in Sendai, Japan, on 18 March 2015 (UN, 2015a).

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The Global Wildland Fire Network: 2016 IN REVIEW

A round-the-world reflection on working with and facing off fire: where we're at, and directions we're headed

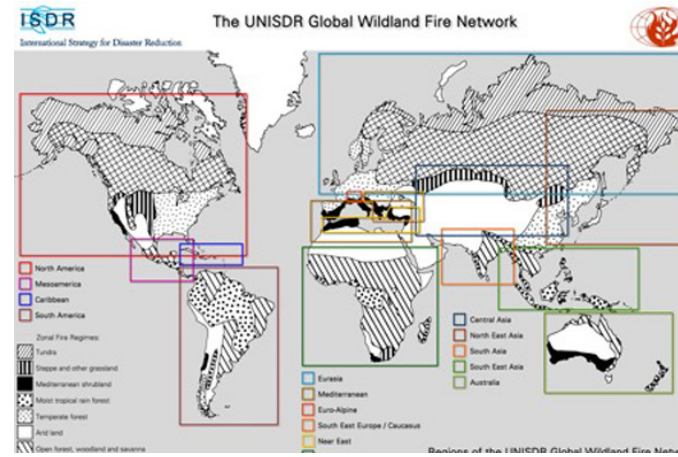
By Lindon Pronto
Global Fire Monitoring Center

Wildland fire is a global phenomenon and often one of our most challenging and intractable environmental challenges – for communities, nations, landscapes and our climate, air, and watersheds. Nearly a year ago, when I profiled some of the overall challenges that fire managers around the world face in "Local Fires, Global Worries" (Wildfire Magazine, January-February 2016), not only were the negative consequences of fire highlighted, but some insights on successes too. Community-led fire management, for instance, offers solutions from Ghanaian villages to the suburbs of Boise Idaho.

Last October (2015), when the 6th International Wildland Fire Conference was held in South Korea—a gathering of international fire management professionals, it could not have come at a better time considering the Climate Treaty negotiations in Paris in early December 2015. At the time, I also reported on the impacts of vegetation fire emissions on climate (and climate change)—a discussion that was suddenly no longer insulated within our own fire community due to global media attention on Indonesia's disastrous fire-smoke season, triggered by the El Niño drought and the continuing excessive use of fire in land-use change. Vegetation fire, a previously less visible topic in the context of global emissions discussions, was quickly put back on the global agenda. Studies on fire and emissions and health consequences became news headlines the day they were accepted into journals.

Cycles of media and political attention come and go on major fire events—the attention nearly always on Western wildfires—but in the sensitive carbon- and biodiversity-rich peat ecosystems of Indonesia the last comparable event was in 1997-98. During the late 90s and early 2000s, there was a rush of international development aid, capacity building and expert consulting along with major monetary investments into the region. Yet many of those fire folks that ended up over there at the time, and who never left the region, will corroborate that despite international efforts, not a whole lot changed in the past 17 years. Finally, the political will seems to have shifted, and the Indonesian government has taken major steps in the past months—for instance, by tasking the newly installed Peatland Restoration Agency to restore illegally drained, burned and exploited protected peat lands, and government has begun prosecuting and fining companies huge sums of money, suspending or revoking plantation licenses.

As for the rest of us, our collective understanding of the impacts of fire in this region, and on sensitive peat ecosystems—a carbon sink, the whole world leans on—has been on the rise. Greater attention has been brought to some of the root causes such as social conflicts, land-use rights, corruption, or the role of multi-national palm oil and pulp and paper corporations in deforestation, draining peatlands, and setting illegal fires to pave the way for plantations. Even consumers and supply chains have taken action through boycotts and product branding schemes. We now have more sophisticated satellite monitoring capacity, smoke emissions modeling, and even the use of drones to show the extent of fire damage. Aside from a shift in political will, this example of Southeast Asia highlights the growing importance of science and technology for fire management—an evolution in scientific understanding and technical innovation (think also social media) which resulted in a very different response to a nearly identical disaster—nearly 20 years on.



This world map shows the delineation of the Regional Wildland Fire Networks. The vegetation types correspond to characteristic fire regimes in the regions that are described in the background documents on the regional network web pages. The "Global Wildland Fire Network" consists of a set of Regional Networks that had been in place for some time or were initiated since 2001.

Opening of the Fire Management Week by Colonel Ghasem Sabz Ali, Commander of the Forest Guard, Forests, Range & Watershed Management Organization (FRWO); Islamic Republic of Iran. Training Website including Picture Gallery here. Photo: FRWO

Science and Technology

In January 2016, the UNISDR Science and Technology Conference, as part of the implementation strategy of the Sendai Framework for Disaster Risk Reduction 2015-2030, was held at the United Nations in Geneva. The conference saw our international fire management community represented: the Global Fire Monitoring Center (GFMC) and the Global Wildland Fire Network is serving as a thematic partner for the implementation of the Sendai Framework and assisting UN member states with combining science and technology and bridging it with the practitioners and local communities as a crucial activity of disaster [impact] reduction and fire management in general. Evident either for fiduciary considerations like the current "fire-borrowing" discussion in the U.S. Congress, or for humanitarian dimensions, fire has increasingly become a part of the international dialogue on Disaster Risk Reduction.

Developing capacity

Not all parts of the world are blessed with the sophistication and capacity as say, the U.S., Canada and Australia (aka the "Big Three"). With a changing and warming climate, some regions and nations are just recently discovering they have a fire problem, and furthermore, that they need to first develop the political awareness and technical infrastructure to cope with the emerging (mostly drought induced) wildfire challenge. In May of 2016, the First International Fire Management Week— a national round table on fire management and training on Integrated Fire Management (IFM) was held in the Islamic Republic of Iran. These activities were conducted by the GFMC, the Regional SE Europe / Caucasus Fire Monitoring Center, and the Fire Management Resource Center of the Central Asia Region. Vegetation fire regimes in the Middle East and neighboring regions (i.e. Caspian Sea, South Caucasus, Near East, Balkans and Central Asia) are becoming increasingly affected by climate change and socio-economic and land-use changes. These changes include increasingly severe wildfires—which for countries like Iran, pose a serious challenge. In general, with the Middle East being a non-destination for many forms of cooperation and capacity building in fire management, such a round table and training course was a significant happening; it is good to see Iran included in the global fire family.

Cross-border cooperation and international sharing of expertise is critical for countries that have limited capacities in fire management. Even with technical capacity and training aside, one of the major obstacles for such collaborations are language barriers. While not relevant for everyone in all regions, some basic guidelines, terminology and SOPs can break down some of these barriers. In early 2016, the EuroFire competency standards, best practices, and trainings were translated into Persian and introduced to the authorities of IR Iran. Their application for capacitating local administrations and rural communities in the safe and efficient control of wildfires was encouraged; at future regional trainings, the materials will also be used for cross-boundary training as practiced in joint regional trainings in Turkey, attended by up 10 nations in 2010 and 2014. The EuroFire materials are meanwhile now available in 14 languages for the use in over 50 countries globally.

Working across borders

Challenges in capacity can be best overcome through local, national and international collaboration and cooperation. This understanding prompted the organization of the First Regional Symposium on Cross-Boundary Cooperation in Fire Management in South America. The event took place between May and June 2016, and was hosted by Uruguay and attended by officials from state agencies responsible for fire management in Argentina, Brazil, Chile and Paraguay. The participants developed recommendations for the development of protocols and standards for systematically enhancing interoperability for cases of cross-border cooperation in addressing wildfire emergencies in South America. Here too, the EuroFire competency standards (e.g. baseline understandings like LCES, fireline construction methods, ignition patterns etc.) were presented in the Spanish and Portuguese (Brazilian) languages to be used in the future to prepare firefighters for international missions. Also the concept of the International Wildfire Preparedness Mechanism (IWPM) and state of development of the International Fire Aviation Guidelines (IFAG) that are aiming for improving aerial firefighting safety, effectiveness and efficiency and creating the conditions for international interoperability of aerial firefighting missions, were presented. Typical of such a symposium to bring regional actors together, is the subsequent outreach work which is followed up at national level by GFMC and Network members—in this case a National Round Table on Fire Management in Uruguay. This outreach and facilitation support-work at a national level, builds relationships and confidence for future collaboration with current and proposed regional fire management resource centers.

Once strides in cross-border fire management diplomacy among countries are underway, the practical means of cooperation in fire suppression can be addressed. That is where the IWPM, the EuroFire competencies and the IFAG come into play. Internationally (e.g. in the Mediterranean region), one of the most borrowed assets are aviation resources. Fire aviation is also extremely costly and accounts for one of the highest fatality rates in the business. As you may know from your own experience, even in the extremely well-greased air-to-air and air-to-ground operations in the Western United States, it is a very complex work environment that depends on skill and communication (both on the ground and in the sky) to carry out operations safely and effectively. Coordination of fire and aviation resources under circumstances of language barriers, varying rules, experience levels etc. can easily present unsafe situations or prompt flat-out refusals by officials or pilots to engage. The IFAG begins to address these sorts of challenges. As an example, in September 2016, the U.S. Forest Service, GFMC, and the Regional SE Europe Network / Caucasus Fire Monitoring Center (RFMC), teamed up for a training course on "Enhancing Ground and Aerial Forest Fire Suppression Capacities in the Former Yugoslav Republic of Macedonia" to introduce the IFAG and International Manual of Common Rules for Fire Aviation. This event will be followed up in November 2016, with a regional consultation on cross-boundary fire management in the Western Balkans.

Heavy dependency on aerial firefighting assets is a luxury and not a given in some parts of the world. The cost of an 'airshow' on a single California fire may exceed the total annual fire suppression budget for an entire country elsewhere. Nepal is a great example of an extremely economically disadvantaged nation, but still being a leader in fire management by employing exemplary and effective community-led fire management, combined with an ambition to strengthen regional cooperation in the South Asia region. In early October 2016, Nepal hosted a Workshop on Cross-Boundary Cooperation in Fire Management for South Asia which produced the Godavari Resolution. This activity brought together the usual docket of agencies responsible for fire, forest resources, and the scientific community; however, it was also supported by international interests like the Korea Forest Service through the National Institute of Forest Science (NIFoS)—with assistance from the GFMC and the U.N. International Strategy for Disaster Reduction (UNISDR).

International priorities and areas of concern

In the neighboring network of Southeast Asia (as mentioned earlier), activities and efforts are ramping up, particularly in Indonesia following last year's deadly fire and smoke episode. Even at the late-2015 Paris Negotiations, there was no lack of incentive for wealthy nations to target global emissions reductions by heavily investing in one country responsible for a significant share in global emissions as a result of human induced fire. Between August and September 2016, the International Workshop and training course "Forecasting Emissions from Vegetation Fires and their Impacts on Human Health and Security in South East Asia", was held in Jakarta, Indonesia. While once again, an array of actors participated, sponsored and assisted in organizing—the workshop was comprised mostly of members of the scientific community in the arena of atmospheric modeling; the primary sponsor was the World Meteorological Organization (of the U.N.) and hosted by the Indonesian Agency for Meteorological, Climatology and Geophysics (BMKG). In addition to the workshop, the GFMC conducted a number of side-talks with the Ministry of Environment and Forestry and the Peat Restoration Agency (BRG) in preparation of planning for the establishment of the Regional SE Asia Fire Management Resource Center (more to come to Wildfire Mag in Spring 2017).

The socio-economic, political and environmental complexities—and international implications of the situation in Southeast Asia, might just be the Niger Delta of fire management. However, such high-profile complexities exist even in two of the most sophisticated fire management settings: The U.S. and Canada. The growing wildland-urban interface challenge stayed pretty well in the headlines this summer and spilled into the halls of Congress (at least more seriously than in recent memory). Between 2015 and 2016, Californian towns were razed—yet any single incident was hardly comparable to the Canadian Fort McMurray fire devastation that, beyond the physical damage, has had a marked psychological toll, impacted the entire country's GDP, and even has the (re)insurance agencies rethinking how they do business.

A country with much in common with Canada is Russia. The northern boreal forests circling the Earth's high latitudes may be a much bigger ticking carbon bomb than the draining of peatlands or the drying of the Amazon. You may have recently seen some news snippets or NASA satellite imagery of unchecked fires burning millions of acres in Siberia. In the next issue of Wildfire Magazine, Johann Georg Goldammer, Director of the GFMC, will feature some news from the Eurasian region, addressing the fire management challenges in Eastern Europe, Central Asia, and

delve into the exceptional challenges in the Russian Federation which have very global implications.

While a changing climate and shifting fire regimes present challenges universally, some regions struggle with more localized challenges. For instance, some countries have reported a spike in human-caused fires as a result of the refugee crisis in the Middle East. Sometimes, the threat of wildfire can combine with an existing threat, such as landscapes littered with munitions and UXOs from old artillery ranges or past armed conflicts. Another notable example is the threat posed by vegetation fires consuming terrain in the radioactively contaminated Chernobyl Exclusion Zone in Ukraine—an issue that caught international news attention in 2015 when several fires threatened the old reactor site. Radioactive smoke transport into Russia or the European Union was a major concern (more on this in the next issue).

Moving toward solutions: Launching Regional Fire Management Resource Centers

A recent development towards addressing these international fire concerns, is the effort to establish several new specialized Regional Fire Management Resource Centers in South America, Sub-Saharan Africa, South Asia and Southeast Asia. Like the currently operational centers in Southeast Europe (based in FYR Macedonia), Eastern Europe (Ukraine) and Central Asia (Mongolia), these centers are to expand local to international cooperation and response mechanisms, facilitate cross-sectoral communication and exchanges of information and technical and scientific expertise, facilitate training programs and especially enhance local and regional capacity by promoting principles of Integrated Fire Management.

In pursuing this objective, 2016 has been (and continues to be) a very productive year for the Global Wildland Fire Network, as it serves to help reduce the negative impacts of vegetation fires, and promote the benign application of fire, in all corners of the globe. Just as on the fireline, open and ongoing communication is key for advancing awareness of fire management challenges and successes. For the fire manager, keeping in touch with personal networks, expanding them and taking the occasional moment to look outside one's own forests, regions and borders can have an impact; from study tours to aiding entire countries in establishing or enhancing fire management capacity. While there may not be a method or single forum for tracking these evolutions, the GFMC Calendar provides a sample of international efforts by many in the global fire community. For ongoing coverage of significant or noteworthy incidents around the world, the 'Current' and 'Media' tabs on the GFMC website is also updated daily. Just as fire knows no borders, when we work as a global fire community, we can build capacity and help each other grow, or if need be, lean on each other in times of crisis.

Air-ground coordination in wildfire suppression operations: Display of helicopter aerial fire suppression capabilities at Skopje Airbase, Former Yugoslav Republic of Macedonia. Photo: RFMC

Eastern Fires, Western Smoke

Visit the online issue at wildfiremagazine.org for complete galleries and background.

Preface: Reflecting on 25 years of global fire

The last two essays in *Wildfire Magazine* published by the Global Fire Monitoring Center (GFMC) provided global perspectives of wildland fire – *Local Fires, Global Worries* (January 2016) and *The Global Wildland Fire Network: 2016 in Review* (November 2016). The author, Lindon Pronto – a Californian and second generation wildland firefighter, after working in US forest firefighting for almost a decade – joined the GFMC in early 2015. Since, he has witnessed the agenda and unprecedented pace of global development in cooperation of the international wildland fire community that brought the 6th International Wildland Fire Conference to East Asia – hosted by the Republic of Korea in October 2015 – and subsequent message to the World Climate Conference in Paris. Lindon's essays in *Wildfire Magazine* reflect that not only is wildland fire science globalizing, but fire management, too.

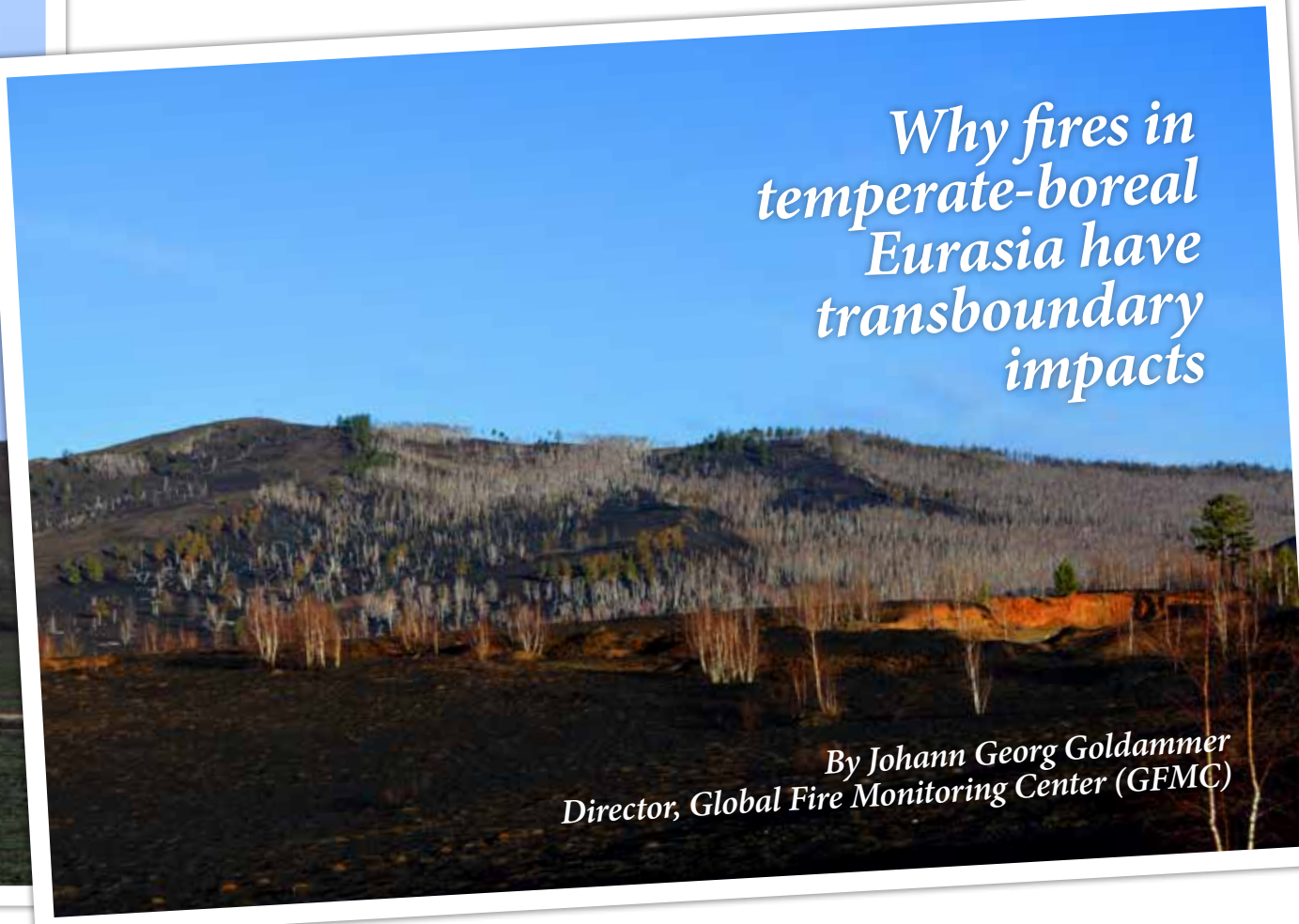
In 2016, *Wildfire Magazine* and its academic sister, the *International Journal of Wildland Fire* (IJWF) celebrated their 25th Anniversary. In its December 2016 issue, the editors-in-chief of IJWF reminded us that IJWF is the only journal dedicated to publishing peer-reviewed research on all aspects of wildland fire, and thus being the voice of a rapidly globalizing wildland fire science. The motivation to launch the IJWF was not just for a family of scientists to "have their own journal," but to expand insight into the role of vegetation fires in the Earth System.

Two years before the launch of the journal, I recall that Andy Koonce, a wildland fire researcher at the U.S. Forest Service Pacific Southwest Forest and Range Experiment Station in Riverside who passed away several years ago, presented the visions and concept of the *International Association of Wildland Fire* to the international community.

That was in 1989, at the international conference *Fire in the Tropical Biota*, hosted by the Fire Ecology Research Group of Freiburg University, predecessor institution of the GFMC. This conference, including its resulting policy statement, the *Freiburg Declaration on Tropical Fires*, revealed, from an interdisciplinary point of view, that the so far less observed – not to say "forgotten" – regions of the world were playing a major role in the global wildland fire theater. Thanks to Jason Greenlee, the custodian of the world's largest wildland fire library, who served as its first editor, the IJWF was launched in 1991. *Wildfire Magazine*, as it celebrates this landmark anniversary, can be lauded for successively widening its original North America focus to global coverage over the past quarter-century.

The ice melts

In the late 1980s, the "Eastern" fire world was not yet on the screen of an emerging international community of wildland fire scientists and practitioners. No wonder – the *Cold War* had separated the world by the *Iron Curtain* leading to a separate evolution of fire science and fire management systems in both political hemispheres – without exchange and cross-fertilization. The fall of the *Berlin Wall* a quarter-century ago and the thawing



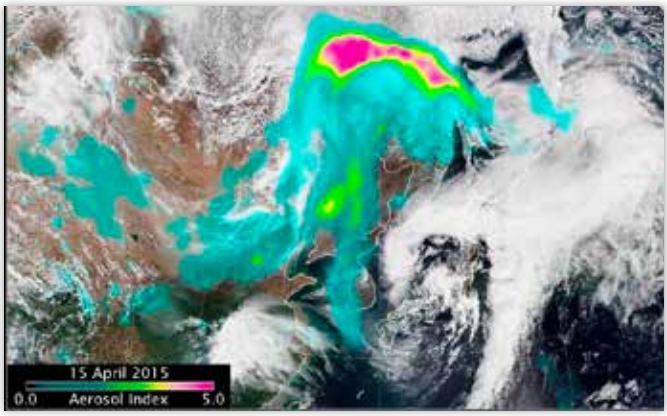
Why fires in temperate-boreal Eurasia have transboundary impacts

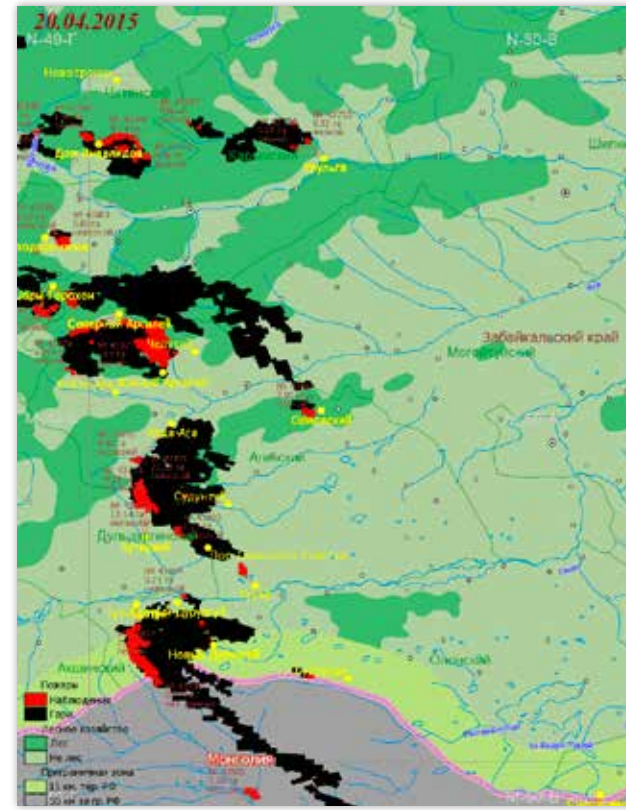
By Johann Georg Goldammer
Director, Global Fire Monitoring Center (GFMC)

of the political ice age, coincided with the advancement of satellite remote sensing capabilities. Indeed, insight from space with the increasing capacity and accuracy of satellite sensors paved the way towards a wildland fire *glasnost* in a region where the visibility and transparency of fires and fire regimes had been obscured.

In 1991, scientific dialogue and technical cooperation in fire management between the East and the West finally commenced. Two years later, the first East-West International Conference *Fire in Ecosystems of Boreal Eurasia* was held In Krasnoyarsk in Central Siberia, followed by the *Fire Research Campaign Asia North* (FIRESCAN) with its *Bor Forest Island Experiment* (1), numerous bilateral and multilateral research projects in the years after and in 1996, the first-ever international conference addressing *Forest Fire and Global Change* was held in Shushenskoe, Siberia. Thus, another landmark anniversary of 25 years of East-West cooperation in fire research management and fire research was commemorated in September 2016 at the headquarters of the Aerial Forest Fire Center *Avialesookhrana* in Pushkino (Moscow Region) and the Sukachev Institute of Forests, Russian Academy of Sciences, Krasnoyarsk (Siberia). These numerous anniversaries bear testament that the late 1980s and the early 1990s saw an awakening and the promise of a globalization of fire science and fire management towards an unprecedented era of exchange and cooperation around the world.

Visual impressions from the wildfire assessment in Eastern Mongolia in May 2015 (above and left). Extended areas of steppe ecosystems, birch, pine and larch forests were affected by the fires. Intensive grazing in and around settlements resulted in low fuel loads and slowing down the wildfire intensity and thus many villages could be successfully defended. Photos: RFMC-CAR.





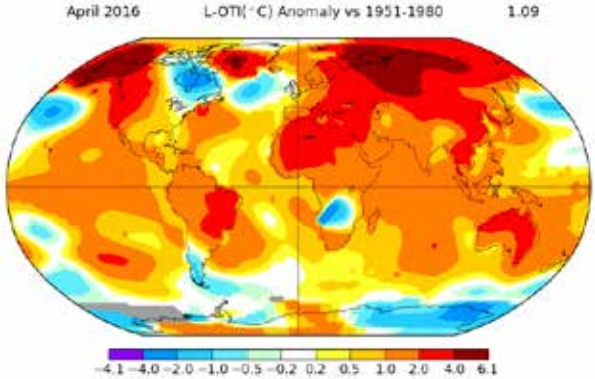
(LEFT) Smoke plumes of the wildfires in Central Asia were transported to the South (North and South Korea) and to the East (reaching the Canadian and the U.S. Pacific West Coast). Satellite observations show the Aerosol Index captured on 15 April 2016: The blue, green, yellow and orange colors show the aerosol concentrations associated with the smoke from the fires burning in Eastern Russia and Eastern Mongolia on 15 April 2015. Source: NASA. (RIGHT) Satellite tracking of wildfires crossing the border between the Russian Federation and Mongolia on 20 April 2015. Daily fire maps like this one are provided by the Sukachev Institute of Forest, Siberian Branch, Russian Academy of Sciences (SB-RAS) and its "Federal Krasnoyarsk Science Center SB-RAS."

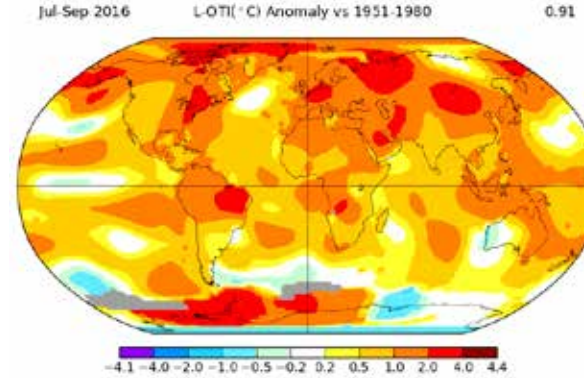
Eastern fires: Mongolia

The past year (2016) we again witnessed significant fire activity around the world. North America experienced wildfires with disastrous effects on local communities – from the devastating rampages of Fort McMurray fire in Alberta, to the tragic loss of life and dark skies over Gatlinburg, Tennessee. A comparatively small wildfire in Israel attracted an international crowd of firefighting airplanes and firefighters rushed in from all over the world. Again, after their response to the Mt. Carmel fires of 2010, Palestinian firefighters crossed the borders and assisted Israel to overcome the emergency – ignoring political and emotional boundaries and following only their mission and oath.

Urban wildfires and those burning at the fringes of urban and residential areas logically attract the attention of the media as human assets, health and lives are at risk. However, similar events in the remote regions of Central Asia did not make headlines.

For instance, in March 2015 wildfires burning in the Southeast of the Russian Federation, notably in *Zabaikal Krai*, claimed 34 lives, injured 7,500 people, destroyed over 1,400 homes and left 5,000 people homeless; by April, these fires had crossed the border into Eastern Mongolia. By the close of April, fires had scorched 5.5 million ha (13.6 million acres) of steppes, forests and pasture lands, killed several thousand livestock and burned down nomadic *gers* and injured several people over an area of more than 2000x (two thousand times) the size of the 2016 fire in Israel – or nearly as big as the entire country of Croatia (see prior pages and above, and online Gallery 1 and 2).





Climate Change Observed: Surface temperature anomalies for April 2016 and the Northern Hemispheric during Summer 2016 for Central Asia as compared to the baseline observations 1951-1980 reveal the above-average recorded temperatures and thus increased meteorological wildfire danger in the northern latitudes – and the need for enhanced preparedness. Source: NASA

The increasingly visible impacts of regional climate change have prompted the governments of Central Asia to take decisive steps to prepare for climate change including changing fire regimes, and to mitigate increasing wildfire threats. In 2015 the *Organization for Security and Cooperation in Europe* (OSCE) assisted Mongolia to set up the *Fire Management Resource Center – Central Asia Region* (RFMC-CAR).

With financial assistance from Switzerland through the OSCE and with technical support from the GFMC, the regional fire center was established at the National University of Mongolia in Ulaanbaatar with the aim to serve Mongolia and its Central Asian neighbors as an advisory and capacity-building center of excellence in fire management. The expertise of the Head of RFMC-CAR, Dr. Oyunsanaa Byambasuren, includes his responsibility as coordinator of the Regional Central Asia Wildland Fire Network and Deputy Chief of GFMC and, among other, as Secretary of the National Coordination Committee on Forest and Steppe Fire Protection (NCCFSFP), an inter-agency fire management coordination mechanism of the government of Mongolia. This is the third such Center since the establishment of two others in Southeast Europe / Caucasus in 2010 (based in Skopje, FYR Macedonia) and Eastern Europe in 2013 (Kiev, Ukraine). And in 2017, two more Regional Fire Management Resource Centers will be established in Southeast Asia (Indonesia) and Latin America (Brazil).(See below and online Gallery 3]

Eastern Fires: Russia

While the 2016 fire season gave Mongolia a break, Russia however, faced extended drought in Central Siberia and the Far East. Satellite imagery of wildfires and a satellite-derived map of aerosol emissions on 18 September 2016 North of Lake Baikal and the regional capital Irkutsk, gives an impression of the size of area affected by fire: The map of fire locations in Siberia and in the Russian Far East during the fire season of 2016 (Gallery 4) show that the territories affected by wildfires stretched from 60° to 135°E within a belt between 50° and 60°N, with main fire-affected regions around Baikal Lake and in the Amur region of the Far East. The preliminary evaluation of satellite data revealed that within Siberia about 14,000 fires burned a total vegetated area of 11.4 million ha (28 million acres), and in the Far East of Russia 4,800 fires affected 6.4 million ha (extent and boundaries of the regions – see map in Gallery 4). In both regions of Russia wildfires larger than 2000 ha affected 8.96 million ha (22 million acres) of forests.

These numbers do not distinguish the different types of fire management regimes in Russia. Since 2016 an amendment of the Federal Forest Code requires the Guidelines on Fire Management to be refined and obliges the regions of the Russian Federation to delineate in detail the different zones of fire response and fire management respectively. Depending on values at risk – economic and ecological values of forests, the socio-economic development of the areas and the natural fire danger risk – three types of fire protection zones will be distinguished:

- **Ground Fire Suppression Zones**: Forest fire suppression using ground resources is obligatory, currently covering ca. 80 million ha countrywide
- **Aerial Fire Suppression Zones**: Obligatory use of aerial firefighting resources in remote areas that cannot be reached by ground forces within 3 hours, currently covering ca. 503 million ha (fire suppression is obligatory)
- **Forest Fire Management (Controlled Regime) Zones**: Regional authorities may decide letting wildfires burn under a controlled regime, currently covering ca. 561 million ha of the country

Details of zoning in the regions are currently under deliberation. This process reflects the response of the government to reorganize and restructure fire management in Russia. In-depth discussions at the science-policy interface had been held over the last years: Two *International Fire Management Weeks* were held in Krasnoyarsk in 2012 and 2013. During these weeks, roundtables and discussion forums for fire scientists, practitioners and decision-makers fostered open discussions of state-of-the-art science, fire ecology and the implications for practical application and strategic planning.

The National Round Table of 2012 concluded that there is an urgent need to revise the policy and practice of fire management

The response: Establishment of the National Coordination Committee on Forest and Steppe Fire Protection in Mongolia, setting up the Regional Fire Management Resource Center and signing of a bilateral agreement between Mongolia and the Russian Federation on cross-boundary fire management, including regular consultations, exchange activities and exercises. Photos: RFMC-CAR.

The 2016 summary map of wildfires in Siberia and the Far East of the Russian Federation was prepared by the Federal Krasnoyarsk Science Center of the Russian Academy of Sciences. This is a pre-publication of the upcoming monograph "Monitoring of wildfires in Siberia: Dynamics of burning under the current climate, the spatial-temporal patterns, characteristics and forecasts", with the permission of the first author Evgenii Ponomarev (4). The publication contains the detailed methodology for satellite-derived data and the land cover and forest maps of Russia used.

in the Russian Federation, and agreed upon 10 recommendations – the *Krasnoyarsk 10-Point Programme on the Future of Fire Management in Russia*. Among other, it was recommended to further develop principles, capacity and apply the use of prescribed fire in Russia. In late 2013 the international congress *Forest Fire and Climate Change: Challenges for Fire Management in Natural and Cultural Landscapes of Eurasia* was held in Novosibirsk and addressed the consequences of climate change on fire regimes and fire management. The congress participants released a statement in which governments of the region were alerted and warned that the threat from wildfires in the region will become increasingly dangerous in the coming years as a consequence of climate change and socio-economic and demographic changes.

While there is a recognized need for enhancing the application of integrated fire management in Central Asia (i.e. the application of sound practices of prescribed burning and the integration of beneficial effects of natural wildfires) the vulnerability of the Eurasian landscape and their inhabitants is growing. The impact of air pollution generated by vegetation fire is one problem that is increasingly noted in many regions of the world. The severe fire and smoke episode in Western Russia in 2010, which affected the regional population through the interactions between extremely high temperatures and air pollution from the wildfires, may have contributed to the premature deaths of more than 2000 people in the Moscow region (2); globally the amount of premature deaths due to vegetation fire smoke is estimated to be in the range of 180,000 people annually (3). In September 2016, for the first time, a group of more than 3000 residents of the City of Bratsk went public and signed a petition under the headline *City of Bratsk is choking from smoke* asking President Putin and his Emergencies Minister for relief. (See above and online Gallery 4.)

The dark side of fire

The dark side of Eurasian fires is almost invisible. The fine particulate matter causing global transboundary headaches is called *Black Carbon (BC)*, also referred to as elemental carbon or soot. BC is microscopically small and primarily emitted by transport and industrial sources, but agricultural burning is emerging as a signifi-

cant yet little-understood source of anthropogenic BC emissions. Human health implications aside, BC particles have a severe environmental impact once deposited on Arctic snow and ice. Black carbon emitted from fires burning in North America and mainly from Eurasia, is transported to the Arctic environment by northerly flowing air masses. The fine particles change the albedo, i.e. the reflectance of incoming solar radiation. While the pristine white snow and ice cover reflects the incoming solar radiation back to space, a BC-darkened surface absorbs solar energy resulting in surface warming and accelerates the melting of snow and ice.

Smoke pollution episodes stemming from Eastern Europe and Russia have led to discussions of whether vegetation fire smoke may be tackled as part of the existing United Nations Economic Commission for Europe (UNECE) *Convention on Long-Range Transport of Air Pollution* (CLRTAP). Recently, this debate has emphasized BC pollution and particularly its effect on the Arctic. The Gothenburg Protocol of 1999 expanded the original 1979 CLRTAP to include numerous industrial pollutants and in 2012 this was amended to include BC as a short-lived atmospheric pollutant with significant climate forcing potential (online Gallery 5).

Apart of the impacts of gaseous and particulate emissions of vegetation fires on human health and climate, there are other collateral damages of wildfires – such as those burning on contaminated terrain, some of which are transboundary. The most dangerous fires are those burning on terrain contaminated by radioactivity and those burning on terrain contaminated by unexploded ordnance stemming from armed conflicts or military activities (online Gallery 7).

The promise of fire

Extended rural areas of temperate-boreal Eurasia are affected by land-use change and / or the abandonment of agricultural and pasture lands. This development is threatening the sustainability and survival of open cultural landscapes including habitats of open-space dependent species. Abandoned lands are undergoing rapid succession. Substitution measures, which are practiced in some places to counter succession and to maintain open space habitats, are often highly subsidized in Western European countries. Mechanical measures or targeted grazing, however, are limited by the sheer magnitude of land area to be treated and by rapidly increasing costs.

Since the 1990s, the use of prescribed fire is increasingly applied in Central and Northern Europe and is now being introduced in integrated fire management approaches for conservation purposes and wildfire hazard reduction in the temperate-boreal coniferous (pine and larch) forests. The rationale, principles and suggestions for the way ahead in the application of prescribed fire in the European biota have been expressed in the *White Paper on Use of Prescribed Fire in Land Management, Nature Conservation and Forestry in Temperate-Boreal Eurasia* and the monograph *Prescribed Burning in Russia and Neighbouring Temperate-Boreal Eurasia* (6). The *Eurasian Fire in Nature Conservation Network* is promoting the use of prescribed fire in conservation, forestry and landscape management and has organized numerous conferences, seminars and workshops addressing fire ecology and fire management throughout temperate-boreal Europe.

The very recent introduction of the use of prescribed fire in Eastern Europe and Russia is encouraging and reflected by the collection of visual impressions (see below and online Gallery 9).

What we've learned, what we need next: the search for common cross-border solutions

With this overview in "Eastern Fires" the GFMC intends to highlight – with emphasis on the Eastern part of the region – specific phenomena and problems of wildland fire in temperate-boreal Eurasia, including transnational issues, and the search for common solutions by cross-border cooperation in fire management.

In most countries of the region, financial support and human capacity for this work is unfortunately rather limited. Thus, networking, exchange and mutual assistance are imperative. These initiatives are coming from civil society – scientists and practitioners – and increasingly from governments. International organizations and frameworks such as the UN international Strategy for Disaster Reduction (UNISDR), the Organization for Security and

Cooperation in Europe (OSCE) and the Council of Europe through its Major Hazards Agreement in close cooperation with the Global Wildland Fire Network, have been essential drivers in this process.

UNISDR IWPM
International Wildfire Preparedness Mechanism

EuroFire

FOCUS on COOPERATION: In 2013 the UNECE Regional Forum on Cross-Boundary Fire Management, which was organized by the GFMC at the United Nations in Geneva, issued this key recommendation:
"The cross-boundary effects of wildfires require jurisdictions at all levels to cooperate in fire management and to define collective solutions. While prime emphasis should be given to cooperation in fire management between jurisdictions sharing common borders, the long-range consequences of fire emissions are calling for strengthening existing and, if necessary, developing additional protocols addressing the reduction of adverse consequences of wildfire at international level."

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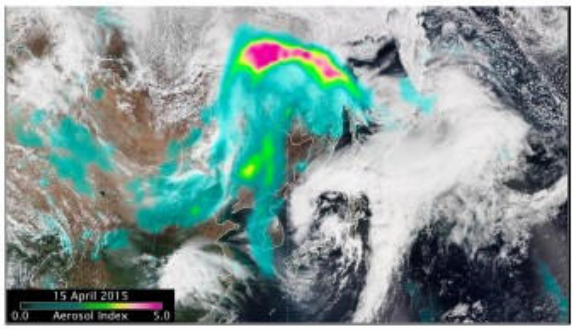
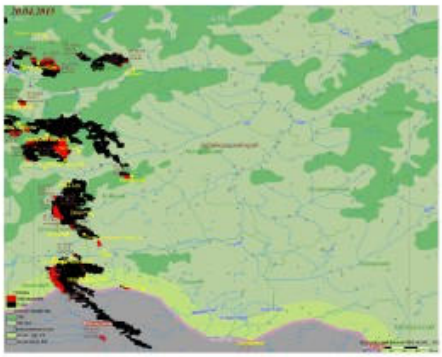
The aim of prescribed fire application in temperate-boreal Europe is to maintain biodiversity-rich open vegetation and landscapes that are home to species endangered by forest succession.
Networking and Exchange of Fire: Practitioners and targeted public relations work have proven essential in introducing prescribed fire in sustainable forest management and conservation in Mongolia, Ukraine, Russia and Poland. Examples include Pg 24, left: First prescribed burning training course for students in **Mongolia, 2015**. Pg 24, right: Training of prescribed burning practitioners and university students in **Ukraine, 2015**. Pg 25, left: First pubic demonstration to the media and practitioners of prescribed burning and underburning in **Russia, 2012**. Pg 25, right: A team of fire managers setting the first prescribed burn in **Poland, 2015**. Photos: A. Zamakhin and GFMC.

Eastern Fires, Western Smoke

*These **online galleries** expand on the article and share mores stories than could be published in the print version.* ***Text by Johann Georg Goldammer.***



Online Gallery 1. Wildfires in Central Asia 2015 with smoke plumes stretching to South Asia and across the Pacific. Smoke plumes of the wildfires in Central Asia were transported to the South (North and South Korea) and to the East (reaching the Canadian and the U.S. Pacific West Coast). Satellite observations show the Aerosol Index captured on 15 April 2016: The blue, green, yellow and orange colors show the aerosol concentrations associated with the smoke from the fires burning in Eastern Russia and Eastern Mongolia on 15 April 2015. Source: NASA.

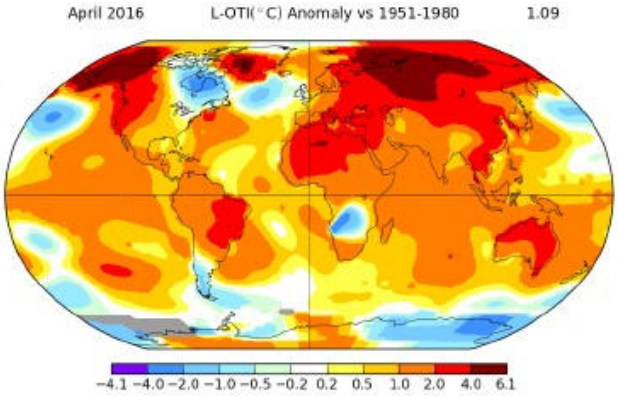


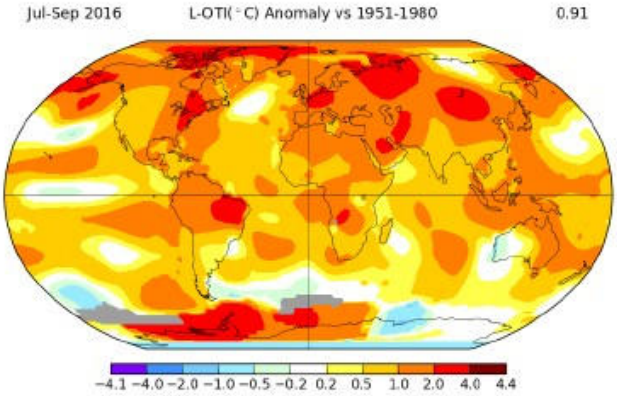
Left: Satellite tracking of wildfires crossing the border between the Russian Federation and Mongolia on 20 April 2015. Daily fire maps like this one are provided by the Sukachev Institute of Forest, Siberian Branch, Russian Academy of Sciences (SB-RAS) and its "Federal Krasnoyarsk Science Center SB-RAS." Right: On-site verification and ground verification of the wildfire impacts in Eastern Mongolia by the Fire Management Resource Center – Central Asia Region (RFMC-CAR), May 2015. Photo: RFMC-CAR.

Online Gallery 2. Wildfire assessment, Eastern Mongolia 2015. Visual impressions from the wildfire assessment in Eastern Mongolia in May 2015: Extended areas of steppe ecosystems, birch, pine and larch forests were affected by the fires. Intensive grazing in and around settlements resulted in low fuel loads and slowing down the wildfire intensity and thus many villages could be successfully defended. Photos: RFMC-CAR.

Eastern Fires, Western Smoke
Online Galleries

Online Gallery 3. Climate-change impacts on fire regimes of Central Asia and the response by governments.





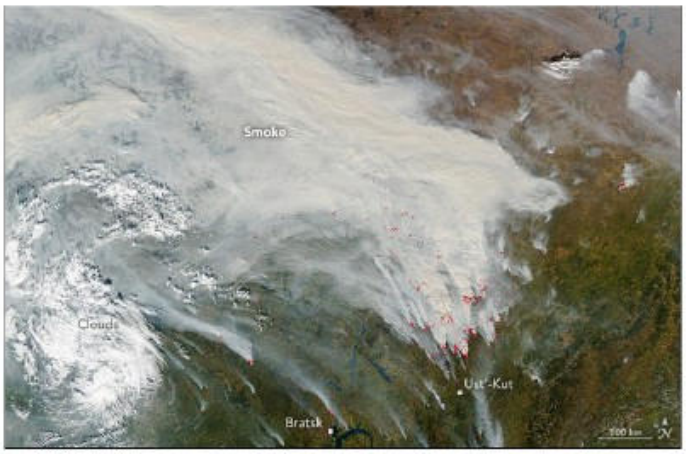
Climate Change Observed: Surface temperature anomalies for April 2016 and the Northern Hemispheric during Summer 2016 for Central Asia as compared to the baseline observations 1951-1980 reveal the above-average recorded temperatures and thus increased meteorological wildfire danger in the northern latitudes – and the need for enhanced preparedness. Source: NASA.

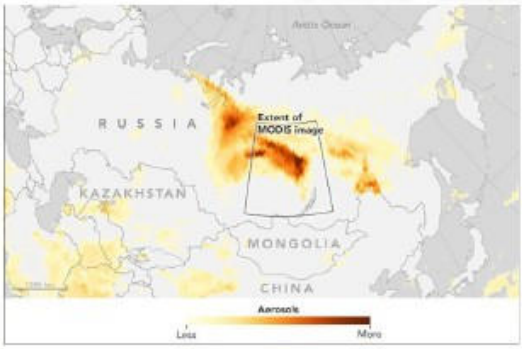
The response: Establishment of the National Coordination Committee on Forest and Steppe Fire Protection in Mongolia, setting up the Regional Fire Management Resource Center and signing of a bilateral agreement between Mongolia and the Russian Federation on cross-boundary fire management, including regular consultations, exchange activities and exercises. Photos: RFMC-CAR.

Online Gallery 4. Wildfires burning in the Russian Federation in 2016 – a year of severe drought.

Eastern Fires, Western Smoke

Online Galleries





Wildfires depicted by the MODIS sensor and a satellite-derived map of aerosol emissions on 18 September 2016 North of Lake Baikal. Source: NASA.

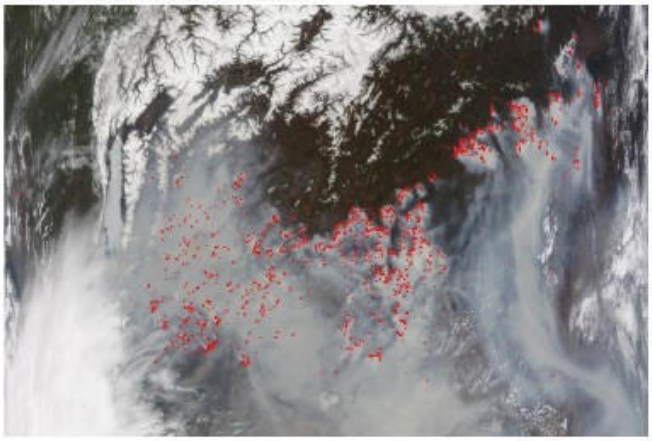
The **smokejumper team** of the Primorskiy *Avialesookhrana* Airbase (Aviabase) of Vladivostok – a regional elite airborne firefighting team of the Russian Federation under leadership of Vasiliy Medvedev (center, second row from the top) – was extremely challenged by multiple large fires in 2016. Photo: Primorskiy Air Base of *Avialesookhrana*

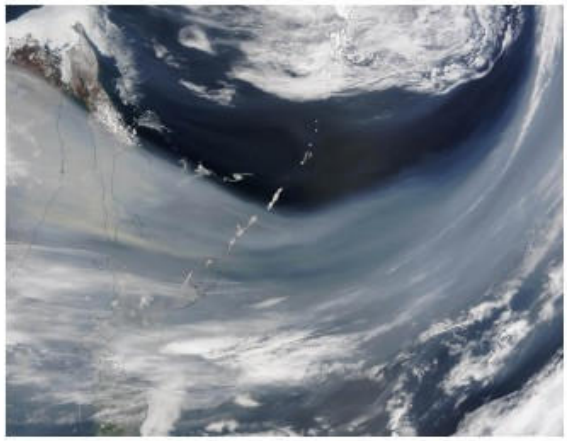
In order to **support regional aerial firefighting teams** the Federal Firefighting Reserve provided additional reinforcements. Chita, one of the regions east of Baikal Lake, was a hotspot in 2016. Photos: *Avialesookhrana*.

Online Gallery 5a: Cross-boundary pollution – the sources and the impacts. Left: Burning of agricultural residues and abandoned agricultural lands (fallow) is a common practice across Eastern Eurasia. Right: Open-land fires successively enter forest fringes resulting in gradual forest regression and decline – such as pictured here in the Irkutsk region, Russia. Photos: GFMC.

Eastern Fires, Western Smoke

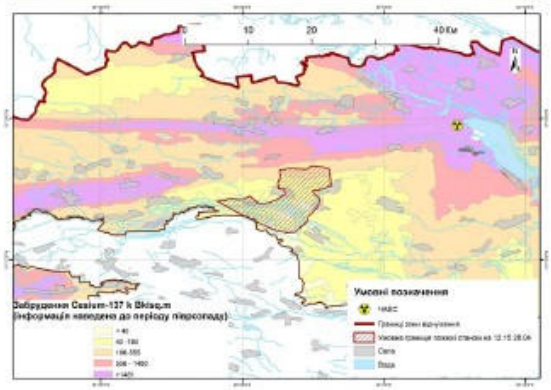
Online Galleries





Online Gallery 5b: Cross-boundary pollution – the sources and the impacts Long-range transport of atmospheric pollutions: Grassland-burning is a common practice in Central Asia, resulting in smoke plumes stretching to the East, often crossing the Far East of Russia, Sakhalin, Japan, reaching to North America and finally traveling circumpolar back to Russia via Europe. Satellite images of May 2003: NASA.

Online Gallery 6: Wildfires burning on terrain contaminated by radioactivity.



Wildfires burning in the Chernobyl Exclusion Zone pose a high risk of secondary contamination of firefighters on the ground and through long-range transport of radioactive smoke. The upper left image shows a satellite-derived map with a fire burning on 28 April 2015, West of the reactor No. 4 which failed in 1986. On the right: Burned area on a map showing the concentration of Cesium-137 contamination. The lower satellite image shows a smoke plume traveling from another fire in the same area on 10 August 2015, stretching into neighboring territories of the Ukraine and the Russian Federation. The photo on the right shows the scrape yard of abandoned helicopters and fire engines that were contaminated during the first response to the nuclear accident in 1986. Satellite Images and map: NASA and Regional Eastern European Fire Monitoring Center (Kiev, Ukraine). Photo: GFMC.

Online Gallery 7: Wildfires burning on terrain contaminated by unexploded ordnance (UXO)

Eastern Fires, Western Smoke
Online Galleries

Many cultural and natural landscapes of Eurasia are **contaminated by unexploded ordnance (UXO)** stemming from armed conflicts or military activities. In Central Europe, Southeast Europe and Eastern Europe wildfires burning on UXO contaminated terrain cover several hundred thousand ha of land in Germany and also pose a threat of uncontrolled explosions to firefighters throughout Eastern and Southeastern Europe and the South Caucasus. Armored fire suppression technology has been developed and prescribed burning on contaminated terrain have been executed by public-private partnerships in Germany (5). The pictures show a 125 mm grenade exposed (not exploded) by a low-severity surface fire in NNE Germany; the SPOT-55 fire suppression tank with 1,000 l water in action; and a BMP OT-R5 command tank converted for prescribed burning and suppression firing with a Pyroshot Green Dragon ignition sphere launcher and an ATV Drip torch. Photos: GFMC.

Online Gallery 8: Regional cooperation and policies.

The OSCE, through its Office for the Coordination of Economic and Environmental Activities and the GFMC, are **addressing wildfire disaster risk reduction** in its Participating States. As a symptom of developments in Europe, the terms necessary and unnecessary burning in the agricultural sector in temperate-boreal northern Eurasia, have entered the wildland fire terminology. The photo shows an OSCE mission in the South Caucasus, monitoring landscape fires. The development of national fire management policies and related implementation strategies is the main aim of the OSCE approach. Photo: GFMC

Eastern Fires, Western Smoke
Online Galleries

Online Gallery 9: Use of prescribed fire in conservation and forestry.
The aim of prescribed fire application in temperate-boreal Europe is to maintain biodiversity-rich open vegetation / landscapes, which are home to species endangered by forest succession. Photos: J. Prüter and GFMC.

ISSN 1022–5439

ITTO Tropical Forest UPDATE

Volume 24 Number 2 2015

A newsletter from the International Tropical Timber Organization to promote the conservation and sustainable development of tropical forests

Putting a brake on wildfire

The huge fires that burned in Borneo in the early 1980s rang alarm bells among tropical forest managers and fire experts. Moist tropical forests, once thought immune to devastating wildfire, were going up in smoke, with huge negative effects on human health and forest sustainability. Heavy rains finally extinguished the fires, and ITTO launched a programme aimed at encouraging integrated, community-based approaches to tropical forest fire management.

This edition of the *TFU* looks at the development of fire management in tropical forests since the 1980s, including through some of ITTO's fire-related initiatives. As the Global Fire Monitoring Center's Johann Goldammer notes in his article (page 3), ITTO's work in assessing the damage caused by the 1982/83 fires in East Kalimantan led to the

Inside: Integrated fire management in Benin, Brazil, Ghana, Guatemala, Indonesia and Panama; guide to carbon benefits in forestry projects

ITTO

Contents

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Design DesignOne
Printing/distribution Print Provider Aps (Denmark)

The *Tropical Forest Update* is published quarterly in English, French and Spanish by the International Tropical Timber Organization. Content does not necessarily reflect the views or policies of ITTO. Articles may be reprinted without charge provided the *TFU* and author are credited. The editor should be sent a copy of the publication.

Printed on METAPAPER SILK RECYCLING, FSC-certified (mixed-sources), 100% recycled and CO_2 compensated paper stock. Printed using vegetable-based soya inks. All METAPAPER papers are produced with an average of 74.66% of renewable energies.

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Images: A firefighter supervises a controlled burn in Guatemala as part of the country's integrated forest management approach (cover). *Photo: C. Goméz.*

Above: A forest community receives training on integrated fire management during a controlled burn in Chiquimala, Guatemala. *Photo: C. Gomez*

... Editorial continued

development of globally applicable guidelines on fire management in tropical forests and a project programme on fire management in ITTO member countries. Dr Goldammer, who played a leading role in developing the guidelines, concludes, in his article, that "ITTO projects have established models to support the building of national-to-local fire management capabilities in several ITTO member countries in Africa, Asia and Latin America".[1]

Bambang Hero Saharjo (page 6) recaps the process to develop a more sustainable approach to fire management in Indonesia after the Borneo fires, including through an ITTO project that helped trained more than 15 000 people in forest fire management. Forest fire management remains problematic in Indonesia, however, with large, polluting fires burning in Kalimantan, Riau and Sumatra in early 2015. More capacity is needed to enforce integrated fire management (IFM) approaches, especially at the decentralized government level.

Laura Steil (page 9) reports that the fire management regime in Brazil is moving from a paradigm in which fire must be prevented at all costs to one in which fire is perceived as a natural part of certain ecosystems and can and should be integrated into land-management regimes. On the other hand, fire is over-used in some ecosystems, and alternatives to fire in agricultural production are being pursued.

Achille Orphée Lokossou and Clément Kouchadé (page 12) report on a strategy for preventing or minimizing fires in state-owned plantations and the Lama Forest Reserve in Benin that involves, among other things, raising awareness in villages near the forests about the damage that uncontrolled fires can cause to forests, soils and local economies.

Carlos Goméz (page 14) reports that Guatemala is pursuing IFM based on an improved understanding of, among other things, fire ecology, socioeconomic factors that affect fire regimes, and the role of local communities as participants and decision-makers in community forest management. An ITTO project there sought to support local communities in four regions of Guatemala to develop IFM approaches.

[1] See the box on page 8 for more information on ITTO's work on fire management.

ITTO is a member of the South Korea Conference Organizing Committee and the International Liaison Committee for the organization of the 6th International Wildland Fire Conference, which will be held on 12–16 October 2015. It will convene a side-event there on 15 October to highlight the Organization's field work on IFM in the tropics.

Eyda Estrada and Matilde Barrios (page 17) describe an ITTO project that has helped improve fire management practices in pilot areas to mitigate the negative impacts of fire and to use fire to support natural resource conservation. Community buy-in to the project, and the strong participation of women and local governments, have been critical for success. Lucy Amissah and Richard Kuutah Ninnoni (page 20) continue the themes of awareness-raising and community participation in fire management in their article on the situation in Ghana.

Finally, Carmenza Robledo (page 23) describes a new guide commissioned by ITTO for measuring and making use of the carbon benefits generated in forestry projects. This article is relevant to the general theme of IFM because uncontrolled fires can release the carbon stored in forests, thereby negating the climate-change mitigation effect of sustainable forest management.

The various guides and guidelines ITTO has developed over the years have had far-reaching effects. The ITTO Guidelines on Fire Management in Tropical Forests, referred to above and published in 1997, have provided a starting point for policies and programmes to address the socioeconomic and environmental problems related to fire in tropical natural and planted forests. This has been an important contribution, although, as Bambang Hero Saharjo points out, the far greater challenge lies in implementing them. As the articles in this edition show, substantial progress has been made in such implementation, but much more is needed.

Dr Goldammer warns (on page 3) that, as of mid-2015, an El Nino event is developing that could become "the strongest such event in the modern era", with the potential to produce extreme fire weather in the tropics in the months ahead. The alarm bells may soon be ringing again, but it's clear that many countries are now better prepared to put a brake on wildfire.

ITTO's proactive approach to fire management

The Global Fire Monitoring Center finds that ITTO has been at the forefront of the international response to the increasing occurrence of wildfire in tropical forests

by Johann Georg Goldammer

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Grassroots: Local community members discuss the defence of village and agricultural assets against wildfire in Mozambique. Photo: GFMC

Since the 1980s, ITTO has supported its producer member countries in wildfire monitoring, assessments, post-fire rehabilitation measures, community involvement in integrated fire management, and policy development (notably through the ITTO Forest Guidelines on Fire Management Tropical Forests—ITTO 1997).

This article summarizes the history of ITTO's involvement in fire management in tropical forests. It presents my view as the director of the Global Fire Monitoring Center; I have been involved in fundamental fire ecology research in the tropics and in advising countries throughout the tropics in capacity building in fire management and in the development of fire management policies since the 1980s. In preparation for the 51st session of the International Tropical Timber Council (November 2015), I was requested to review fire problems and fire management solutions in countries supported by ITTO over the last quarter-century. Did the projects contribute to the achievement of ITTO's Objective 2000 and its policy work on forest fires? What lessons can be drawn to further improve ITTO's programme of work on forest fires?

Escalating fire use and wildfires in the 1980s

In 1982–1983, a severe drought affected the maritime continent of Southeast Asia, the result of an extreme El Niño-Southern Oscillation event (Box 1 outlines the threat posed by the current El Niño event). In northern and eastern Borneo, the drought started in July 1982 and lasted until April 1983, interrupted only by a short rainy period in December 1982. Monthly precipitation dropped below critical values along the coast and for up to 200 km inland. This created conditions favourable for slash-and burn and other land-clearing activities; many of the fires got out of control, however, and escaped as wildfires into highly fire-sensitive tropical forest ecosystems (note that some tropical forests are more sensitive to fire than others—Box 2). By the end of the drought, the area affected on the largest island in the region—Borneo—exceeded 5 million hectares. In East Kalimantan (an Indonesian province on Borneo), about 3.5 million hectares were affected, comprising 0.8 million hectares of primary rainforest, 1.4 million hectares of logged-over forest, 0.75 million hectares of secondary forest and 0.55 million hectares of peat-swamp biomes.

These fires were hardly noted internationally, but the size of the area burned prompted the Government of Indonesia to seek ITTO support in a damage assessment and to investigate options for the rehabilitation of drought- and fire-affected rainforests. A study titled "Investigation of

Box 1: Will a strong El Niño affect fires in the tropics in 2015?

El Niño, the warm phase of the El Niño–Southern Oscillation (ENSO), is associated with a band of warm ocean water that develops in the central and east-central equatorial Pacific (approximately between the International Date Line and 120° W). El Niño is accompanied by high air pressure in the western Pacific and low air pressure in the eastern Pacific. High air pressure over the "maritime continent", which includes the archipelagos of Indonesia, Papua New Guinea and Malaysia, and the surrounding shallow seas, results in a decrease in precipitation and extended drought and consequently in an increase in the flammability of tropical ecosystems. Teleconnections of the ENSO may also result in droughts elsewhere, including in Africa, Central America and parts of North America. In 2015, El Niño is intensifying much earlier than usual. At the time of writing (July 2015), the sea-surface temperature anomalies in the near-equatorial Pacific Ocean had climbed to 1.5 °C above average, which is the threshold for a strong El Niño if persisting for a three-month timeframe. This El Niño is expected to continue intensifying into spring 2016 because most El Niños last 9–12 months. Later this year, the 2015 El Niño may become the strongest such event in the modern era. Countries traditionally affected by an El Niño-triggered drought should be prepared for extreme fire weather in the months ahead.

For more short-to-long-term fire-weather forecasts and models, see the Global Wildland Fire Early Warning System, a portal offered by the Global Fire Monitoring Center in cooperation with the Canadian Forest Service, at www.fire.uni-freiburg.de/gwfews/index.html.

Safe preparation: A fire management team assists a local farmer to conduct a safe prescribed burn to prepare the land for a vegetable crop in Brazil's cerrado biome. Photo: Prevfogo/IBAMA

steps needed to rehabilitate the areas of East Kalimantan seriously affected by fire" included a complete inventory of the fire damage (with the results quoted above) and led to the establishment of a demonstration plot for the rehabilitation of fire-affected forests.

It soon became apparent that Indonesia's Ministry of Forestry had limited capacity to deal with the complex issues related to fire. The manifold interacting factors—such as the underlying reasons for fire use by small landholders, the impacts of the growing palm-oil industry, the consequences of the transmigration programme, and the role of climate variability—required a coordinated national approach to fire management if Indonesia was to cope with the problem in the long term. Part of the country's response was the development of the National Guidelines on the Protection of Tropical Forests Against Fire, a process that was also supported financially by ITTO and which aimed to build national capacity in fire management at all levels. The article by Bambang Hero Saharjo in this edition (p. 5) discusses the emergence of the issue of smoke pollution in Indonesia (and beyond) from the 1990s.

Indonesia and other Southeast Asian nations were not alone in having to grapple increasingly with fire problems, which accelerated throughout the tropics in the 1980s. Satellites showed, for the first time, the increased use of fire in the conversion of tropical forests to agricultural and grazing lands and in the establishment of large-scale forest, oil-palm and bioenergy plantations in the tropical rainforest zones of South America and Central America, prompting an international response.

In 1989, the Fire Ecology Research Group at Freiburg University in Germany convened the 3rd International Symposium on Fire Ecology, "Fire in the Tropical Biota", the first global conference to address fire in the tropics using an interdisciplinary and cross-sectoral approach (Goldammer 1990). The conference heard alarming reports from the tropics and received scientific contributions, and the conference resolution, the "Freiburg Declaration on Tropical Fires"[1], resulted in the formation of new coalitions, projects and programmes in interdisciplinary research and development.

1 Visit www.fire.uni-freiburg.de/latestnews/firebulletin.htm for the complete text of the Freiburg Declaration.

Box 2: The role of fire in tropical forest ecosystems

The impacts of fire and fire management options in tropical forests depend on the vulnerability, resilience and adaptation of the various types of forest ecosystem, broadly described below.

- **Natural equatorial evergreen (perhumid) tropical rainforest.** Tree species and other endemic vegetation (understorey) are highly sensitive to fire because even surface fires of low-to-moderate intensity kill the trees due to their thin bark, which does not protect the cambium from lethal temperatures. Regeneration after fire is limited due to the slow recolonization by seeds distributed by wind or animals. The endemic fauna is generally not adapted to fire. *Fire management*: complete fire exclusion.
- **Natural seasonally dry tropical forests.** In the regions adjoining equatorial evergreen rainforests, distinct rainy and dry seasons support the establishment of natural deciduous and semi-deciduous forests. These forests are highly flammable in the dry season; for millennia they have been subject to natural and—most importantly—human-caused fires. With thick protective bark, tree species in natural seasonally dry tropical forests may survive surface fires of low-to-moderate intensity occurring in the early dry season. Resprouting (coppicing) and an active seed bank allow regeneration in case of damage by high-intensity fires in the late dry season. Fire is often used by forest dwellers to favour the growth and harvest of non-timber forest products, such as fodder, fruits, honey and leaves. *Fire management*: the application of traditional early burning practices (setting fire during the early dry season) will stimulate the production of non-timber forest products and reduce the amount of combustible material ("surface fuels" such as leaves, shrubs and grass understorey) which, in the late dry season, could otherwise lead to high-intensity damaging fires.
- **Tropical industrial forest plantations.** Many species planted in industrial plantations, such as exotic *Pinus* and *Eucalyptus* species, evolved in natural fire ecosystems. The natural role of fire in the home ranges of these species should be considered in plantation establishment. *Fire management*: regular natural—and in case of industrial plantations—management-set prescribed fires will help reduce damaging wildfire in planted forests. Prescribed burning is used to reduce the thick layers of needles, leaves and other fallen woody materials and thereby also to stimulate natural regeneration.

Response since the 1990s

The 1990s saw an increased number of initiatives that addressed, among other things, fire science at the ecosystem level in the tropics; the social, economic and political dimensions of fire use and wildfires; and the implications of fire at the transboundary and even planetary scales, such as the role of vegetation fire emissions in global biogeochemical cycles, atmospheric functioning, and climate change.

The need for pragmatic action was obvious, and ITTO stepped in, initiating, soon after the Freiburg conference, the development of the ITTO Guidelines on Fire Management in Tropical Forests. ITTO entrusted the Fire Ecology Research Group at Freiburg University, which meanwhile had become a subdivision of the Max Planck Institute for

Box 3: White paper on vegetation fires and global change

Vegetation fires and global change: challenges for concerted international action, produced by the Global Fire Monitoring Center, is a white paper directed at the United Nations and international organizations. It is a global state-of-the-art analysis of the role of vegetation fires in the Earth system and is published as a collective achievement of the world's most renowned scientists and research groups working in fire science, ecology, atmospheric chemistry, remote sensing and climate-change modelling. The aim of the white paper is to support the endeavour of the United Nations and international organizations, including ITTO, and their affiliated processes and networks, to address global vegetation fires. The paper provides the rationale for coordinated international action in crossboundary fire management at a global scale. Margareta Wahlström, Undersecretary-General and Special Representative of the United Nations Secretary-General for Disaster Risk Reduction, wrote the foreword, and she will also deliver the opening speech at the 6th International Wildland Fire Conference, to be held in the Republic of Korea on 12–16 October 2015.

Goldammer, J.G. (ed.). 2013. *Vegetation fires and global change: challenges for concerted international action.* A white paper directed to the United Nations and international organizations. Kessel Publishing House, Remagen-Oberwinter, 398 p. ISBN 978-3-941300-78-1. €35. To order go to: hwww.forestrybooks.com.

Chemistry and was transiting to the Global Fire Monitoring Center, and an Indonesian partner, to develop the basic materials for the guidelines. After a broad process of development, the final draft of the guidelines (ITTO 1997) was adopted at the 18th session of the International Tropical Timber Council.

With the guidelines in hand, ITTO encouraged countries to look at fire cross-sectorally and at a landscape level, funding ten projects on fire management in the period 1987–1999.[2] Ghana is one country that took action. In 1983 and 1987, West Africa was affected by extreme drought, and out-of-control land-use fires caused considerable damage to most forest reserves in Ghana and made affected forests more prone to subsequent fires. The article on page 20 of this edition describes two ITTO projects that helped Ghana develop a structured and efficient fire management system involving all relevant stakeholders.

ITTO was also requested to support capacity building at the community level in Latin America as a key approach to addressing fire on the ground and at the grassroots. Countries in the region (e.g. Brazil, Guatemala and Panama—see articles in this edition) recognized the importance of partnerships involving civil society and government agencies in fire management.

2 ITTO has funded another nine projects on fire management since 1999 (and another 11 with fire-related components).

Box 4: The International Wildfire Preparedness Mechanism

The International Wildfire Preparedness Mechanism (IWPM) was developed as a follow-up to the UNECE/FAO Regional Forum on Crossboundary Fire Management, which was convened in Geneva, Switzerland, in November 2013. The IWPM, currently hosted by the Global Fire Monitoring Center, is a non-financial instrument serving as a broker and facilitator between national and international agencies, programmes and projects to exchange expertise and build capacities in wildland fire management and particularly in enhancing preparedness for large wildfire emergencies. The IWPM has been developed in tandem with the International Fire Aviation Guidelines and the International Manual of Common Rules for Fire Aviation. National agencies responsible for the management of vegetation fires as well as projects seeking or offering expertise are encouraged to visit the IWPM website at www.fire.uni-freiburg.de/iwpm/index.htm.

Conclusion

ITTO projects have established models to support the building of national-to-local fire management capabilities in several ITTO member countries in Africa, Asia and Latin America. National and international fire management guidelines have helped in developing concepts, policies and implementation strategies in fire management. The development of national fire management policies, associated with legal frameworks and implementation strategies, is now at the top of the agendas of many countries.

The exchange of experiences between neighbouring countries in "regional wildland fire networks" is receiving increasing attention. Among other things, these networks aim to increase capacity in both the public and private sectors by sharing expertise in fire management and the development of fire management policies. Three regional fire management resource centres—for Southeast Europe/Caucasus, Eastern Europe and Central Asia—have been established to facilitate the exchanges, and the utility of such models for tropical Latin America, Africa and Asia should be considered.

In the future, ITTO should continue building fire management capacities at the national-to-local level by supporting crossboundary and regional cooperation in fire management (Box 3). Bilateral and multilateral crossboundary cooperation in response to wildfire emergencies could also be enhanced through the International Wildfire Preparedness Mechanism, which constitutes an additional toolbox for creating efficient and safe interoperability in managing wildfire crises (Box 4).

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Indonesia's efforts to improve forest fire management

After 25 years of effort, many of the big challenges in reducing forest fire remain

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Health hazard: Smoke-haze pollution caused by land-use preparation, city of Palembang, South Sumatra, October 2014. Photo: Saharjo

The wildfires that affected Indonesia in 1982/1983 burned 3.7 million hectares, mostly in East Kalimantan Province (Lennertz and Panzer 1984). In their wake, the government attempted to find a way of preventing a repetition of the disaster, but without success,with fires affecting 66 000 hectares of forests in 1987, more than 500 000 hectares in 1991, and 5.11 million hectares in 25 provinces, including Maluku and Sulawesi, in 1994 (Goldammer 2001, 2006).

In 1995, President Soeharto launched a policy called "Land Preparation Without Fire" ("Pembukaan Lahan Tanpa Bakar") in an effort to reduce the use of fire; under the policy, fire could no longer be used in preparing lands belonging to communities and corporations. It was hoped that this policy would eliminate the use of fire in land management and the initiation of wildfires, but it was not complemented by field or technical guidelines or by the provision of assistance to communities and corporations. Fire use increased, with subsequent wildfires.

The ITTO guidelines

As a follow-up to ITTO-sponsored activities in the rehabilitation of forests destroyed by fires in East Kalimantan, Indonesia, the International Tropical Timber Council embarked on the development of guidelines for the protection of tropical forests against fire. Pursuant to a decision of the Council, an expert panel comprising specialists from producer and consumer members was convened in Jakarta in 1995. Draft guidelines were formulated based on a background paper prepared by Dr Goldammer (Germany) and Professor Manan (Indonesia) and subsequently presented and published at the 18th session of the Council (ITTO 1997). The ITTO Guidelines on Fire Management in Tropical Forests were intended to assist the management, conservation and sustainable development of tropical forests, and their publication was an important step in helping forest managers and national planners to overcome the problems they face in managing fire in tropical forests. Nevertheless, the greater challenge lies in incorporating the guidelines into national action plans and especially in implementing them.

Forest and land fires, 1997/1998

In the same year as the publication of the ITTO Guidelines (1997), Southeast Asia was severely affected by an El Niño–Southern Oscillation (ENSO) event. Satellite imagery showed that the first significant fires started in May 1997, reached a peak in September and declined to December; nevertheless, they continued until May 1998, especially in the Indonesian provinces of East Kalimantan, Aceh, Riau and Maluku, when they were extinguished by heavy rains. Fires started again in October 1998 in both Sumatra and Kalimantan, with negative impacts on neighbouring

Devastation: Burnt logs in a land preparation area, oil-palm plantation, Aceh. Photo: Saharjo

countries from the smoke generated by the fires. The cause of the 1997 wildfires was mostly land preparation, in which fire was used to convert native vegetation to forest plantations and estate crops; 65–80% of the forest area burned in East Kalimantan was in forest concessions and estate crops (WWF 1997). The Ministry of Forestry published a list of 176 companies that used fire to prepare their land for forest and estate crops, although none was punished.

ITTO support for building forest-fire management capacities in Indonesia

In 1993, ITTO and the Government of Indonesia negotiated a multi-phased project titled "Integrated forest fire management in Indonesia—Phase I: national guidelines on the protection of tropical forests against fire" [PD 12/93 Rev.3 (F)]. The national guidelines were developed in parallel with ITTO's globally applicable guidelines and completed in March 1999 (Goldammer 1998; Jaya 1998). Indonesia's National Guidelines on the Protection of Forest against Fire addressed the following topics

- National policy and regulations
- Forest-fire prevention strategy
- Mapping and evaluation
- Research and development
- Framework, organization and capacity building
- Social and economic performance
- Forest resources and utilization
- Training and community education.

When the guidelines were finalized, forest fire management trainers were provided with training with the aim of enabling them to teach others how to implement the guidelines (Saharjo and Goldammer 2011). The training was also intended to increase the capacity of local personnel in mitigating bush, estate and forest fires and in preventing fire incidents; provide local personnel with skills in the use of firefighting equipment; strengthen coordination in forest fire management involving forestry and non-forestry institutions at the local and provincial levels; and disseminate national guidelines and other government rules and regulations.

The curriculum for the basic training consisted of:

- Law, regulation and policy on forest fire management
- Basic knowledge fundamentals of forest fire behaviour and ecology
- Forest fire management
- Fuel management
- Fire detection
- Fire control equipment
- Fire control technique and strategy
- Mopping up.

By 1998, the total workforce trained in forest fire management was 15 825 persons—not nearly enough to protect the country's forests, for which it was estimated that a further 40 600 skilled persons were needed.

The guidelines have been important in providing a clearer understanding of how to manage fire, but because of the many obstacles to their implementation in the vast reaches of a country still in a social, economic and political transition, the guidelines have had little impact on the ground (Saharjo and Goldammer 2011). This is partly a consequence of the first era of decentralization, which started in 2000 and provided the head of districts—the *Bupati*—with greater powers, including on law enforcement at the local level.

The Government of Indonesia, through the Ministry of Forestry, adopted the ITTO guidelines, but field implementation was weak, and the use of fire continued to be used for converting native vegetation to other land uses. Of particular concern were conversion burnings of peat-swamp forests in Kalimantan and Sumatra, which significantly contributed to biodiversity loss and carbon emissions and to severe regional smoke pollution, which, in turn, affected human health and security. The burning of peat-swamp forest is a problem that has still not been solved (Heil and Goldammer 2001; Page et al. 2013).

Looking back to the mid-1990s, the science community was well prepared to develop interdisciplinary approaches for analyzing the complex interactions between land use, fire and ecosystem processes (Goldammer 2006) and for investigating the role of emissions on regional and global biogeochemical cycles and short-to-long-term fire-related social issues. The political environment was not enabling for such research, however (Goldammer 2006); the door opened by the Government of Indonesia in 1991–92 when it invited the international donor community to assist the country in "fighting the fires", especially aimed at reducing the regional smoke haze, soon closed again. Even though a number of internationally supported projects were initiated and implemented in the mid-1990s, the Government of Indonesia had limited interest in addressing such issues.

Indonesia's commitment

The ASEAN Agreement on Transboundary Haze Pollution, a regional legally binding agreement aimed at reducing the occurrence and impacts of fire in the ASEAN member countries, was signed in 2002 and had been ratified by all ASEAN countries by 2014.

In 2010, the President of Indonesia declared the aim of reducing national greenhouse-gas emissions by 26% by 2020 through its own resources and by 41% if supported by foreign countries, with a reduction in vegetation fires one of the most important measures for reaching this ambitious goal.

Nevertheless, fires continue to burn. In 2014, an audit compliance team, lead by the author of this article, working with the Ministry of Environment and the Ministry of Forestry under the Presidential Task Force for Supervision

and Management of Development (UKP4), found that none of the 15 corporations operating in forest, forest-plantation and oil-palm concessions in Riau Province were observing the agreed rules of no-fire applications, as stated in signed government-granted licences. Fires returned again this year, blanketing Pelalawan city in January 2015 and spreading to various districts in Riau, reaching a peak in March 2015. Fires started again in June 2015 in Sumatra and Kalimantan, fuelled by precursor climatic conditions to the 2015 El Niño event.

With the ratification of the ASEAN Agreement on Transboundary Haze Pollution by Indonesia in 2014, the country enters a new phase of commitments. The efficient reduction of the use of fire in land use and land-use change will be a challenge. The fire science and management community of Indonesia is ready to contribute to the implementation of the agreement, drawing on almost two decades of cooperative efforts to develop a culture of fire prevention and preparedness and the international and national guidelines developed in partnership with ITTO.

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ITTO's work on forest fire

ITTO recognizes that fire is a serious threat to the forests of many tropical countries. One of its earliest responses was the publication, in 1997, of the ITTO Guidelines on Fire Management in Tropical Forests, which provide policymakers and practitioners with guidance on the development and implementation of forest fire management programmes. Around the same time, ITTO began funding projects aimed at improving fire management in various member countries; to date it has funded 30 projects across the tropics in which fire management is either the focus or a significant component. The ITTO Yokohama Action Plan 2002–2006 requested ITTO to "contribute appropriately to national and international efforts in the area of prevention and management of fire in relation to tropical timber-producing forests". Recent ITTO biennial work programmes (2013–2014 and 2015–2015) have also supported work on forest fire.

In 2002 the International Tropical Timber Council decided to make the services of forest fire experts available to producer member countries experiencing forest fire problems, with the aim of assisting them to evaluate the country's forest fire prevention and management situation, identify strategies and actions and develop project proposals. Colombia, Guyana, Honduras, Nepal, Peru, the Philippines and Togo have all taken advantage of this facility.

ITTO is a member of the South Korea Conference Organizing Committee and the International Liaison Committee for the organization of the 6th International Wildland Fire Conference on 12–16 October 2015, at which ITTO will host a side-event on its field work on integrated fire management in the tropics. ITTO is also a member of the United Nations International Strategy for Disaster Reduction Global Wildland Advisory Group, the Global Wildland Fire Network and the Global Fire Monitoring Center. It has financed the participation of members of the regional networks in the tropics of Africa, America and Asia in a range of relevant meetings.

John Leigh, ITTO Projects Manager

Brazil's evolving approach to fire

Fire management is shifting from a "zero fire" policy towards integrated fire management

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Hazard reduction: Locals conduct a prescribed burn on indigenous lands at Xerente, Tocantins, Brazil. Photo: Prevfogo

Brazil has a land area of 8.51 million square kilometres, making it the largest country in South America and the fifth-largest worldwide. It is home to an extraordinary diversity of ecosystems, climate and topography, including the largest share of the Amazon (the world's largest contiguous rainforest) and other important ecosystems, such as the semiarid zone on the northeast coast ("caatinga"); the mountains, hills and rolling plains of the southwest; the midwestern savannas ("cerrado"); the world's largest wetland, the Pantanal; and coastal lowlands (Figure 1). More than 60% of Brazil's territory is forested, but deforestation, wildfires and systematic burning are important issues that must be tackled with national strategies.

Fire is an important source of greenhouse-gas (GHG) emissions in Brazil. According to the most recent official estimates (MCTI 2013), 55% of the country's GHG emissions between 2005 and 2010 were caused by land-use change, deforestation and agriculture. Fire is used as a tool in the conversion of native vegetation to agricultural lands and pastures, and also in slash-and-burn agriculture, the disposal of agricultural residues, and the maintenance of grazing lands for livestock. The Brazilian government has made an international commitment to reduce the country's GHG emissions by 40% by 2020; achieving this target will involve, among other things, major improvements in fire management.

Figure 1: Brazil's biomes

Brazil's environmental legislation provides a good legal framework for the protection of natural resources, pollution control and the recovery of areas degraded by human activities. The framework is based on the Brazilian Constitution of 1988, which states that everyone is entitled to an ecologically balanced environment, which is a public good for the people's use and is essential for a healthy life. Both government and society have a duty to defend and preserve the environment for present and future generations. Although Brazilian legislators have enacted laws and proposed strategies for fire management aimed at reducing wildfire damage, in practice these legal instruments are not being implemented effectively.

The large-scale land-use fires and wildfires that affected about 80% of the territory of Roraima state in 1998 attracted wide national and international attention and significant firefighting resources. The emergency response to those fires continued to influence fire management in Brazil, long after the emergency had passed. Fire prevention and suppression were at the core of the strategic approach, and little or no action was taken to address the root causes of wildfires.

The need for an integrated approach

An analysis of recorded wildfire causes in Brazil between 2005 and 2008 (Prevfogo 2009) showed that about one-third of wildfires were started by the use of fire in agriculture; about one-third were started by arson; about 6% were due to natural causes (lightning); and about one-quarter were due to other, often unknown causes. Wildfires

Looking for clues: Participants in a Prevfogo training course learn how to investigate the causes and origins of wildfires. Photo: Prevfogo

are rarely restricted to a single sector, such as forestry or agriculture, or to a single landowner; they burn landscapes indiscriminately. Fire management, therefore, requires an integrated approach between government agencies, the private sector and civil society. Fire—both wildfire, and its use as a land-management tool—is an issue that affects everyone, potentially with global impacts, such as by contributing to climate change.

The need for an integrated approach to fire management and to tackle the root causes of wildfire and fire mismanagement is increasingly recognized in Brazil. The rest of this article describes some of the ways in which the National Center for the Prevention and Combat of Forest Fires (Prevfogo) is assisting a shift towards integrated fire management (IFM).

Prevfogo's role

Prevfogo is a federal institution charged with addressing wildfires. Its strategies for reducing wildfires take into account the recommendations of the ITTO Guidelines on Fire Management in Tropical Forests (ITTO 1997) and involve, among other things, fostering interinstitutional cooperation; the implementation of fire-use regulations; the dissemination of sustainable alternatives to the use of fire in rural land management; remote sensing monitoring; fire management; and environmental education and training.

Prevfogo acts in areas under federal jurisdiction where there is native vegetation and a high risk of fire occurrence; its particular focus is on indigenous lands, federal agrarian reform settlements, and Quilombola territories (Table 1), under the Programme of Federal Brigades for the Prevention and Combat of Wildfires. Brazil also has 75.5 million hectares of protected areas in national conservation units; these units are managed by the Chico Mendes Institute for Biodiversity Conservation (ICMBio), which is also in charge of wildfire management in these areas. If required, Prevfogo can support ICMBio and state governments in their fire management programmes.

Training and environmental education

With the aim of building capacity among environmental technicians, fire brigades, farmers and the public, Prevfogo offers courses on: the prevention and combat of wildfires; controlled burning; alternatives to fire use in rural areas; the investigation of the causes and origins of wildfires; participatory methodologies; and environmental education. Prevfogo's environmental education programme examines the issue of wildfires and land-use burning in the context of climate change and addresses causes, consequences and solutions. It involves short courses, lectures, and programmes in schools and rural communities.

The training and environmental education programmes have begun a process of social change away from the previous "zero fire" policy in all situations. Given the fire ecology of savanna ecosystems such as the cerrado, which evolved under the long-term influence of natural and cultural fire regimes, a zero-fire policy is not only unrealistic, it is undesirable. Since 2005, increasing attention has been paid to the underlying causes of land-use fires and wildfires and the role of fire in ecosystem dynamics. Accordingly, more attention is also being paid to building the capacity of local communities, farmers, other landowners, and state institutions in the safe and ecologically sound application of fire, and to reducing unnecessary or detrimental burnings. Brazil is also engaged in an ongoing dialogue with other countries, ensuring the exchange of knowledge and experiences and the continued adaptation of strategic approaches.

Alternatives to fire in agriculture

A distinction is made in Brazil between "controlled" and "prescribed" burning. Controlled burning relates to the use of fire for economic/agricultural purposes, and prescribed burning relates to the role of fire in ecosystem dynamics.

Federal Decree 2.661/98 allows controlled burning in the management of rural properties. It cannot be denied, however, that controlled burning involves negative externalities, such as the gradual impoverishment of

Table 1: Prevfogo's priority areas

Area	No.	Area (ha)	No. of brigades	Priority areas (ha)
Indigenous lands	698	113 599 277	34	17 428 594
Agrarian reform settlements	9 156	88 102 902	27	3 067 398
Quilombola territories	154	1 007 827	01	237 000

Note: Quilombolas are groups who developed resistance practices in the maintenance and reproduction of their characteristic ways of life in a determined place. The origin of such groups is related to the process of resistance to slavery, which for 300 years subjugated blacks brought from Africa to Brazil (Associação Brasileira de Antropologia 1994).

Top class: Children at a rural school participate in a Prevfogo environmental programme featuring "Labareda", Prevfogo´s mascot. Photo: Prevfogo

soils as a result of high temperatures and frequent fire use; increases in water consumption for household cleaning due to the soot produced by such burning (this happens commonly with sugarcane plantations, especially when they are located near the cities); decreasing rural production (due to soil impoverishment); and health problems among farmers. Moreover, the over-use of controlled burning has the potential to decrease water quality and water supply due to an increase in the concentration of certain substances in the water, increasing the need for water treatment. In the absence of such treatment or alternative water sources, water supplies are vulnerable to disruption (Smith at al. 2011).

Many sustainable, low-cost agricultural techniques are available that can substitute for the role played by fire in agricultural production, but many farmers lack access to this knowledge. A pilot project called "Amazon without fire" was conducted in 2000–2010 as a bilateral initiative of Italian Cooperation for Development and the Brazilian government. The project promoted the substitution of fire in rural areas with low-cost, sustainable techniques designed to also improve the quality of life of farming families. The results were so successful that the project has been exported to Bolivia under a trilateral agreement between Bolivia, Brazil and Italy, and a similar trilateral agreement is also under way in Ecuador. Prevfogo is implementing the approach in other projects and programmes aimed at decreasing the illegal and uncontrolled use of fire as a management tool.

The ecological role of fire

Moving more slowly, but also as part of a gradual paradigm shift, the zero-fire philosophy is being replaced by the idea that fire plays an ecological role in some ecosystems and can be useful in minimizing the damage caused by wildfire. Pilot prescribed-burning projects are now starting to happen.

A bilateral project between the Brazilian and German governments, called Prevention, Control and Monitoring of Fires in the Cerrado (the "Cerrado-Jalapão" project), promoted IFM as a means of conserving the cerrado biome as a biodiversity hotspot and a globally significant carbon sink. The project was carried out on the indigenous lands of Xerente in Tocantínia, Tocantins state. A participatory approach was used to study indigenous traditional knowledge on fire use and to develop a prescribed-burning plan. The aim was to meet local land management objectives, promote flowering and fruiting, reduce fuel loads, establish vegetation mosaics, and minimize the incidence of high-intensity forest fires in the late dry season.

Brazil's forest code

The new federal forest code, which came into force in 2012, reflects this change in approach from an unrealistic zero-fire policy to an IFM strategy—in accordance with Principle 4 of the ITTO Guidelines on Fire Management in Tropical Forests—that promotes the safe and environmentally sound use of fire in land and ecosystem management. The implementation of the new forest code, combined with increased knowledge, understanding and experience in IFM, has the potential to produce positive ecological effects while also allowing the redirection of institutional action and resources. Thus, Prevfogo plans to build a national empirical and science-based strategy that enables agencies to better use existing information on fire management and to create national expertise in IFM.

Prevfogo believes that IFM is the best strategy for dealing with the current and future challenges posed by wildfires. With its implementation, we expect great improvements in the effectiveness of fire agencies and in political and institutional approaches that integrate social, economic and ecological needs across administrative boundaries and landscapes.

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Awareness and vigilance reduce forest fire in Benin

A community-awareness campaign and other measures have reduced the area burned in Benin's state-owned forest plantations

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A burning issue: Villagers watch a prescribed burn carried out as part of community awareness-raising and training near the Lama Forest reserve. Photo: DGFRN, Benin

Setting fire to vegetation is a widespread sociocultural practice in Benin; local people use fire to clear fields, in hunting, and for other purposes. Most of Benin's territory is in an agro-ecological zone that is vulnerable to fire. Fires in the dry season (December to March), especially late in the season, are a major cause of forest degradation.

Benin's National Timber Department (Office National du Bois—ONAB) invests considerable human, financial and material resources in managing fire in its 22 917 hectares of state-owned planted forest, as well as in the Lama Forest Reserve, a natural-forest protected area located in the heart of the plantation estate. ONAB is implementing a strategy based on the ITTO Guidelines on Fire Management in Tropical Forests aimed at preventing and managing fires in the state forests with the involvement of communities.

Strategic approach to fire management

The strategy for managing fire in the plantations and the Lama Forest Reserve involves fire prevention based on surveillance with a view to promptly identifying fire outbreaks and their rapid extinguishment. The strategy is based on the following pillars:

- Awareness-raising in villages in the vicinity of forest areas on the damage that uncontrolled fires can cause to forests, biodiversity, vegetation cover and soil conservation and to local economies. Awareness is raised through local radio broadcasts and exchange meetings with target groups—as recommended in principles 16 and 29 of the ITTO Guidelines on Fire Management in Tropical Forests.
- **Setting fires at the beginning of the dry season.** The Ministry in Charge of Forests undertakes early-fire-setting campaigns each year in which fires are set early in the dry season when the vegetation is not completely dry. These early fires decrease the fuel biomass in vulnerable areas, thus reducing the damage that would be caused if fires were set later in the season, when the fuel is dry.
- **Establishing firebreaks along the perimeter of plantations.**
- **Building human capacity through the recruitment and training of fire rangers,** another action recommended in the ITTO Guidelines on Fire Management in Tropical Forests (Principle 8).
- **Establishing an early-warning and fast-response system**, as suggested in Principle 5 in the ITTO guidelines. The system includes the operation of three 25-m-high watch towers at strategic locations. Each watch tower is equipped with a detection and locational system consisting of binoculars, a forest map and a compass. Two rangers staff each watch tower. When a column of smoke indicating a fire outbreak is spotted, the rangers geo-reference the fire and alert fire brigades by mobile phone. This system operates in the core area of the Lama Forest Reserve.

Table 1: Summary of fire management strategy outcome in ONAB's state plantations

Dry season	Managed forest area (ha)	Forest area burned (ha)	Percentage of total forest area burned (%)	Number of fire rangers employed	Average cost of fire management by ONAB (person-day equivalent)*
2011–12	19 668	2937	14.93	145	17 097
2012–13	20 680	1809	6.78	191	23 302
2013–14	22 917	809	3.53	226	28 980

*1 person-day = 1.260 CFA (≈ US$2.52).

Outcome of fire management strategy

The implementation of the fire management strategy in the three dry seasons from 2011 to 2014 resulted in:

- a considerable reduction in the total area of natural and planted forest burned (Figure 1); and
- a reduction in the percentage of forest area burned (Figure 2).

Over the same period, the total area of planted forest increased as a result of reforestation activities. Table 1 summarizes the outcome of the fire management strategy.

The fire management strategy helps increase revenue for local communities by providing temporary jobs, with the number of fire rangers hired over three fire seasons varying between 145 and 226. On average, one fire ranger is employed per 115 hectares.

Future prospects for fire management

ONAB is developing an ITTO project proposal (PD 776/15 (F)) aimed at reinforcing its vegetation fire prevention and control system for the sustainable management of ONAB's plantations. Three outcomes are envisaged: 1) community authorities and target groups in local communities are involved in fire management; 2) an integrated fire management plan is developed; and 3) the technical and organizational capacity of grassroots stakeholders is increased.

Figure 1: Change in the area of forest burned, 2011–12 to 2013–14

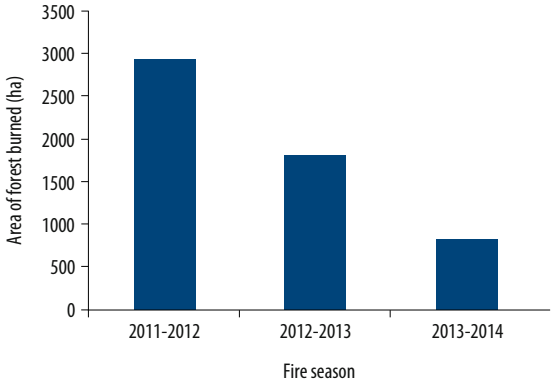
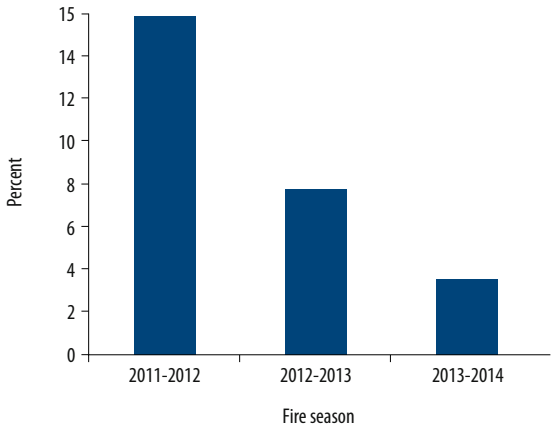


Figure 2: Percentage of total estate burned, 2011–12 to 2013–14



Engaging rural communities in fire management

An ITTO project has helped shift forest fire management in Guatemala from a top-down control model towards community-based integrated fire management

by Carlos Roberto Gómez Quiroa

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Fire management training: Community members of the San Jeronimo National Farm, and CONRED staff, are briefed on the black-line fire prevention method during a training workshop on integrated fire management. Photo: C. Gomez

Guatemala is a highly biodiverse country: it has ten physiographic regions, 14 life zones, 66 ecosystems and 4 million hectares of forest, with ecosystems that are variously adapted and sensitive to fires. Wildfire patterns have been changing in Guatemala as a result of social, cultural, demographic and economic changes and inadequate government policies. In particular, fire has become too frequent in fire-dependent ecosystems, and it has started to occur in fire-sensitive forest ecosystems where previously fire was exceedingly rare. To a lesser extent, fire has also been totally eliminated from some fire-dependent ecosystems, affecting the natural regeneration of trees and other plant species. The exclusion of fire from fire-dependent ecosystems has also led to the formation of deep layers of organic matter, which can become dangerous sources of fuel when favourable wildlife conditions are present.

Climate-change projections for Guatemala indicate higher temperatures, drier seasons and changes to the altitudinal thresholds of ecosystems.[1] Such changes could increase the risk of high-intensity forest fires, with direct impacts on the livelihoods of rural people and indirect impacts on forest environmental services that benefit urban areas.

Today, there is a sound knowledge base on the role of fire in different ecosystems. Fire-dependent ecosystems have evolved a relationship with fire in which species have developed adaption strategies to survive, recover from and respond positively to fire. Fire-dependent ecosystems in Guatemala include pine forests, mixed pine–cypress forests, savannas and natural grasslands, among others. In fire-sensitive ecosystems, most plants and animals lack the attributes required to respond positively to fire or to recover rapidly after fire events. Such ecosystems are generally found in areas of high humidity and rainfall, where fire is naturally inhibited. Nevertheless, some ecosystems that previously had difficulty in supporting fires (e.g. lowland moist tropical broadleaved forests, cloud forests and moist montane broadleaved forests) have been altered—mainly by human activities—to the point where they are now subject to frequent fire, resulting in further ecological change.

Integrated fire management

It is becoming increasingly evident that, for effective forest fire management, there is a need to move beyond the traditional strategy of fire control, firefighting and fire extinguishment towards integrated approaches that take a more holistic view of the role of fire. In Guatemala, integrated fire management (IFM) is based on an improved understanding of: ecosystem responses to fire (fire ecology); the socioeconomic factors that affect fire regimes; the potential role of fire as an ecosystem management tool according to technical, ecological and social requirements; the role of local communities as participants and decision-makers in community forest management and conservation; and the link between changes to the historical fire regime and the deterioration of local community livelihoods and local socioeconomic development. The IFM approach requires the full participation of local communities, with relevant institutions helping such communities to build capacity in managing and conserving their forest resources.

Overview of the project

ITTO project PD 590/10 Rev.1 (F): "Integrated fire management in rural communities of Guatemala: establishment of pilot sites for the implementation of sustainable integrated fire management practices" was financed by ITTO with support from the National Forest Institute (*Instituto Nacional de Bosques*—INAB), the

[1] That is, the altitudinal geographic locations of ecosystems will shift.

National Council for Protected Areas (*Consejo Nacional de Áreas Protegidas*—CONAP) and the National Coordinating Agency for Disaster Reduction (*Coordinadora Nacional para la Reducción de Desastres*—CONRED). The Better Living Association (*Asociación Vivamos Mejor*) implemented the project, with the participation of local civil-society organizations, community representatives and local technical staff in the aforementioned institutions.

The project sought to introduce IFM approaches and support local stakeholders involved in fire management at pilot sites in four regions with fire-dependent pine–cypress and pine forest ecosystems: the La Enea Regional Municipal Park in the municipality of Poptun, department of Peten, in northern Guatemala; the El Pinalon forests in the department of Chiquimula in the east; the San Jeronimo National Farm in the department of Baja Verapaz in central Guatemala; and the forests of the Quiscab river sub-basin in the departments of Solola and Totonicapan, to the west.

Training for institutions

The project made interventions at two levels. At one level, the project provided training on IFM and practices such as prescribed and controlled burning to governmental and non-governmental institutions at the national scale and to the personnel of those institutions in the project regions. The aim of the training was to help mainstream IFM practices into the policies and work schedules of the institutions responsible for forest management in Guatemala and to promote the involvement of their technical staff in project activities.

Developing capacity in communities

The second level of intervention focused on transferring capacities to rural communities in the four project regions by establishing IFM field schools. Training courses were held in community halls, schools, the backyards of houses of community members and in the forest; they provided real local examples, used flip-charts to provide illustrations, and employed participatory techniques and field trips for ecological interpretation. Community awareness and skills were strengthened on the following aspects:

- the role of local community organization in the management of forest ecosystems;
- the ecological roles of fire in local forest ecosystems;
- the causal links between the dynamics of fire-affected forests and the deterioration of local livelihoods and reduced potential for socioeconomic development;
- the possible impacts of climate change on forest fire;
- trends in the traditional use of fire by rural communities;
- participatory and inclusive planning strategies for IFM in community/municipal forests;
- the implementation of sustainable fire management practices, such as firebreaks and prescribed and controlled burns to reduce fuel loads and promote the natural regeneration of forest and ecologically important plant species (i.e. through ecological succession); and
- the monitoring and evaluation of local activities and the impacts of IFM.

Community experience-sharing sessions were held in the project regions with the aim of strengthening the capacity of community leaders. In these sessions, participants from the various regions were able to exchange information on, for example, the problems they encountered in fire management, the limiting factors they faced, and the local strategies they had developed. Participants observed IFM outcomes in different environments and under different conditions, the types of local organizational and regulatory procedures employed, the importance and success of women's participation, and other project impacts.

Throughout the process, the project sought to generate successful community experiences in the implementation of IFM in forest ecosystems so as to develop a forest fire management model that could be replicated in other regions of the country. The approach was based on inclusive and participatory planning (communities, local governments and organizations, and state institutions) in the use of fire as a forest ecosystem management tool.

Project outcomes

Project activities were considered successful because of the high level of participation in project activities and the changes to existing fire regimes achieved at the pilot sites. These sites had previously been characterized by, among other things, a high frequency of forest fire, leading to the degradation of forest stands, limited regeneration and growth of forest tree species, stem deformation, increased bark thickness, an increased incidence of pests and diseases, and severe damage to undergrowth vegetation.

Project activities included the development of a protocol for monitoring IFM practices and impacts at pilot sites so that communities could see the results of their actions. Box 1 contains typical observations made by community members and local government officers on regeneration at project sites.

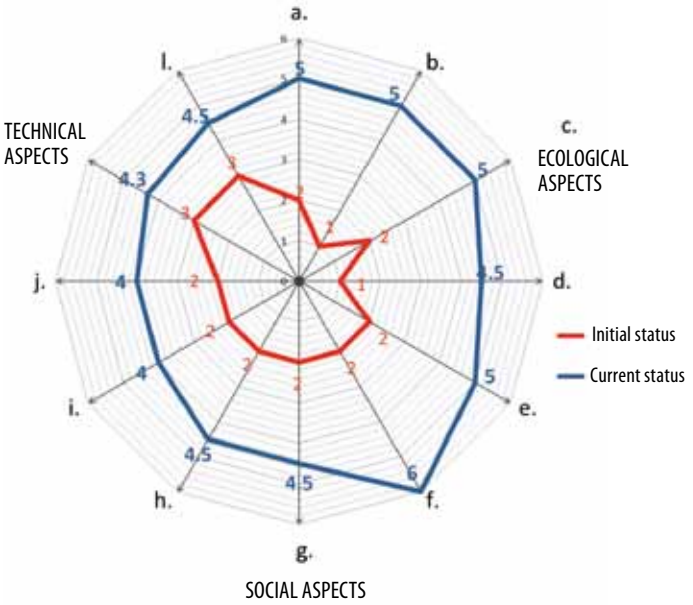
Figure 1 shows the social, ecological and institutional outcomes generated by the project based on an assessment carried out with the participation of community stakeholders and institutional staff. Among other things, the assessment found the following:

- **Social impacts.** There was a highly significant increase in the effective participation of community members in IFM planning. For example, according to Hector Saquil, administrator of the San Jerónimo national farm, Baja Verapaz, INAB, "with the help of the project, we managed to get people to participate in fire management activities".
- **Ecological aspects.** The project achieved a change in fire regimes, which translated into an 80% reduction in the intensity and frequency of forest fires and the identification of areas for the implementation of controlled and prescribed burns. Ecological succession increased in the fire management demonstration plots, with a strong increase in the natural regeneration of both forest and non-forest species. Box 2 contains typical comments by community members showing the increased fire awareness generated by the project.
- **Institutional aspects.** There was an increase in the number of trained technical personnel and a change in mindset about forest fire based on the IFM approach. IFM has been mainstreamed into the policies of government institutions responsible for forest resources with a view to reducing the impact of forest fires and promoting IFM in Guatemala's tropical forest ecosystems.

Benefit–cost assessment

The project was subject to a benefit–cost assessment. Costs included expenditure on community organization workshops, local training, participatory planning processes, and the implementation and monitoring of IFM activities; benefits were mainly improvements in the value of both water and forest resources. Overall, the benefit–cost ratio was assessed at

Figure 1: Project impact assessment



No.	Meaning of numerical code
1	Very bad
2	Bad
3	Fair
4	Good
5	Very good
6	Ideal
See the description of the numerical value of each indicator in the annexed table	

Figure code	Description of indicator
Ecological aspects	
a.	Annual number of fires in the project pilot sites that have an impact on forest fire
b.	Area affected by fire each year in the pilot sites
c.	Protection actions against forest fire (km of black lines)
d.	Level of knowledge of community groups about the role of fire in different ecosystems (concepts)
Social aspects	
e.	Percentage of community participants with a direct relationship with the management areas
f.	Total number of people participating in project activities
g.	Average participation in IFM training per group
h.	Level of planning and implementation of activities related to IFM
Institutional aspects	
i.	Number of local institutional technicians involved in IFM in the regions, by site
j.	Level of involvement of technical personnel in IFM at the pilot sites
k.	Level of skills of local institutional technicians in IFM
l.	Level of mainstreaming of IFM in government institutions responsible for natural resources

Box 1: Typical observations on forest regeneration in response to IFM approaches

"After 45 days, pine regeneration saplings started to come out in the areas where we had carried out controlled burns." *Bacilio Osorio, Hacienda El Santo Community, Chiquimula*

"We saw that, as a result of the prescribed burns, saplings started to come out in the forest and we no longer need to reforest those areas." *Rosario Pérez, community leader, San Juan Village, San Jeronimo Farm, Baja Verapaz*

"We have seen that in those areas where prescribed burns are carried out, the rate of pine regeneration is much higher than in areas where these burns are not carried out." *Dennis Josue Pérez, CONRED, Regional Municipal Park of La Enea, Poptún, Petén*

Box 2: Typical comments on the project by community members

"Now we don't have as many fires as we had before the implementation of the project." *Adrián Carranza, Hacienda El Santo Community, Chiquimula*

"Now we can establish black lines[2] to protect our young trees from fires." *Fernán Pérez Teodoro, president of the community association, Guardianes del Bosque de Chiquimula*

"We received training thanks to the Integrated Fire Management Project, and now we know that fire is a part of our forest and as such needs to be managed and not just eliminated." *Arturo López, President of the Community Council of the Novillero Quiscab micro-basin, Department of Sololá*

[2] A "black line" is a line of controlled burns to protect against forest fire.

+14.74 in the San Jeronimo National Farm; +16.25 in the Quiscab forests; +2.20 in the Pinalón forests; and +2.18 in the Regional Municipal Park of La Enea. Thus, the project investment was assessed as cost-effective and advisable.

The project provided Guatemala with an opportunity to identify approaches leading to the adoption of IFM among the country's rural communities. Such approaches include: the establishment of field schools; participatory planning, both in the implementation of activities and in local decision-making; monitoring; and benefit–cost assessment of IFM. The combination of these actions will stimulate the uptake of participatory approaches seeking to manage fire regimes in accordance with ecological, technical and social requirements while improving the ecological condition of forests so as to ensure the sustainability of the goods and environmental services they provide.

The project is in line with the ITTO Guidelines on Fire Management in Tropical Forests, which highlight the importance of strengthening and involving communities in the protection and management of forest fire and recognize that some forest activities carried out by local communities require the use of fire. The project could serve as a model to be replicated nationally to address the issues associated with forest fire.

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Community buy-in to fire management

An ITTO project is showing that educating young people is a key to improving forest-fire management in Panama

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Making a break: Community volunteers clear a firebreak in Panama's El Montuoso Forest Reserve. Photo: ANAM.

Panama has a land area of 75 417 km^2. It has nine provinces, five indigenous territories and a total population of 3.41 million people (2010 census), of whom 63% are urban. Three-quarters of the poor and 85% of the extremely poor live in rural areas; poverty is most severe among indigenous communities, with up to 95% of indigenous people classified as poor or extremely poor.

The pressure exerted by poor communities on natural resources affects soil productivity and watersheds, causes deforestation, has a negative effect on biodiversity and, ultimately, reduces the quality of life of local people. The main cause of deforestation is clearing for subsistence agriculture and cattle-raising, both of which use fire as a means of eliminating forest cover. Although regulated by the National Environmental Authority (*Autoridad Nacional del Ambiente*—ANAM), slash-and-burn agriculture remains a feature of every dry season in Panama. In view of this, ANAM is implementing ITTO project PD 441/07 Rev.2 (F): "Institutional strengthening of ANAM for integrated fire management in the tropical forests of Panama" with the aim of improving fire management in the country through community participation. Specifically, the project is developing techniques to help resolve problems associated with the devastation caused by forest fire, taking into account the cultural values of communities within a framework of natural resource protection, environmental conservation and national policy guidelines.

The project's pilot areas were selected using the following criteria:

- a high incidence of forest fire affecting unique ecosystems and increasing their vulnerability;
- a high incidence of deforestation and degradation in water catchment protection forests;
- private-sector interest in forest-fire prevention and control techniques in plantations;
- interest among local governments in integrated fire management and the conservation of natural resources; and
- a high level of community organization and interest.

On the basis of these criteria, the following three areas were selected:

1) Guacamaya Mount Hydrological Reserve (*Reserva Hídrica Cerro Guacamaya*), province of Coclé;
2) El Montuoso Forest Reserve (*Reserva Forestal El Montuoso*), province of Herrera; and
3) Buenos Aires Municipality (*Corregimiento Buenos Aires*), Ngäbe Buglé Comarca.[1]

The work in the pilot areas is directed mainly at rural communities with the aim of reinforcing the importance of natural resources and stressing how forests, as a cornerstone of development, provide goods and environmental services for all. Awareness-raising activities were carried out with the aim of changing the attitudes of local people, especially the young, as well as of local authorities and education institutions.

The role of fire is now recognized in the pilot areas as an appropriate tool for good forest management; the objective is not to eliminate fire but to modify existing practices by applying prevention and control techniques to mitigate the negative effects of fire and to use it to support the conservation of natural resources. The project also includes activities for the rehabilitation of fire-affected areas so that, in the future, local communities can sustainably use the natural resources therein, thus improving their economies and living conditions.

[1] In Panama, a comarca is an autonomous territory.

Guacamaya Mount Hydrological Reserve

The Guacamaya Mount Hydrological Reserve was established through Municipal Resolution No. 10 of June 2000 and was elevated to the status of "protected area" in March 2012. The reserve covers 5117 hectares in the districts of Penonomé and La Pintada; it is part of a scenic landscape containing many tourist attractions and is one of the few sites in Panama that are both hydrological reserves and ecological reserves. The Guacamaya Mount Hydrological Reserve supplies drinking water to more than 12 000 people living in 42 communities in Coclé province.

In ten communities in the pilot area, the project established a cooperation and participation scheme with the aim of increasing local understanding of the problems arising from the inappropriate use of fire as a (cheap) tool of agriculture and cattle-raising. The greatest impacts of forest fire in the reserve are soil erosion and the total destruction of vegetation cover; these limit rainwater retention and water infiltration into the soil and groundwater, thus reducing community water supplies in dry periods.

The project has worked to change the behaviour of local people by providing training in basic forest-fire prevention and control techniques; reforestation activities in fire-affected areas; the construction of firebreaks in high-risk areas; the training of environmental volunteers, both at the community level and in schools located within the reserve; setting up a volunteer forest-fire brigade; and establishing an interinstitutional committee to coordinate these efforts and thus raise community awareness about fire management.

El Montuoso Forest Reserve

The Montuoso Forest Reserve was established through Act No. 12 of March 1977 over an area of 12 043 hectares in the district of Las Minas. It was established with the objective of maintaining the supply and quality of water from the La Villa, Mariato, Tebario and Suay rivers, the sources of which are within the reserve; these rivers supply drinking water to approximately 90 000 people in the provinces of Herrera and Los Santos.

Early in the project the people living in the reserve and in neighbouring areas indicated that they were willing to participate in project activities; they were aware of the importance of the reserve for the development of the province, given that it is considered to be a last refuge of biodiversity and the "lungs" of Herrera province. This positive attitude among the communities greatly facilitated project implementation; moreover, organized groups in the reserve already implementing activities for other ANAM projects could be relied on.

A particular feature of this pilot area is that its management plan does not allow the use of fire in agricultural activities, despite the complaints of local people who believe that fire is the cheapest tool available for soil preparation. In this pilot area, therefore, the project provided training to increase the commitment of communities to respect existing laws so as to avoid forest fire. As a result of the ongoing close relationship that the project has established with the communities and education centres, an environmental volunteer programme has been set up in local schools and communities, and a volunteer forest-fire brigade has been established. These actions have encouraged local people to assume their responsibilities as residents of the reserve.

Buenos Aires Municipality

The Buenos Aires Municipality covers an area of 496 km^2 and has a population of 1499 people. In accordance with its ancestral culture, the Ngäbe Buglé Comarca is governed by its traditional authorities, made up of general, regional and local congresses, as well as the general, regional and local *caciques*, immediate chiefs and spokespersons. In this pilot area, therefore, the project adopted a different and rather unusual approach because it was necessary to obtain the approval of the comarca's General Congress.

With a full sense of respect for the idiosyncrasies of the indigenous population, the project provided training in basic forest-fire prevention and control techniques aimed at strengthening the community's cultural values in natural resource use and the responsible use of fire. The project helped establish a group of environmental volunteers in local schools and a volunteer forest-fire brigade. One of the greatest achievements of the project was that the work was carried out in full compliance with official rules and regulations governing the internal affairs of the comarca.

Project outcomes in pilot areas

In order to measure the project's impact, the problems to be addressed were identified from the point of view of the communities and all other stakeholders involved. To this end, baseline studies were carried out in each pilot area, generating information on climate, geology, geomorphology, hydrogeology, flora, fauna, hydrology and land use.

A SWOT ["strengths, weaknesses, opportunities and threats"] analysis workshop was held to identify the strengths and weaknesses in local communities and the opportunities and threats they face in relation to fire use. Among the threats identified at the workshop were deforestation, water resource degradation, impoverished soils and forest fire. With the identification of the problems, the project began to implement an environmental education programme focused on fire prevention with the aim of modifying the behavioural patterns and decision-making processes of community members.

The project has had a favourable impact in all three pilot areas: for example, it has raised awareness in participating communities on the integrated use of fire; produced changes in behaviour regarding the use of fire; and established student and volunteer environmental groups and volunteer forest-fire brigades. A total of 1489 adults and 354 children and other young people in communities have been trained under the project. The table summarizes the main project activities, and their extent.

Forest-fire brigades. These are teams trained in basic fire prevention, control and extinguishment techniques, first-aid procedures, controlled and prescribed burns, the rehabilitation of areas affected by burning practices, risk management procedures and climate-change awareness. The brigades are composed of personnel from ANAM, other relevant institutions and members of each community.

Environmental volunteers. These teams are designed to advise communities on how to conserve natural resources. They have been trained in topics related to environmental care and protection, and they are responsible for producing a multiplier effect using the knowledge gained.

Table 1: Main project activities

Activity	Indicator
Training community members in three pilot areas in forest-fire prevention techniques	480 people
Establishment of three forest-fire prevention and control brigades (one in each pilot area)	36 people
Training field-days on integrated fire management techniques for community members in the three pilot areas	493 people
Organization and implementation of courses for forest firefighters addressed to community members in pilot areas	480 people
Educational field-days on the appropriate use of fire for primary and secondary education students in pilot-area communities	200 students
Follow-up activities for students participating in the environmental groups representing their schools in the communities	154 students
Firebreak construction in the three pilot areas	14 km
Control of forest fires	12 fires
Rehabilitation of areas affected by forest fire	18 ha

School environmental groups. These are teams of school children and other young people who have been made aware of and trained in forest-fire prevention; climate change; soil, air and water pollution and its impacts; recycling; conflict resolution; risk management; and first aid. They will also act as multiplying agents in their communities by creating awareness among community members.

Community buy-in

Communities have generally been receptive to the project and the need to improve fire management and to participate in efforts to do so. A large part of the mountain range that runs through Panama has been deforested, and this has been associated with an increased scarcity of water and changes in the microclimate, making it much drier than in the past. This, in turn, has affected water supplies and agricultural production and made areas more prone to fire, particularly community plantations (both agriculture and trees) and the remaining secondary and degraded forests. Moreover, most local communities live on the fringes of forested areas, and forest fires have the potential to destroy their villages and towns. Last but not least, the communities have learned the hard way that they will have to fend for themselves, because the central government is able to provide few fire management facilities and infrastructure.

Lessons learned

The project has produced the following key lessons:

- Community buy-in to the project has facilitated the implementation of activities—people are committed to project outcomes and existing organizational structures are involved. This has created synergies among the various stakeholders that should help ensure the sustainability of project outcomes.
- To ensure the active participation of communities it is important to consult all members about existing organizational set-ups and individual and community interests.
- The participation of women is a key element in the implementation of project activities (especially given that the gender ratio in the local population is 60% women to 40% men). Women's roles are changing; increasingly women not only manage households but are also involved in community activities developed through projects.
- The support of institutions active in the pilot areas, such as the National Civil Protection System (*Sistema Nacional de Protección Civil*), fire brigades, the Catholic Church, the Ministry of Education, the National Police, local authorities and ANAM, has made it possible to integrate the efforts of all these participants in project implementation.
- If communities can see that they will benefit directly from a project they are more likely to provide their labour inputs, while the project provides logistical support.
- The participation of local governments (e.g. mayors and town councillors) as key stakeholders has empowered them in all areas related to the environment and, in particular, in the use of fire. This, in turn, has facilitated the integration of these authorities with communities in the pilot areas.
- We have learned that it is not easy to change cultural patterns, traditions and customs on fire use in communities. Fire prevention activities and everything related to the care and protection of natural resources should go hand in hand with a holistic education process, which must begin at an early age so that children learn to respect, care for and protect the environment.

Project sustainability

Even after project completion, the highly motivated brigades of environmental volunteers and forest firefighters, in coordination with community members in each of the pilot areas, will continue to coordinate patrolling, surveillance and firebreak construction activities during dry seasons as forest-fire prevention measures. Teachers are committed to continuing the fire-education programme in schools, thereby ensuring that the school-based environmental groups continue to act as multipliers of information and knowledge and to raise awareness about the appropriate use of fire among young people, including in communities that have not yet been reached.

This project, carried out in Panama with ITTO financing, has been a very positive experience. It has ensured the participation of—and worked hand-in-hand with—local communities in decision-making and the coordination and implementation of all project activities. Such participation is essential if the ongoing and increasing threat posed by forest fire in Panama is to be managed effectively.

Forest fire management in Ghana

ITTO-funded projects have been important in developing an efficient fire management system, but more needs to be done

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Paying attention: Parade of community fire volunteers adjacent to an established green firebreak at the Bosumkese Forest Reserve, Bechem, Ghana. Photo: R.K. Ninnoni

At the end of the twentieth century, Ghana had a forest area of 8.2 million hectares (ha), but by 2010 this had decreased to 4.9 million hectares (Oduro et al. 2012). A suite of factors contributes to forest loss and degradation, but wildfire is regarded as the most important cause of forest degradation (Hawthorne 1994). Ground fires had been recorded in some forest reserves in Ghana before 1983, but they had caused little damage. However, an extended drought triggered by the El Niño-Southern Oscillation (ENSO) event in 1982/83 predisposed almost all forest reserves to wildfires, which caused considerable damage to forest and wildlife and made the affected forests more prone to subsequent fires.

The Government of Ghana promulgated the Control and Prevention of Bushfires Law in 1990, which sought to establish institutional structures across the country, including volunteer fire groups, and set fines and penalties for people starting bushfires. Contrary to expectations, however, the law had little impact because there was a general lack of data on which forest managers, local authorities and policymakers could base their actions. Additionally, there was little stakeholder collaboration in wildfire prevention and control, with many forest-fringe communities lacking sufficient training (and motivation) in fire prevention and suppression. To address these gaps, two ITTO-funded fire projects [PD 32/98 Rev.1 (F) and PD 284/04 Rev. 2 (F)] were implemented in Ghana to establish an efficient fire management system with the participation of all relevant stakeholders. The system developed through these projects has served as a blueprint for wildfire management interventions in Ghana.

Developing a fire management system

The first project, "Forest fire management in Ghana" [PD 32/98 Rev.1 (F)], was implemented from 1999 to 2003 with the specific objective of reducing the rate of natural forest depletion by developing efficient fire management systems. The CSIR-Forestry Research Institute of Ghana (CSIR-FORIG) implemented the project in collaboration with the then Planning Branch (now Resource Management Support Centre) of Ghana's Forestry Commission and Ghana National Fire Service. The project also benefited from the expertise of staff in the United States Department of Agriculture Forest Service.

Identification of causes and effects of forest fires

The causes and effects of fire and its role in farming systems were identified and documented through a series of surveys of forest-fringe communities and other fire users. The study showed that fires in forest areas were mostly related to farming activities. It also found that using fire in land preparation had numerous benefits for farmers, and farming without fire was impractical. This led to a recommendation for the development of guidelines on fire use in farming systems, which was subsequently achieved through a successor project implemented by the Ghana Forestry Commission. A system of fire reporting was also institutionalized (and is now used by Forestry Commission staff) to monitor fire occurrence and evaluate the impact of fire management interventions. Tracking the dynamics of fire occurrence helps forest managers in planning and deploying resources to prevent and control fire.

Effective forest-fire control systems

In collaboration with community leaders, district assemblies and the Ghana National Fire Service, ITTO project PD 32/98 Rev.1 (F) recruited and trained 412 fire volunteers and equipped them with basic firefighting tools. These volunteers formed a network of patrol teams for early fire detection, alerts (through the use of motorized transport) and suppression. The project piloted the effectiveness of "green firebreaks" (40-metre-wide bands of evergreen species that are relatively fire tolerant, with the ability to branch laterally along the periphery of the forest) in suppressing undergrowth, thereby reducing fuel loads and slowing the spread of fires into forest reserves and other protected areas. The green firebreaks were assessed as effective in slowing the spread of fires into forest reserves, thus facilitating the natural regeneration of fire-degraded forests. The establishment of green firebreaks around forest reserves is now an integral part of the operations of the Forestry Commission's Forest Services Division in rehabilitating fire-degraded forests. A manual of procedures for forest fire management was developed to assist district-level forest officers in protecting forest reserves.

Wildfire prevention education and awareness programmes

A number of fire prevention activities are carried out at the onset of each fire season in Ghana. Various stakeholders (i.e. the Forest Service Division, the Ghana National Fire Service, traditional authorities, district assemblies, fire volunteers and farmers) are brought together to launch the annual anti-bushfire campaign with the purposes of sensitizing fire users and putting them on alert in the event of wildfires. Education and awareness-raising on fire prevention was carried out before the project; it was done without a communication plan, however, and messages were not targeted at specific audiences. The project developed a fire prevention communication plan with messages for target audiences, and this has been used by successor projects in awareness-raising programmes.

Development of mechanisms for rehabilitating fire-degraded forests

Different plant species at different stages of growth have varying degrees of fire tolerance. Plants that can tolerate or survive fire have certain traits that afford them protection against it. In rehabilitating fire-degraded forests it is important to select the right tree species because survival through the seedling stage of the life cycle is critical for successful establishment. The following 13 Ghanaian forest tree species representing a wide range of ecological types were tested for their suitability for rehabilitation in fire degraded forests—*Antiaris toxicaria, Blighia unijugata, Celtis zenkeri, Cola gigantea, Malacantha alnifolia, Mansonia altissima, Milicia excelsa, Myrianthus arboreus, Nauclea diderrichii, Nesogordonia papaverifera, Tetrapleura tetraptera, Trichilia prieuriana* and *Triplochiton scleroxylon*. Traits tested included relative dry weight growth (relative biomass gain), relative diameter growth, root length, root volume, root/shoot ratio, moisture content and leaf surface area per dry weight ratio. *Milicia excelsa* and *Antiaris toxicaria* showed consistent dominance in traits (e. g relative biomass gain and large root volume) related to re-sprouting ability of tree species.

A canopy of *Senna siamea*, part of a green firebreak adjacent to Worobong South Forest Reserve. Photo: L. Amissah

One of the factors militating against programmes for the rehabilitation of degraded forests has been a lack of funds, but the adoption of a collaborative approach involving communities considerably reduces the cost of planting and maintenance. The main strategy identified for forest rehabilitation was using the taungya system of plantation development; a modified version of this system is in use today.

Project to strengthen community participation

The second ITTO-funded project, "Fire management and post-fire restoration with local community collaboration" [PD 284/04 Rev.2 (F)] was undertaken by IUCN from 2005 to 2011, with FORIG as the implementing agency and the Forestry Commission as a collaborating agency. The project worked with local communities with the aim of halting forest loss due to uncontrolled fires and improving the effectiveness of community-based fire management in Ghana, building on existing structures and the programmes developed by the earlier project. Among other things, this project improved coordination among stakeholders and clarified the various roles and responsibilities associated with fire management. The Ministry of Lands and Natural Resources adopted guidelines and a manual for the implementation of community-based fire management in Ghana developed by the project. The capacity of stakeholders was increased through training on fire prevention, pre-suppression and suppression. To consolidate the achievements made in the earlier project, 87 fire volunteers were recruited, trained and equipped. The project supported the reforestation of 87 hectares of fire-degraded forest using the modified taungya system.

Project impacts

The occurrence of fire in forest reserves has declined in recent times. In the 2011–2012 fire season (October to March), for example, the number of fires recorded was 13% lower than in the 2010–2011 season. This may seem a relatively small decline, but it is having a positive impact on cocoa cultivation in the forest transition zone. Some cocoa farmers who migrated from this zone to the southwestern part of Ghana because of the large-scale destruction of cocoa farms by wildfires in the 1990s have now returned to rehabilitate old cocoa farms.

The ITTO-financed projects laid the ground work for the development of the National Wildfire Policy (2006) through a project funded by the Government of the Netherlands, which provides a framework for interventions to address wildfire in Ghana. The National Wildfire Policy is facilitating coordination among stakeholders and reducing the duplication of efforts because the policy document identifies the roles and responsibility of all relevant stakeholders, and dialogue and collaboration among stakeholders in the implementation of wildfire interventions has improved. Overall, awareness of the negative effects of wildfires has increased among forest management actors and especially among forest-fringe communities. An important achievement of the ITTO-funded projects is that they afforded Ghana the opportunity to translate research results into practice and policy development in finding solutions to an emerging problem. More broadly, the ITTO projects have helped train a new generation of fire management experts and practitioners at various levels.

Conclusions and way forward

The two ITTO projects have helped Ghana develop a more structured and efficient fire management system that involves all relevant stakeholders. Forest-fringe communities on the frontline of fire prevention and control have the willingness and some capacity to help bring fires under control. Nevertheless, the supply of basic tools for fire suppression remains inadequate and unsustainable. This shortage is demoralizing for the network of fire volunteers, whose activities are helping to reduce fire and ultimately to promote natural forest regeneration and biodiversity conservation. The projects focused on a few selected forest-fringe communities, and there is an urgent need to spread the knowledge and capacity to deal with wildfire issues to other communities. The provision of firefighting tools to frontline firefighting groups and the inclusion of additional forest-fringe communities will consolidate the gains made. Green firebreaks are important in reducing wildfire spread, but almost all forest reserves in the transition zone have only partial coverage of such firebreaks.

Training in fire use and non-fire methods in agricultural activities is also needed. To achieve this, fire-use guidelines developed by the Dutch-funded project mentioned above should be published and used as a manual for training farmers. To determine the costs and benefits of fire management interventions and to make a case to the central government for funding for fire management, forest managers and other practitioners need training on the accurate assessment of fire damage.

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Quantifying the carbon benefits of forestry activities

ITTO has published a new guide on how to measure and make use of the carbon benefits generated in forestry projects

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Needing benefits: Local beneficiaries in an ITTO project stand in a field of newly planted teak seedlings in Papua New Guinea. ITTO projects—and other practitioners—can use the *Technical guide on the quantification of carbon benefits in ITTO projects* to monitor the carbon benefits of their activities. Photo: H.O. Ma, ITTO

According to the latest report of the Intergovernmental Panel on Climate Change (IPCC; Smith et al. 2014), the "agriculture, forestry and other land uses" (AFOLU) sector produces 25% of annual greenhouse-gas (GHG) emissions globally. A major reduction in these emissions is needed if the climate-change mitigation objective agreed in the 2009 Copenhagen Accord of the United Nations Framework Convention on Climate Change (UNFCCC) is to be achieved.

A significant fraction of the AFOLU sector's GHG emissions arise from tropical forests due to unsustainable land-use and forest management practices. Conversely, conservation and sustainable forest management can provide carbon benefits, thereby helping to mitigate climate change. Several mechanisms have been created with the aim of supporting forestry activities that generate carbon benefits. The uptake of such mechanisms has been slow, however, due partly to a lack of knowledge among forest managers on the mechanisms and their regulations and a lack of information on how to estimate and measure the carbon benefits of forestry activities over time.

To help fill the knowledge and information gap, ITTO published the *Technical guide on the quantification of carbon benefits in ITTO projects* in early 2015. Prepared by the author as part of ITTO's REDDES ["Reducing Deforestation and Forest Degradation and Enhancing Environmental Services in Tropical Forests"] Thematic Programme, the guide considers and builds on existing methods (e.g. FAO 2011; Harris et al. 2012; IPCC 2003, 2006; Herold and Johns 2007; Pearson et al. 2012; Petrokofsky et al. 2012) with the aim of simplifying decisions on the use of climate-change mitigation mechanisms within the UNFCCC, other regulated carbon markets, and voluntary carbon markets. This article describes the various components of the manual.

Questions addressed in the Technical guide on the quantification of carbon benefits in ITTO projects

General:

- What are the carbon benefits of forestry activities?
- How can these benefits be measured?
- What existing frameworks are relevant to forestry activities?

Related to carbon benefits in specific interventions:

- Which climate-change mitigation framework best fits particular circumstances, and have national decisions changed the options?
  - Is REDD+ an option?
  - What about the Clean Development Mechanism market?
  - Should another regulated market be used?
  - Should voluntary markets be used?
- How do you select the methodology that best fits your circumstances?
- Which stakeholders should be included, and how?
- Who owns the carbon benefits?
- Are there specific considerations for monitoring the carbon benefits in sustainable forest management?
- How can the carbon benefits in ITTO projects be monitored and reported if the project is not participating in a mitigation framework?

Target audience, and objective

The guide targets forest managers at the forest management until (FMU) level who want to: calculate the potential carbon benefits generated by their forests; determine which existing mechanism to use; and learn about the specific requirements and challenges of the various mechanisms and methodologies. The guide adds value to existing technical guidelines on carbon accounting for forestry by offering a comparison of existing mechanisms and methodologies. The guide is not an assessment of those mechanisms and their methods or procedures, but, rather, a tool to help

Table 1: Potential impacts of various forestry activities on carbon stocks

Forestry activity	Mitigation activity	Carbon benefit (according to decisions and ongoing discussions in the UNFCCC)	Relation to land-use change if no project takes place (i.e. relation to "baseline/reference")
Conservation, sustainable forest management (improved forest management, avoided deforestation, reducing deforestation)	Maintain a forest area and long-term carbon density in areas under pressure	GHG emission reduction	Avoiding change from forest to non-forest Avoiding degradation
Afforestation or reforestation	Increase forest area and carbon stocks	Carbon sequestration/carbon enhancement	Non-forest to forest
Restoration	Increase site-level carbon density		Forest to forest
Agroforestry and silvopastoral systems	Increase landscape-scale carbon stocks		Non-forest to forest
Biofuel plantations (wood and non-wood products)	Increase input for biofuel production and substitution through harvested wood products, when biofuel production does not increase GHG forest emissions	Creating the potential for substitution	Non-forest to forest

understand the options available for given activities at the FMU level and to enable forest managers to select the best option for their circumstances. The box lists the questions the guide seeks to address.

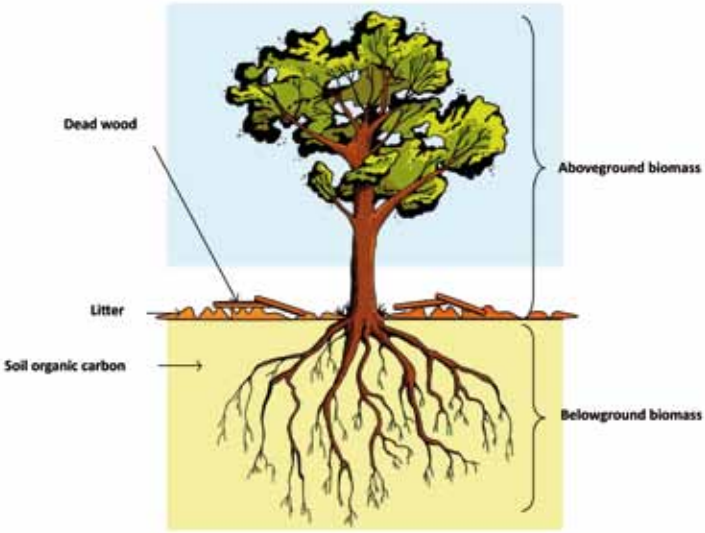
Carbon benefits from forestry activities

Forestry activities can generate carbon benefits in three main ways: 1) reducing GHG emissions; 2) sequestering carbon/promoting carbon enhancement; and 3) substituting carbon. Table 1 lists some of the many forestry activities that provide these benefits.

Carbon benefits arise when the carbon stock increases or is maintained. Forests have five carbon pools: aboveground biomass; belowground biomass; deadwood; litter; and soil organic matter (Figure 1). The harvesting of timber products reduces carbon stocks in the forest's living biomass, and this loss is accounted for as a reduction in the potential *in situ* carbon benefit. If, however, the harvested wood is used in construction or for other non-destructive purposes, it may constitute a long-term carbon sink; thus, harvested wood products are recognized as another carbon pool (outside the forest). Wood and non-wood forest products can be used in the production of bioenergy; when this bioenergy is used as a substitute for fossil fuels, it can have a carbon benefit. Quantifying the carbon benefits arising from substitution involves calculating the difference in GHG emissions and sinks between the substitute and substituted materials.

Carbon benefits are estimated at the beginning or in the planning phase of an intervention ("ex-ante" estimation) and measured regularly during implementation. Two major challenges in estimating, measuring and monitoring carbon benefits are permanence and leakage. Permanence relates to the time that carbon remains in the biosphere—for example, a wildfire can release carbon into the atmosphere prematurely, reversing mitigation benefits; interventions should therefore promote an effect on the atmosphere that is as permanent as possible. Leakage concerns the potential for an intervention to cause GHG emissions beyond the boundaries of the intervention area; forest managers in charge of mitigation

Figure 1: Forest carbon pools



activities should therefore try to ensure that interventions in one area do not result in emissions in another (forested) area.

Possible mitigation frameworks

The guide differentiates between three mitigation frameworks: 1) the UNFCCC; 2) regulated markets; and 3) voluntary markets.

United Nations Framework Convention on Climate Change

The UNFCCC considers carbon benefits from forest ecosystems in three mechanisms: REDD+[1], A/R CDM, and NAMAs.

REDD+ refers to a negotiation item within the UNFCCC as well as to a series of ongoing processes, programmes and initiatives that are exploring climate-change mitigation options in the forest sector. Although there is no binding agreement (yet) on (or including) REDD+, the Conference of the Parties to the UNFCCC has agreed on a set of decisions regulating it. The guide explains these decisions.

A/R CDM refers to project activities on afforestation and reforestation (A/R) in the Clean Development Mechanism (CDM) of the Kyoto Protocol

1 REDD+ = reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.

and the possibility of establishing programmes of activities at the national level. The modalities and procedures of the A/R CDM were agreed in 2003, and several approved methodologies are available.

Nationally appropriate mitigation actions (NAMAs) are voluntary: countries are free to include forestry activities in their NAMAs in accordance with the decisions of, and guidance provided by, the UNFCCC.

Forest carbon markets and voluntary standards

The guide discusses two regulated markets (both based in the United States) that may be of interest to ITTO producer countries: the California Climate Action Registry (CCAR) and the Climate Action Reserves (CAR). The guide also presents standards for participation in voluntary markets, which, for any given voluntary standard, comprise the sum of "over the counter" transactions. The various standards are self-regulated but open to international scrutiny; they include Plan Vivo; Climate, Community and Biodiversity Standards (CCBS); Verified Carbon Standards (VCS); the Gold Standards; the American Carbon Registry (ACR); and REDD+ Social and Environmental Standards (REDD+-SES).

Considerations at the forest management unit level

The guide proposes a step-wise approach to considering carbon benefits at the FMU level (Figure 2). At each of the first six steps, the guide addresses three questions:

1) Why is this step necessary?
2) How is this step undertaken?
3) What happens if there is a significant change in circumstances and over time?

Step 1: Define boundaries

Forest managers need to consider both geographical and temporal boundaries. Geographical boundaries relate to the question of where an activity will take place, and temporal boundaries respond to the question of when it occurs. Changes in the boundaries over time will affect ex-ante estimation and monitoring requirements and need to be documented.

Step 2: Identify the institutional framework

In the guide, the "institutional framework" comprises the rules and regulations applying to different social actors that are relevant to the current and future management of a given area of forestland. Social actors include forest users as well as regulatory bodies and investors. Interactions between social actors and institutions can have a great influence on how forestland is used, and the guide explains how to characterize the social actors and the institutional arrangements relevant to an intervention.

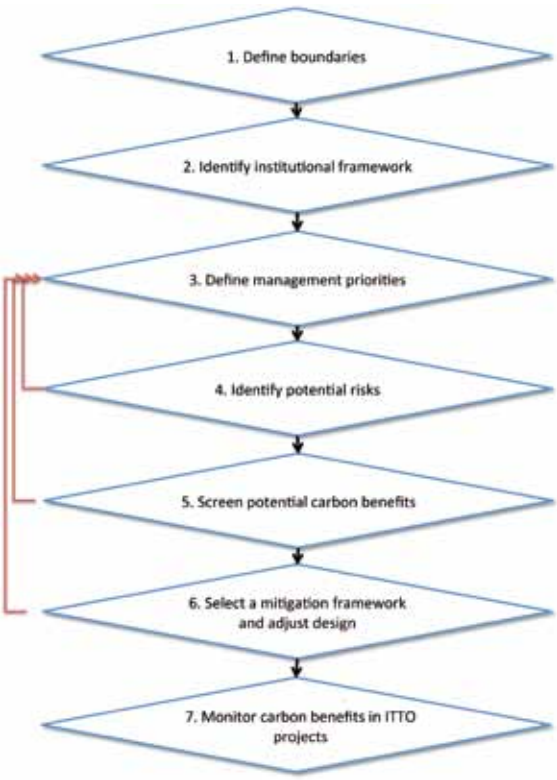
Step 3: Define the management priorities

Management priorities form the basis of forest management plans. If the highest priority is to maximize carbon benefits, planting/harvesting activities should be geared to ensure this, but this may affect other management priorities. Achieving an appropriate balance in management priorities is critical.

Step 4: Identify potential risks

The process of identifying risks provides information on the feasibility of management practices over time. If a project is liable for the carbon benefits in an FMU, it is responsible for keeping those benefits secure. Risks can affect the permanence of carbon benefits and need to be managed. The guide distinguishes between the following potential risks: political and regulatory; social; economic and financial; and natural disturbances and hazards.

Figure 2: Step-wise approach, from activity design to the monitoring of carbon benefits



Note: red lines show possible feedbacks.

Step 5: Screen potential carbon benefits

The aim of screening is to obtain preliminary estimates of the potential carbon benefits of a forestry project or activity in a cost-efficient manner. Thus, screening should be doable with information contained in the forest management plan and using existing (default) values for estimating carbon benefits. The guide explains the three recommended steps in screening potential carbon benefits: 1) select the most important carbon pools; 2) define the strata; and 3) select the most appropriate screening tool.

Step 6: Select the mitigation framework and adjust design

The mitigation framework defines which activities are eligible, the carbon accounting regulations and monitoring requirements, and the available carbon markets or payment schemes. To realize the carbon potential of an intervention it is important, therefore, to select the most appropriate framework. To facilitate the selection process and the quantification of carbon benefits, the guide presents the main frameworks and explains the regulations and methods governing each, and it provides a decision process for selecting the most appropriate framework.

Step 7: Monitoring carbon benefits in ITTO projects

This step explains how ITTO project managers can undertake the monitoring of carbon benefits derived in their projects when no other mitigation framework has been used, and it

Table 2: The main challenges in monitoring carbon benefits in SFM

Challenges in monitoring the carbon benefits of SFM	Strategies currently used	Remaining challenges
Clarifying forest status (e.g. the stage of degradation), which is necessary for defining boundaries and strata	Remote sensing—a good option for differentiating forest from non-forest but less useful for determining the stage of degradation	Estimating the stage of degradation, which is necessary for accurate stratification
Getting appropriate aboveground biomass equations or quantification for different sites; estimating the degradation stage	Use radar and optical remote sensing technology	Radar remote sensing can acquire data irrespective of haze and the persistently cloudy conditions in the humid tropics, but the signal of all available radar sensors tends to saturate at a lower value than the actual aboveground biomass volumes of tropical rainforests and increasingly there are errors in mountain areas
	Use light detection and ranging (LiDAR) sensors to overcome sensor saturation	Large-scale applications are not feasible due to narrow swath and high costs
Estimating aboveground biomass growth after harvesting (under differing regimes)	Ongoing research projects are aimed at developing the necessary models and testing aboveground biomass estimation techniques, combined with field inventories	
Quantifying carbon benefits in carbon pools other than aboveground biomass	Field inventories and ongoing research	Reducing the cost of field inventories for non-aboveground biomass pools (in remote areas)

clarifies who is responsible for it. Nevertheless, forest managers should always check if there are specific norms regulating the monitoring of carbon benefits in their countries. It is especially important that measurements are consistent with ongoing developments in national forest monitoring systems.

The guide provides information on establishing the land/activity area; emission factors; how to deal with uncertainties; how to establish and quantify leakage; and how to involve stakeholders in monitoring activities. It also provides a format for the voluntary monitoring and reporting of the carbon benefits of ITTO projects.

Opportunities and challenges in monitoring the carbon benefits of SFM

Although the capacity of SFM to generate carbon benefits has been recognized for some time, it is only starting to be included as an activity in mitigation frameworks. Table 2 outlines some of the challenges involved in monitoring the carbon benefits arising from SFM.

Who owns the benefits?

In promoting carbon benefits in an FMU, it is important to clarify who owns those benefits. This is a requirement for the sale of carbon certificates, and it is increasingly important in REDD+ negotiations, too. The clarification of the ownership of carbon benefits should be in line with land-tenure and land-use regulations and customary rights and claims.

Other guidelines

To promote consistency among intergovernmental organizations and avoid the duplication of work by forest managers, the guide refers to other guidelines for accounting for carbon benefits developed by intergovernmental organizations other than ITTO. They include guidelines prepared by the IPCC, the Global Environment Facility, the United Nations Development Programme, the United Nations Environment Programme, and the Food and Agriculture Organization of the United Nations.

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Market trends

The international trade of tropical timber is due for a period of relative stability

Sometimes it is worth reminding ourselves that, despite the success of many tropical-timber-producing countries in developing an international trade in added-value products, very little has changed in the past half-century or more in the market for natural tropical hardwood products.

A close look at the main tropical exporters of added-value products—Brazil, Indonesia, Malaysia, Thailand and Viet Nam—will show that the trade of such products depends largely on plantation resources such as rubberwood, acacia, albizzia and pine. The main traded products from natural tropical forests are still logs, sawnwood and plywood.

Sure, the trade in wooden furniture and the like is worth far more than the trade in primary products; nevertheless, logs, sawnwood and plywood remain the backbone of the international trade in tropical hardwoods. This trade has experienced considerable uncertainty in recent years, but an upturn in the economic cycle could mean relatively calm times ahead.

Log import trends

China and India are the major tropical log importers; combined, they imported around 3.5 million m^3 in the first quarter of 2015, down from almost 4.8 million m^3 in the corresponding period in 2014.

Weakening demand for logs in China was partly responsible for the overall drop in log imports (China's first-quarter tropical log imports fell by 22%). Moreover, the log export ban by Myanmar eliminated a sizeable volume of logs from international trade, and the impact of this ban was felt in China and particularly India.

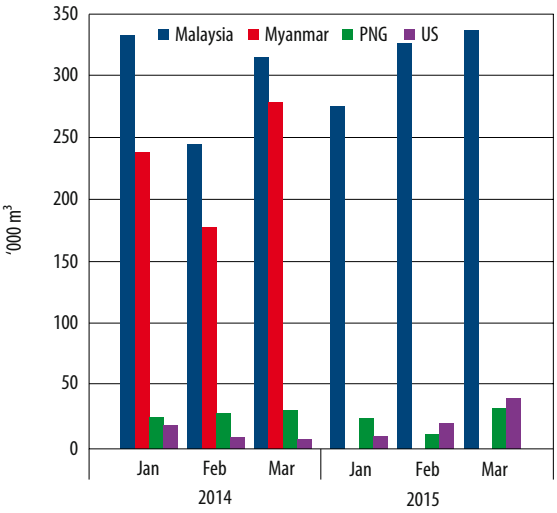
Indian importers accumulated vast quantities of teak and other hardwoods from Myanmar in the first quarter of 2014 in advance of the log export ban. Natural forest teak and gurjan from Myanmar have been the cornerstones of the timber industry in India, with teak used for interior end-uses and gurjan for plywood face veneers. Figure 1 clearly shows the impact on Indian imports of the log export ban in Myanmar.

Indian plywood manufacturers have struggled to find an alternative to gurjan, which Indian end-users prefer over pale veneers, mainly because of its red colour. Nevertheless, poplar-faced plywood is gaining acceptance, with the added benefit that it is cheaper than panels made previously with gurjan.

An alternative solution adopted by some major India plywood companies has been to invest in veneer production in Myanmar and to ship the veneers to India to be laid up into plywood.

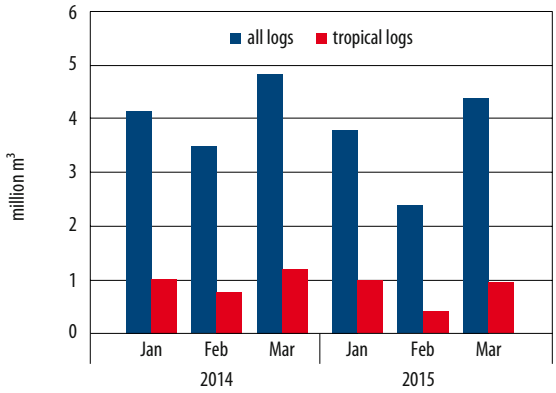
Japan is a significant tropical log importer, but its importance in the trade is declining rapidly. The country imported more than 500 000 m^3 of tropical logs in 2010, but the volume declined to 300 000 m^3 in 2013 and to 250 000 m^3 in 2014.

Figure 1: Indian hardwood log imports, first quarter 2014 and 2015



Source: Zuba.com

Figure 2: China log imports, first quarter 2014 and 2015



Source: Chinese Academy of Forestry.

There was a 27% increase in tropical log imports in the first quarter of 2015 compared with the same period in 2014, but care is needed in interpreting this—the 2014 numbers were exceptionally low as importers braced for the negative effect on construction and house building of an increase in the domestic consumption tax.

Sawnwood import trends

US and Canadian sawnwood markets head in different directions

The differing trends for tropical hardwood sawnwood imports in the US and Canada in the first quarter of 2015 reflects the differing directions of the two economies. United States' imports increased by around 25% in the quarter, and Canadian imports fell by the same amount.

Almost all major suppliers have shipped significantly more to the US this year (to date) than they did in the corresponding period in 2014. The largest increases were from Cameroon (+108%) and Peru (+78%).

Brazil's shipments of sawnwood to the US grew by 20% month-on-month in March. Ipê sawnwood imports were almost unchanged, but imports of sawn virola and other species increased substantially.

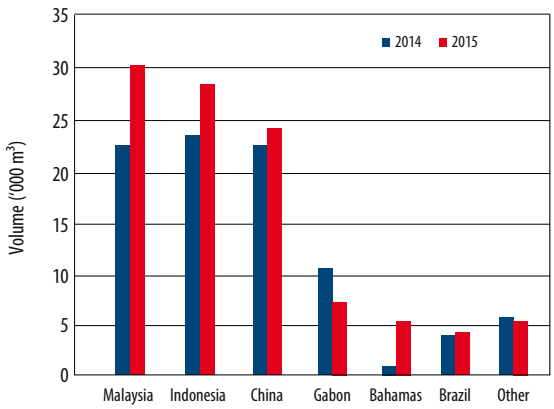
Canadian imports of sapelli and balsa grow, despite overall decline

Canada's overall imports of tropical hardwood sawnwood declined by 24% in the first quarter of 2015 compared with the same period in 2014 (although the volume of sapelli imports increased by 46%, mainly from the Congo). The decline reflects the slowing of Canada's economy.

Growth in EU tropical hardwood sawnwood imports

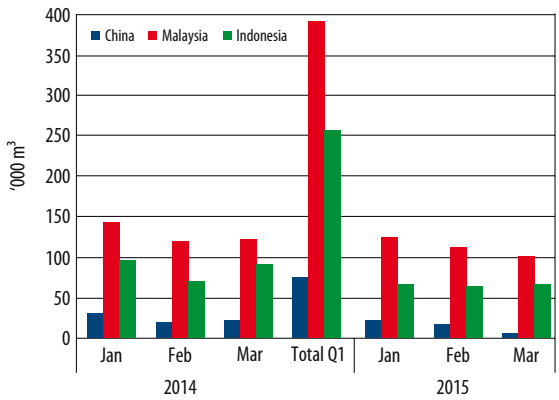
European Union (EU) hardwood sawnwood imports from the region's three most important supplier countries increased sharply in the first quarter of 2015—by 10% from Cameroon, 18% from Malaysia and 31% from Brazil. There were also significant increases in imports from Côte d'Ivoire (+11%), the Congo (+4%) and the Democratic Republic of the Congo (+25%). Imports also increased from Guyana and Suriname, which have not featured strongly in EU supplies in recent years. Imports were down by 14% from Gabon and by 31% from Ghana, however.

Figure 3: EU tropical plywood imports, first quarter 2014 and 2015



Source: ITTO/IMM analysis of EUROSTAT.

Figure 4: Japan's plywood imports from Malaysia, Indonesia and China, first quarter 2014 and 2015



Source: Ministry of Finance, Japan.

China's hardwood sawnwood imports rising

China has not been a major importer of hardwood sawnwood, but this is changing; imports of this product rose by 14% in 2014, to 8.01 million m^3. About 85% of the country's hardwood sawnwood imports came from ten suppliers in 2014, with Thailand (mainly rubberwood) and the United States contributing 52% of the total. China's hardwood sawnwood imports declined by 32% in the first quarter of 2015 compared with the same period in 2014, however, mainly in response to China's slowing economy and weakening domestic housing market. The decline in tropical sawnwood imports was less severe, at 6%.

Plywood import trends

China leads hardwood plywood shipments to US

US imports of hardwood plywood grew by more than 40% in the first quarter of 2015 compared with the same period in 2014, with more than half coming from China. Hardwood plywood imports from China were higher in March 2015, at 178 000 m^3, than at any time in 2014, and they were up by 28% in the first quarter of 2015 compared with the same period in 2014.

US hardwood plywood imports from Indonesia and Malaysia also increased in the first quarter of 2015, but at a slower pace than those from China. In contrast, first-quarter hardwood plywood imports were down, year-on-year, from Canada, Ecuador and the Russian Federation.

EU imports of tropical hardwood plywood increase

The EU imported about 105 000 m^3 of tropical hardwood plywood in the first quarter of 2015, up by 19% over the same period in 2014. Imports from Malaysia, the largest supplier, were up by 33%, while imports from Indonesia were up by 21% and from China by 9%. After several years of decline, imports from Brazil increased by 19% during the period.

More than 80% of all EU imports of tropical hardwood plywood in the first quarter of 2015 was destined for the following four member states, in descending order: the United Kingdom, Belgium, the Netherlands and France.

The sharp year-on-year rise in EU plywood imports from Malaysia in the first quarter of 2015 is partly explained by particularly low levels of trade in the same period in 2014. Malaysia lost Generalized System of Preferences preferential tariff status on 1 January 2014, which contributed to a spike in EU imports from Malaysia in the closing months of 2013, followed by a slowdown in early 2014.

EU imports of Indonesian plywood benefited during the first quarter of 2015 from a stronger construction sector, particularly in the United Kingdom and the Netherlands, more regular break-bulk shipments, and positive perceptions of Indonesian efforts to stamp out trade in illegally sourced timber.

Imports of okoume plywood for the EU construction industry were lively in the first quarter of 2015, particularly for interior remodelling and especially in the Netherlands. The consumption of okoume plywood is rising slowing in the boat industry. The French market, while subdued, has regained some ground so far in 2015.

Improved demand combined with limited supply, especially for certified wood, has allowed okoume plywood manufacturers to push through minor price increases this year. Delivery lead times are becoming longer.

Double wammy for Japan

Japan's plywood imports fell by 15.5% in the first quarter of 2015 compared with the corresponding period in 2014, with imports from China dropping a massive 35%. Imports from the top suppliers, Malaysia and Indonesia, fell by 11.5% and 22.5%, respectively.

Demand for both domestic and imported plywood remains sluggish in Japan. Prices in the domestic market fell early in 2015 until one of the major domestic manufacturers announced a price increase, which took hold even though there was no change in the demand structure.

Because of the weak demand, plywood inventories grew in the first few months of the year but have now corrected. Plywood manufacturers in Sarawak, which supply large volumes of plywood to Japan, are facing log shortages, which is driving down production. This would normally mean price gains but, with the Japanese market so subdued, the gap between the price expectations of suppliers and importers is growing wider. Add to this mix the impact of the rapid depreciation of the yen, and the hurdles to stable trade become clear.

Looking ahead at demand drivers

Key EU tropical timber markets are bouncing back

There was significant growth in the euro value of tropical timber imports in nearly all the main EU markets in the first quarter of 2015. A particularly encouraging sign is that imports to the traditional tropical timber markets in Belgium, France and the Netherlands also increased sharply.

US housing market normalizing after seven years of turmoil

The housing market in the US is a major driver of wood product consumption, and prospects are improving. More Americans are looking for mortgages to buy homes, but the pace of loan applications has begun to slow, a sign that the economy and housing markets are normalizing.

The Federal Home Loan Mortgage Corporation, known as Freddie Mac, has forecast that housing starts will increase by 14% in 2015 and by more than 20% in 2016.

Japan private-sector demand projections

The Japan Lumber Importers Association has projected that wood-product imports will fall by almost 4% in 2015; housing starts will be lower than in 2014, and a weak yen will affect the profitability of importers. The general view is that demand for building materials will decline, affecting sawnwood and plywood imports, but demand for logs (mainly softwoods) is expected to hold up.

Greater timber self-sufficiency in China

China surpassed the US as the largest global trading partner in 2013; it is the main trading partner for more than 40 countries. With so many economies depending on trade with China, the projected continual slowing of growth in its economy will have a significant impact.

China's appetite for raw materials, including wood products, is showing signs of slowing, and recent announcements on investments in strategic timber reserves to increase self-reliance needs close attention. China's State Forestry Administration has reported that it will establish an additional 14 million hectares of strategic national forests by 2020. These forests will comprise fast-growing tree species such as poplar and eucalypt, as well as high-value species.

In the long term, the plan to expand the planted forest estate may lead to a drop in the country's dependence on imports. In the short term, however, a decision to withdraw the right to approve felling from local administrations in northeast China and the Inner Mongolia Autonomous Region may result in a log shortfall that would boost the need for imports.

Strong growth forecast for India

India has emerged as a major timber importer. According to the Organization for Economic Co-operation and Development (OECD), the Indian economy will deliver growth of 7.3% in 2015, which augurs well for tropical timber suppliers. The OECD report notes that increased investment in infrastructure and some proposed structural reforms will improve the ease of doing business and encourage private-sector expansion.

India has a rapidly increasing urban population, and the current housing shortage of 62 million units is holding back development. The central and state governments are adopting measures to remove obstacles to investment in housing.[1] "Slum-free India by 2022"—the centre piece of the government's housing plan—will deliver incentives to companies building affordable homes through slum renovations. Such government plans for the housing sector will have an impact on demand for wood products, including tropical wood products.

The corner has been turned

The negative effects of the global financial crisis seem to be fading, and traders are looking forward to a period of calm before the next market downturn. Demand in the major Asian consumer markets will be sustained as India looks to import more and as China's government continues with its policy of transforming the economy to one based on domestic consumption rather than export-led manufacturing.

The signals from the EU are mixed, but it is encouraging to see some of the main tropical timber-consuming member countries beginning to import more tropical hardwoods. This momentum would be boosted if the EU can conclude voluntary partnership agreements with countries with which it is now negotiating.

1 "Housing—the game changer", a Cushman & Wakefield research report, analyzed the impact that the housing sector had on various aspects of the Indian economy. See: credai.org/sites/default/files/reports/Housing-The-Game-Changer-Report.pdf.

Tropical and topical

Fires rip through Indonesia's Tesso Nilo National Park

A large number of forest fires are raging in Indonesia's Tesso Nilo National Park, once considered one of the world's biologically richest forests. According to analysis by the World Resources Institute based on satellite imagery from NASA, up to 185 fires have started in the park since late May 2015, most likely associated with land-clearing operations for oil-palm plantations and other development. Although Tesso Nilo is a protected area and home to endangered Sumatran tigers and elephants, among other species, the park has a long history of agricultural encroachment.

Read more at: www.wri.org/blog/2015/07/forest-fires-blaze-indonesia

ITTO and JICA extend collaboration

ITTO Executive Director Emmanuel Ze Meka and Japan International Cooperation Agency (JICA) Director-General Kunihiro Yamauchi signed an agreement on 30 June 2015 extending collaboration between ITTO and JICA.

The agreement (formally called the "Minutes of Discussion", or MOD) aims to facilitate joint activities for the conservation and sustainable use of tropical forest resources within the context of ITTO action plans, biennial work programmes and thematic programmes and JICA's programme of work in the field of nature conservation. The MOD, which was signed at ITTO headquarters in Yokohama, Japan, is an extension of a 2010 agreement between the two organizations.

Read more at: www.itto.int/news_releases/id=4416

ITTO and APFNet launch project in Sarawak

ITTO and the Asia-Pacific Network for Sustainable Forest Management and Rehabilitation (APFNet) have launched a project to promote sustainable forest management (SFM) in the Sungai Mediht watershed in northern Sarawak, Malaysia. This 35 400-hectare forest has been degraded by unsustainable logging practices, with devastating impacts on the Kelabit and Penan peoples, whose livelihoods are based on shifting cultivation, collecting and hunting.

The community-based project will work to reverse the degradation of the watershed by establishing a baseline of data on forest resources, biodiversity, traditional knowledge and socioeconomic conditions; assisting the development of community-level forest management plans; demonstrating SFM practices; establishing community-based forest management mechanisms; introducing alternative livelihoods, such as vegetable-growing, ecotourism and the raising of poultry, fish and livestock; and creating or improving village infrastructure, such as a multifunctional meeting hall, a community school, alternative energy facilities and a gravel road.

Read more at: www.itto.int/news_releases/id=4360

JLIA to maintain focus on securing verified legal wood products

The Japan Lumber Importers Association (JLIA) elected Mr Satoru Yasuda as its new chair. In accepting the post, Mr Yasuda said the focus of his term in office will be on maintaining the system to ensure the consumption of only legal wood products. The JLIA will continue to require wood-product suppliers to supply verified legal products. Mr Yasuda is managing director of Sojitz Building Materials Corporation.

Read more at: www.itto.int/mis_detail/id=4425

Brazilian wood-product exports increase in the first quarter

Brazilian timber exports grew by 20% between January and April 2015. The rise was due mainly to the effect of a weaker currency against the US dollar and because producers actively sought export markets in the face of weak domestic consumption. The Brazilian Association for Mechanically Processed Timber, ABIMCI, said that while a recovery in US demand was helping, it will be insufficient to sustain overall output because domestic consumption is falling fast.

Read more at: www.itto.int/mis_detail/id=4406

Video demonstrates Guatemala's comprehensive electronic forest information system

Guatemala's National Forest Institute (INAB) recently released a video showcasing the Electronic Forest Enterprises Information System (SEINEF), which has been established through the ITTO project TMT-PD004/11 Rev.2 (M) (see *TFU* 24/1). SEINEF is a traceability system for registering, monitoring and controlling the flow of forest products through companies that are legally established and registered in the country.

The video is available in English and Spanish at www.youtube.com/watch?v=MyhZNKVYMqU and www.youtube.com/watch?v=Ol2s7UGoB_k

Video shows master plan for sustainable management of the Douala-Edea Wildlife Reserve

The non-governmental organization Cameroon-Ecology (Cam-Eco) has released a video in French showing the steps taken under an ITTO project to sustainably manage the tropical mangrove ecosystem in Cameroon's Douala-Edea Wildlife Reserve. The reserve has been subject to a wide range of destructive uses, but ITTO project PD 492/07 Rev.3 (F): "Participatory rehabilitation and management project for mangroves and watersheds in the coastal area of the Douala-Edea wildlife reserve " is aiding Cam-Eco in developing and implementing a master plan for the sustainability of the reserve, along with income-generating activities with low environmental impact.

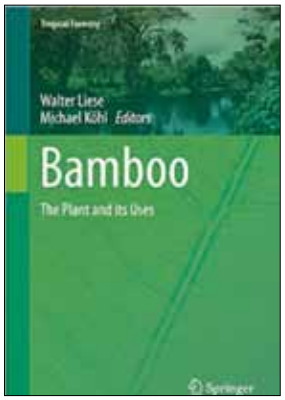
See the ITTO website at www.itto.int/project_search/detail/?proid=PD492%2F07+Rev.3+%28F%29 for a description of the project. View the video at: https://youtu.be/a7ZcZ4pK4mM

New fellowships announced

ITTO awarded 28 fellowships in the 2015 spring cycle. This newest group of fellows comes from 15 countries and includes 14 females, and the total value of the fellowships is US$150 000. ITTO offers fellowships through the Freezailah Fellowship Fund to promote human resource development and to strengthen professional expertise in member countries in tropical forestry and related disciplines. The goal is to promote the sustainable management of tropical forests, the efficient use and processing of tropical timber, and better economic information about the international trade in tropical timber. Read more and access the fellowship network at www.itto.int/feature20.

The deadline for fellowship applications in the autumn cycle is 21 August 2015. Pending review, the results of the Selection Panel will be posted on the ITTO website by November 2015, and fellowships should commence no earlier than 1 February in the following calendar year.

Recent editions

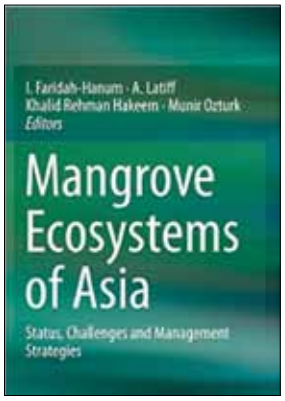


Liese, W. & Köhl, M. (eds) 2015. *Bamboo: the plant and its uses*. Springer International Publishing.

ISBN: 978-3-319-14133-6 (eBook)

Available at: www.springer.com/gp/book/9783319141329

This book presents state-of-the-art knowledge on bamboo. It introduces the plant's biology, taxonomy, habitat, morphology and growth and discusses its silviculture, pests and diseases, and harvesting techniques. The book also includes a comprehensive presentation of the properties and uses of bamboo, and preservation treatments.



Faridah-Hanum, I., Latiff, A., Hakeem, K.R. & Ozturk, M. (eds) 2014. *Mangrove ecosystems of Asia: status, challenges and management strategies*. Springer International Publishing.

ISBN 978-1-4614-8582-7 (eBook)

Available at: www.springer.com/gp/book/9781461485810

This book provides an up-to-date account of mangrove forests in Asia, together with restoration techniques and management requirements for these ecosystems to ensure their sustainability and conservation. The book has three sections: the distribution and status of mangrove ecosystems in Asia; their challenges, issues and opportunities; and management strategies for their conservation.

Romero, C., Putz, F.E., Guariguata, M.R., Sills, E.O., Maryudi, A. & Ruslandi (eds) 2015. *The context of natural forest management and FSC certification in Indonesia*. Occasional Paper 126. Center for International Forestry Research, Bogor, Indonesia.

ISBN: 978-602-387-002-8

Available at: www.cifor.org/library/5653/the-context-of-natural-forest-management-and-fsc-certification-in-indonesia/

The studies presented in this paper serve as a foundation for designing an evaluation framework for the impacts of Forest Stewardship Council (FSC) certification of natural forests in a participatory manner with interested parties, including institutions, organizations, communities and individuals.

Proceedings of the workshop on "assessment of forest management and REDD+ governance quality in PNG"

The "Workshop on assessment of forest management and REDD+ governance quality in Papua New Guinea" was held on 21–22 May 2015 under ITTO project PD 628/13 Rev.1 (F): "Development of quality-of-governance standards for reducing emission from deforestation and forest degradation (REDD) in Papua New Guinea". The purpose of the workshop was to develop principles, criteria and indicators of forest governance standards.

Available at: www.itto.int/project_search (please use the project ID to find the publication)

Poynton, S. 2015. *Beyond certification*. D, Oxford, UK.

ISBNs: pdf 9781910174555
epub 9781910174548
print 9781910174531

Available at: www.dosustainability.com/books

In this short book, Scott Poynton, founder of The Forest Trust, makes a compelling case for a new approach to social and environmental problems that goes "beyond certification". Certification emerged from the 1992 Rio Earth Summit amidst great hope. Since then, despite a proliferation of certification schemes in 25 industry sectors, the destructive exploitation of natural and human resources has worsened.

Beyond certification reviews the positive aspects of certification, of which there are many, but argues that we can no longer afford to gloss over its failures.

FAO 2015. Forests, trees and disasters. *Unasylva* 66: 243/244.

Available at: www.fao.org/3/a-i4447e.pdf

This double edition of *Unasylva* teases out the complex interrelationships between forests, trees and disasters and examines the ways in which forests and trees can best be managed to resist and protect from shocks. The edition was published to coincide with the World Conference on Disaster Risk Reduction, held in Sendai, Japan, on 14–18 March 2015. It covers a range of disasters and crises, especially natural disasters but also human-induced disasters and other complex crises.

Meetings

19–23 August 2015
New Frontiers of Forest Economics: Forest Economics Beyond the Perfectly Competitive Commodity Markets
Beijing, China
Contact: shashi.kant@utoronto.ca; http://neffe.nsd.edu.cn

23–30 August 2015
Sustaining Ecosystem Services in Forest Landscapes: Concepts, Research, and Applications
Tartu, Estonia
Contact: sandra.luque@irstea.fr; http://iufrole2015.to.ee

1–4 September 2015
A Global Perspective on the Ecology and Management of Bark and Wood Boring Insects
Bariloche, Argentina
Contact: Barbara J. Bentz, bbentz@fs.fed.us; www.iufro.org/fr/science/divisions/division-7/70000/70300/70305/

7–11 September 2015
XIV World Forestry Congress
Durban, South Africa
Contact: WFC-XIV-Info@fao.org; www.fao.org/forestry/wfc/en/

7–10 September 2015
ITTO side-events at the XIV World Forestry Congress
ITTO will host four side-events:
7 September: Voluntary Guidelines for the Sustainable Management of Natural Tropical Forests
8 September: ITTO–CITES Programme
9 September: Mangrove Forests and Ecosystems—Opportunities and Challenges for their Future
10 September: Electronic Tools for Ensuring Timber Legality and Wood Utilization.
Contact: www.itto.int/workshop_detail/id=4422

9–11 September 2015
Ecobuild Southeast Asia
Kuala Lumpur, Malaysia
Contact: www.ecobuildsea.com

9–11 September 2015
Wilder By Design? Managing Landscape Change and Future Ecologies
Sheffield, UK
Contact: info@hallamec.plus.com; www.ukeconet.org/events/event/wilder-by-design

15–16 September 2015
5th China Global Wood Trade Conference
Shanghai, China
Contact: www.gwtchina.org

16–18 September 2015
6th International Hardwood Conference
Copenhagen, Denmark
Contact: info@ihc2015.info; www.ihc2015.info

September 30–1 October 2015
Second International Conference on Community Land and Resource Rights
Bern, Switzerland
Contact: conference@rightsandresources.org

September 30–1 October 2015
17th St Petersburg International Forestry Forum
St Petersburg, Russian Federation
Contact: Andrei Vladimirovich Afanasiev, afanasiev@restec.ru; http://spiff.ru

6–7 October 2015
Timber Expo 2015
Birmingham, UK
Contact: www.timber-expo.co.uk

13–17 October 2015
Linking Ecosystem Services to Livelihood of Local Communities
Republic of Korea
(Seoul, 13–14 October; Naju-si, 15 October; Gurye, 16 October)
Contact: min34071@gmail.com; selenium78@krei.re.kr

14–16 October 2015
ATIBT Forum: Tropical Wood Feeding the Future
Milan, Italy
Contact: www.atibt.org/milan-2015-en/4588983445

12–16 October 2015
6th International Wildland Fire Conference
Pyeongchang, Republic of Korea
Contact: www.fire.uni-freiburg.de/course/meeting/2015/meet2015_02.htm html#

15 October 2015
Side-event at the 6th International Wildland Fire Conference: ITTO'S Field Work on Integrated Forest Fire Management in the Tropics—Best Practices and Lessons Learned on Fire Management in Tropical Forests. Starting at 12:00 p.m.
Contact: www.itto.int/workshop_detail/id=4423

19–20 October 2015
7th Palm Oil and Rubber Summit
Krabi, Thailand
Contact: friyana@cmtsp.com.sg; www.cmtevents.com/eventschedule.aspx?ev=151026&

19–23 October 2015
22nd Meeting of the CITES Plants Committee
Tblisi, Georgia
Contact: www.cites.org/eng/news/calendar.php

21–24 October 2015
Scientific Cultivation and Green Development to Enhance the Sustainability of Eucalypt Plantations
Nanning City, China
Contact: sxchen01@163.com; www.iufro.org/events/calendar/current/

26 October 2015
18th RRI Dialogue on Forests, Governance, and Climate Change
Washington DC, USA
Contact: dialogue@rightsandresources.org; http://rightsandresources.us10.list-manage.com/track/click?u=aac546f8cc4973feaef2608d9&id=e687c56921&e=3eb9466d7a

28–31 October 2015
Eco Expo Asia
Hong Kong, China
Contact: www.ecoexpoasia.com; ecoexpo@hongkong.messefrankfurt.com

3–5 November 2015
Managing Forests to Promote Environmental Services: Climate Change Adaptation and Mitigation, Water Protection, Biodiversity Conservation, and Soil Quality Maintenance
Copenhagen, Denmark
Contact: http://ign.ku.dk/english/outreach-publications/conferences-seminars/car-es-final-conference/

5–6 November 2015
7th International Symposium of Indonesian Wood Research Society
Bandung, West Java, Indonesia
Contact: iwors2015@mapeki.org; www.itto.int/workshop_detail/id=4240

16–21 November 2015
51st Session of the International Tropical Timber Council and Associated Sessions of the Committees
Kuala Lumpur, Malaysia
Contact: itto@itto.int; www.itto.int/workshop_detail/id=4240

16–21 November 2015
3rd European Forest Week and the 72nd Joint Session of the ECE Committee on Forests and the Forest Industry
Engelberg, Switzerland
Contact: paolo.cravero@unece.org; http://forests-l.iisd.org/events/silva2015-and-third-european-forest-week/#more-249570

30 November–11 December 2015
21st Session of the Conference of the Parties and 11th Session of the Conference of the Parties Serving as the Meeting of the Parties to the Kyoto Protocol
Paris, France
Contact: www.cop21.gouv.fr/en

2–3 December 2015
Log Trade Trends: a Global Perspective
Portland, Oregon, USA
Contact: http://logtradetrends.worldforestry.org

21–23 April 2016
PERCEPTION–PREDICTION–ACTION: Managing Risk in Uncertain Times
Istanbul, Turkey
Contact: http://riskanalysis-iufro.org//2016Meeting_Announcement.pdf

25–29 April 2016
Global Change and Forest Health—Climate Change, Biological Invasions, Air Pollution, Forest Pathology, Forest Entomology, and Their Interactions
IUFRO All-Division 7 Conference
Istanbul, Turkey
Contact: eckehard.brockerhoff@scionresearch.com

15–19 August 2016
15th International Peat Congress
Kuching, Malaysia
Contact: peat2016@gmail.com; www.ipc2016.com

24 September–5 October 2016
17th Meeting of the Conference of the Parties to CITES
Johannesburg, South Africa
Contact: www.cites.org

12–14 October 2016
Mexico's Forestry Expo
Guadalajara, Mexico
Contact: expoforestal@conafor.gob.mx; www.expoforestal.gob.mx

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