

The development of a community-based approach for an integrated forest fire management system in East Kalimantan, Indonesia

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Abstract

Every 3-5 years, El Niño-driven severe forest and land fires have occurred in East Kalimantan, Indonesia. In 1997/98, approximately 5.2 million ha were burned, affecting 25 percent of the entire province. During the last 20 years, fire prevention and suppression efforts have been limited and ineffective. Since 1994, the Integrated Forest Fire Management (IFFM) project has been supporting the provincial forestry department in developing a comprehensive fire management approach that includes prevention, information and suppression. An important aspect of this approach is the co-operation among agencies, the private sector and local communities. This paper focuses on the basic strategy and contents of a community-based fire management (CBFiM) system at the village level. Extension, training and technical support for village fire crews are planned to benefit the entire community. In addition, environmental education programmes are designed to increase public awareness of the negative impacts of wildfires. The Fire Information Unit supports CBFiM by providing information on fire occurrence, fire danger criteria and fire risk maps, while the Fire Operation Unit trains village fire crews. The provincial and district fire centres are the hubs of a governmental fire management organization. The role of these fire centres in promoting CBFiM is discussed.

1. Introduction

Every 3-5 years since the early 1980s, severe vegetation fires driven by El Niño Southern Oscillation (ENSO) have been reported in East Kalimantan, Indonesia (Goldammer *et al.*, 1996; Barber and Schweithelm, 2000). The worst ever-recorded wildfire occurred in 1997/98, which threatened the health of thousands of people in the province, partly interrupted sea and airborne transportation, and caused huge economic and ecological damage. Many reports have studied the impacts of vegetation fires in East Kalimantan and other Indonesian provinces (Goldammer *et al.*, 1996; Hinrichs, 2000; Mayer, 1989; Schindele *et al.*, 1989; Bappenas, 1999; Barber and Schweithelm, 2000; Schweithelm, 1999; State Ministry for Environment of the Republic of Indonesia and UNDP, 1998).

Most fires in East Kalimantan are human-induced. Only in very limited areas, burning coal seams, mostly ignited by previous fires, have some significance in causing wildfires. A large number of fires are the result of forest conversion for industrial plantations and escaped small-scale agricultural fires. Fire is the least expensive land-clearing method, and for most of the smallholders the only one available. Many local people are upland farmers who use fire to clear their land, but they have also experienced damage and losses due to wildfires.²

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² Assumptions are derived from interviews with villagers in fire-affected areas (unpublished), and also from Mayer (1989).

The Integrated Forest Fire Management Project (IFFM), jointly implemented by the provincial forestry service, Dinas Kehutanan, under the Departemen Kehutanan (DEPHUT - Department of Forestry of the Indonesian Ministry of Forestry) and the German Agency for Technical Co-operation (GTZ), is developing fire management capacities in East Kalimantan. The participation of local communities is fundamental to fire management concepts. Past experiences have shown that fire management can only be implemented successfully in a vast province like East Kalimantan, with limited access and infrastructure, if local communities participate. At the same time, this approach is directed towards community development, with a self-help focus.

2. The fires in East Kalimantan

2.1. Past and recent fire events

Lowland tropical rainforests are normally thought to be free of natural fire because of their moist environment. However, carbon dating of soil charcoal in East Kalimantan indicates that ancient fires occurred between 350 and 17,500 years ago (Goldammer and Seibert, 1990). This generally corresponds with the possible development of a more arid climate in the area between 15,000 and 18,000 years ago. These ancient fires are thought to be ignited when lightning struck exposed coals seams and through anthropogenic fire use. However, since the present wet, rainforest climate stabilised about 7,000 to 10,000 years ago, fires of the past 350 to 1,280 years may be attributed to the combined effects of periodic droughts and human activities (Goldammer *et al.*, 1996).

The large wildfires in the past 20-30 years are attributed to extreme drought (coinciding with ENSO) and numerous escaped fires originating from slash-and-burn land-clearing activities such as swidden agriculture and forest conversion. The first comprehensively recorded and evaluated large-scale forest fires in East Kalimantan were those in 1982/83, which affected an area of 3.2 million ha, of which 2.7 million ha were tropical rainforests (Schindele *et al.*, 1989). Significant fire events also occurred in 1987, 1991/92, 1993/94 and 1997/98 coinciding with prolonged droughts triggered by the ENSO phenomenon.

In 1997/98, the 12-month drought in East Kalimantan provided prime conditions for large-scale wildfires. At the peak of the event, National Oceanic Atmosphere Administration (NOAA) satellites recorded more than 2,000 "hot spots" in the province.³ Despite international support, the situation was uncontrollable and far beyond the existing firefighting capacity in the province. Approximately 5.2 million ha of natural forests, plantations, agricultural land, bush and grassland were burned, affecting a quarter of the entire province (Hoffmann *et al.*, 1999; Siegert *et al.*, 2001).

2.2. Fire causes

While most of the fires in the province are anthropogenic, glowing coal layers near the surface are also a potential wildfire source. Personal observations and interviews with villagers suggest that human-caused fires sweeping through the area often ignite such coal seams. Once lighted, these seams increase future fire risks by smouldering for a long time in an already degraded environment.

Until the mid-1990s, local communities were believed to be the main cause of wildfires in the province. Satellite observations and field reports during the 1997/98 fires helped to change this perception. In many cases, fires were used to clear land for large-scale oil palm plantations (Barber and Schweithelm, 2000). In addition, recent research indicates that shifting cultivation by

³ Satellites operated by NOAA's National Environmental Satellite, Data and Information Service (NESDIS). The prime customer for the satellite data is NOAA's National Weather Service, which uses the data to forecast weather for television, radio and advisory services. For fire detection, two infrared channels of the Advanced Very High Resolution Radiometer (AVHRR) sensor onboard of the NOAA satellites are used. Reference: www.noaa.gov/satellites.html.

traditional Dayak communities is not a significant cause of wildfires.⁴ Long traditions, customs and extensive knowledge normally prevent the irresponsible or uncontrolled use of fire in such communities (Aspiannur *et al.*, 1997; Colfer, 2001; Colfer and Dudley, 1993; Vayda, 1999). Nevertheless, information gathered from several villages in the Samarinda-Balikpapan and middle-Mahakam areas revealed that some accidental wildfires are caused by escaped shifting cultivation fires mainly started by farmers from non-indigenous ethnic groups (Abberger and Beebe, 1999; Aspiannur and Baraq, 1999; Colfer, 2001).

In addition, fires are sometimes lit to reduce land values. Obviously, land is assessed at lower values if covering trees or plants are destroyed (Vayda, 1999; Gönner, 1999).

Arson was a frequent cause of fires in 1997/98. In some areas, fire was used as a weapon in land-use conflicts between communities and concession or plantation companies (Abberger and Beebe, 1999; Nicolas, 1999). In other areas, people living within or adjacent to protected areas burned the forest in retaliation for being denied access and use of the forests (Aspiannur and Baraq, 1999). Gönner (1999) also reported disputes between families within a single community, which might have led to arson. Further examples of intentionally set fires were for hunting turtles in the swamp forests in the middle Mahakam area (Hoffmann *et al.*, 1999; Jepson *et al.*, 1998; Vayda, 1999) and fires lit to mask illegal logging (Vayda, 1999). Other wildfire causes reported by locals and concession staff include abandoned cooking fires in the forest, discarded cigarettes and burning garbage.

3. The IFFM fire management approach in East Kalimantan: an introduction

Established in 1994, the IFFM project works to develop and strengthen provincial and local fire management capacities in East Kalimantan. The project consists of the three technical sections – Fire Information, Fire Prevention and Fire Operations – which elaborate concepts, modules and training aimed at institutionalising fire management at provincial and district levels.

The provincial fire management organization in Samarinda, located at Dinas Kehutanan, is currently being inaugurated. It is designed to support fire management activities in East Kalimantan by identifying “hot spot” locations; producing fire danger-rating indices, fire risk maps and materials for prevention campaigns; supporting training and fire-suppression methods to all involved agencies and institutions. In addition, the provincial organization provides training, co-ordination and advice to develop local fire centres in the districts.

Local fire centres at 10 district forest offices as well as Kutai and Kayan Mentarang National Parks are currently being established and equipped with a wide variety of firefighting equipment including pumps, hand tools, vehicles, personal safety equipment, computers and office items. The centres are the core of a fire management organization at the district level. They are designed to establish and provide co-operative assistance, guidance and services in fire prevention, operations and information. They are to co-ordinate and directly support fire management efforts in the field, partly with their own firefighting crews, but also in co-operation with local communities and concession holders. The participation of local communities is essential for the success of fire management in East Kalimantan. Local fire centres provide information, materials, training and techniques to protect community land (homes, gardens, fields, forests) from fire. Local fire centre staff assists village leaders and/or extension workers in identifying and acquiring appropriate firefighting equipment and advise on techniques of proper fire use and control. At the same time, it is hoped that local communities will support the fire centres and concessions in preventing and fighting forest fires.

⁴ The term *Dayak* is a collective name for traditional (indigenous) communities in Indonesian and Malaysian Borneo. In East Kalimantan, they consist of 9 major groups - Kenyah, Punan, Bahau, Benuaq, Bentian, Tunjung, Lundayeh, Penehing and Dayak Pasir - and make up 20 percent of the province's population.

4. Community-based fire management approach in East Kalimantan

4.1. Selection of villages and rapid rural appraisal

Most of the 1,264 villages (BPS, 1999) in East Kalimantan are concentrated in the eastern lowland areas and along rivers. Due to the 1997/98 fires, many gardens and fields in the villages were damaged, resulting in crop reduction or failures. In anticipation of future droughts, these villages need to develop fire management capacities to protect their land from fires.

Approximately 70 villages are currently included in the IFFM programme. Villages are prioritised according to their location in relation to areas of high fire risk. A fire risk map that distinguishes five different risk classes, based on previous fire events, vegetation classifications and land-use information, is available at the province and district levels (Figure 1). It serves as the primary reference in selecting up to 15 priority high-risk villages in each district. Field workers visit these villages to discuss with formal and informal leaders the wildfire problem and identify necessary support. The major concern of villagers has been to improve their fire protection capabilities. All villages in the programme have suffered damage from previous wildfires. Village leaders often complain about the absence of governmental support for protecting their villages from fire, citing the lack of co-ordinated efforts and effective strategies as well as unsuitable or non-existent firefighting equipment.

IFFM offers a support programme to address these issues including modules for institutional development, fire management training, equipment use and maintenance.

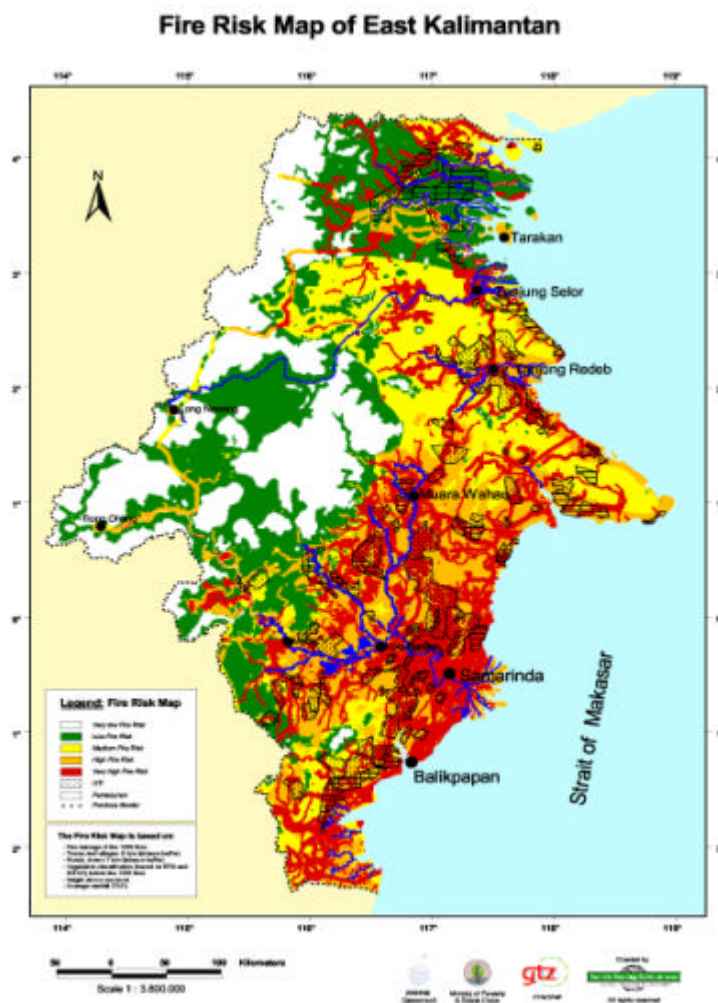


Figure 1: Fire risk map of East Kalimantan

4.2. Institutional development

IFFM's training module addresses the institutional aspect of fire management at the village level. In a two-day training workshop, strategies to protect village areas from future fires are discussed with participants from selected villages. The purpose of the workshop is to encourage villagers to organize themselves and discuss different aspects of village fire management. This training workshop has been successfully carried out at two locations, with participants from 11 villages (Figure 2).

The development of fire (management) crews – or volunteer village fire brigades – is a decisive step towards institutionalising village fire management. The major task of such crews is to prevent and suppress wildfires in the village and to promote safe burning practices in slash-and-burn agriculture in co-ordination and co-operation with the village and district authorities. Crews develop their own Standard Operating Procedures (SOPs) and require a regular budget from the village administration. These SOPs need to be simple and based on local conditions, knowledge and experience. Standard methods for hand tool maintenance and patrolling plans should also be included. Furthermore, the elaboration of an early warning system is needed to alert village fire crews of the increased risks of burning during extended dry periods.

The elaboration of SOPs is an initial step in developing co-operation and co-ordination among village fire crews and the district government, local fire centres, other land management agencies, and private forest and plantation management companies. Once co-operation agreements are prepared, government authorities can monitor and evaluate village fire prevention and suppression efforts more easily.

Establishing co-operation among neighbouring villages is another essential aspect of community-based fire management (CBFiM). IFFM helps to facilitate meetings among different villages to discuss experiences and solutions in fire management and identify common interests in fire prevention and suppression. Important aspects include communication among villages, prevention campaigns, patrolling and firefighting. Such efforts should result in formal village co-operation agreements and need to be included in the SOPs of village fire crews.



Figure 2: Village training exercise

4.3. Fire prevention and suppression training

Since the start of IFFM, more than 60 villages have received basic fire management training. In the first phase of the project, it mainly focused on fire suppression. The programme later evolved to provide a mix of theory and field practice, and give greater consideration to local conditions, knowledge and experience of the participants. A participatory approach is used to facilitate discussions, role-playing and other activities. The curriculum includes fire prevention, environmental education, institutional issues, the role, functions and responsibilities of fire crews, the use and maintenance of simple equipment and also firefighting strategies and techniques. A comprehensive training manual will be published in 2002.

A five-day “Training of Trainers” approach has been designed for extension workers, forestry staff, crew bosses and community leaders, who have already passed the basic fire management training. Two training sessions have been carried out successfully in 2001. Supporting training manuals and materials are being prepared.

4.4. Firefighting equipment at the community level

Equipment traditionally used to fight fires consists of simple hand tools like machetes, wooden rakes and small bamboo hand-pumps. When nothing else is available, banana leaves or a bundle of wooden sticks are used to fight fires. Generally, such equipment is effective in fighting grass fires or safeguarding small “slash-and-burn” fires, but it is unsuitable for “hot” wildfires like those in 1997/98.

To elaborate a standard for firefighting at the community level, hand tools have been introduced and evaluated during training. Hand tools have to be suitable for local conditions. They have to be light and their dimensions have to fit the people who use them. The backpack pump, the Pulaski (two-function hoe) and the McLeod (two-function rake) are the most favoured tools. Additionally, the fire swatter, useful to fight grass fires, is well accepted. IFFM has assembled “tool boxes” to support village fire crews of 15 to 20 members. More than 100 hand toolboxes are being handed over to communities in close co-operation with the district forestry services and the local governments on condition that the villages have officially established fire crews and drafted SOPs. In addition, suitable storage rooms have to be provided, which can also serve as village fire (management) posts. In the future, one task assigned to local fire centre staff will be the support of village crews in maintaining and repairing their firefighting hand tools.

4.5. Further incentives to support CBFiM

The provision of training and hand tools by IFFM are initial incentives to support villages in building their capacities in wildfire prevention. To further develop CBFiM and eventually enhance the sustainability of such efforts, continuous support by the government is needed. Once a village develops a fire management organization, the village fire crew needs official recognition by the district and provincial governments to receive administrative, financial, organizational, educational and legal support. Apart from these basic steps, further incentives are necessary. For example, successful wildfire prevention and suppression might be rewarded with village infrastructure and income-generating programmes.

5. Fire information – potential benefits for local communities and their necessary contribution

The IFFM supports the Fire Information Unit of the provincial fire management organization by providing fire danger-rating information through drought index calculation, weather forecasts including El Niño predictions, satellite-based hot spot data and fire risk mapping (Figure 3). Such information is the foundation of fire management planning and has been made available at the national, provincial and district levels. It remains, however, unclear how this information can reach villages in fire risk areas and be translated into essential details for fire prevention or suppression in the field.

5.1. Early warning system

The Keetch Byram Drought Index (KBDI), introduced and applied by IFFM and calculated by the governmental meteorological service – Badan Meteorologi dan Geofisika (BMG) – for the province, is the basic tool for an early warning system for fire.⁵ The index is input into a fire danger-rating matrix that describes four fire danger classes as low, moderate, high and extreme.

⁵ IFFM adapted the KBDI, used in some states in the US, to East Kalimantan conditions. See Deeming (1995) and Weidemann (2002).

The SOPs for fire prevention and suppression depend on the current and expected fire danger rating, in combination with other factors such as El Niño predictions, and local weather forecasts and conditions. Village fire crews elaborating SOPs have to combine drought index information with their knowledge of local conditions, and a seasonal calendar for land preparation, planting and harvesting. The fire danger-rating information has to reach the village fire crew regularly. This can be accomplished by establishing communication links among villages, the local government, and concession and plantation companies.

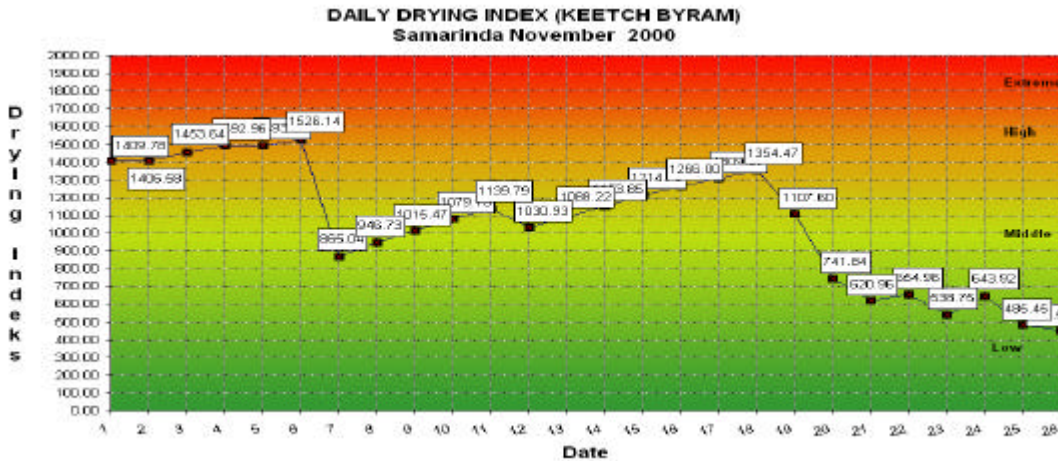


Figure 3: Example of the fire danger-rating information used in East Kalimantan

5.2. Communication system

Communication technology is still limited in the interior of East Kalimantan. Although telephones are available in almost all the smaller towns in the province, most villages remain unconnected. The only communication lines available in such areas are satellite telephones and short-range radio systems, used mainly by concession and plantation staff.

In many villages, simple battery-powered stations are used to communicate with neighbouring villages and towns, reaching sometimes as far as 40-50 km. In addition, most of the government sub-district offices have radio communication stations that allow them to contact the district administration and villages. Early warning messages can be relayed to villages through direct communication between local fire centres and villages within the communication range of the centre. However, very often such information might reach villages through governmental communication links and should be reported from village to village following a fixed sequence. The participation of concession and plantation companies in transmitting early warning will be important to fill the gaps. Additionally, field workers of the Forestry and the Agricultural Service can broadcast messages, especially during high or extreme fire danger in certain areas.

With the support of IFFM, the provincial forestry service plans to develop a radio communication system for fire management in East Kalimantan. Once this system has been established at each local fire centre, fire danger index, hot spot and other relevant information can be provided to district government agencies, concession and plantation owners, and villages. Likewise, all field observations can be reported to the local fire centres. The system has to allow access to the villagers apart from concession and plantation staff.

5.3. Village fire risk sketch-mapping

One of the tasks of a village fire crew is to sketch-map fire hazards and determine fire risk areas based on previous fires and the knowledge of local conditions in relation to existing vegetation types and land use. A sketch-map is an elementary instrument for the elaboration of SOPs in combination with determining the village fire crew's response area for firefighting. Additional information such as village posts, water reservoirs and equipment locations should be included.

Village fire risk sketch-maps can become a valuable information source for the provincial and district fire centres by adding more specific details from such maps into district fire risk maps, digitally produced by the provincial fire centres. They will also support the provincial fire centre in setting up a database of fire relevant information such as available firefighting resources in the province, which includes village fire management efforts.

5.4. Hot spot information and early detection

Hot spot data might be useful as early fire detection information and therefore can support initial response efforts, assuming that they reach government or concession fire crews in time. The usefulness of hot spot data for village fire crews, however, is questionable. Villagers may have already spotted a fire before hot spot data are available. In addition, hot spot data or co-ordinates are useful for village fire crews only if they are translated into descriptions of estimated fire locations, since Geographic Positioning System (GPS) tools are not easily available. The parties that potentially benefit most from hot spot data might be concession/plantation companies and government agencies. Normally, the provincial fire centre would evaluate hot spots in combination with land-use information, based on government land-use maps, and send daily reports to local fire centres, which then inform companies and district government agencies about fires in their respective areas.

6. Environmental education as part of CBFiM

From the beginning, IFFM has been continuously designing fire prevention materials and carrying out campaigns in various forms together with government agencies, non-governmental organizations (NGOs) and other institutions to directly or indirectly support CBFiM in East Kalimantan. Dozens of campaigns – with hundreds of participating villagers – were carried out in the past years within the framework of village extension work to raise awareness on the negative impacts of uncontrolled fires and the importance of CBFiM (Table 1). Additionally, IFFM has disseminating information on fire prevention to teachers, government extension workers, NGOs, university students and others, and distributed thousands of leaflets, posters, stickers, and fire prevention comics at seminars, workshops and training events. Such activities are aimed at supporting and encouraging potential “community agents” to help spread the fire prevention message to as many people as possible.

Most households in East Kalimantan have access to radio transmissions and to a large extent also to television and newspapers. Consequently, the co-operation with the mass media has been intense from an early stage of the project. It resulted in numerous newspaper campaigns, interviews, television talk shows, and television and radio coverage of fire prevention campaigns. A future goal will be to integrate early warning information into the daily weather news for the province, particularly in high and extreme fire danger situations. IFFM also has been co-operating with an Indonesian television star (Kak Seto) to promote the Indonesian fire prevention mascot “Si Pongi” (Figure 4). Together, various marketable Si Pongi items have been produced, a theatre show for children designed and carried out, and a music cassette produced. Recently, Si Pongi has become a regular attraction in a national children's television show that is watched by millions of children all over Indonesia.



Figure 4: “Si Pongi”, the Indonesian fire prevention mascot, attracts children at a shopping centre in Samarinda

7. Framework for the success of CBFiM in East Kalimantan

The participation of communities is crucial for a successful fire management system in East Kalimantan. However, an important question remains: why should communities fight wildfires if they do not have access to the areas or draw immediate benefits from the areas where the fires occur?

The misuse of fires to resolve land-use conflicts, as well as the uncertainty of land tenure, and unclear or conflicting land-use allocation need political solutions, whereas using fire as a tool in shifting cultivation or accidental fires can be addressed by educational and training programmes that are supported by government institutions. The Indonesian government must formulate and implement policies to deal with the underlying causes of wildfires that occur almost every year and become most severe during El Niño years. Special attention has to be given to land allocation and tenure rights. Very often, rights granted to concessionaires or in connection with transmigration contradict or challenge traditional rights of local communities. A just and transparent legal system and procedures to resolve emerging conflicts must be developed and implemented, taking into account the traditional and social aspects of the communities affected by government policies and actions. To implement and enforce such policies and legal concepts, the capacities of government institutions and other stakeholders have to be increased strengthened. A dialog among all stakeholders to tackle these political issues is urgently needed, as is a system of incentives for local communities that fight fires. The provincial fire management system and the district fire centres will have to help implement the political means that promote the rights and involvement of local communities in an overall fire management system, in which all stakeholders from all levels have to take part.

Table 1: IFFM fire prevention efforts in East Kalimantan

Prevention activity	Details	Comments
Extension work in villages	Around 40 prevention campaigns have been carried out in different villages, attended by an average of 50–100 villagers. In a three-hour event, fire prevention was discussed, videos shown and materials distributed.	A high and costly input, long-term impact is questionable without follow-up training and institutional development.
Training and seminars with school teachers	Fire prevention was discussed and materials distributed.	Representatives of the Education Department approach IFFM regularly to obtain support (materials and information) for school events in the province.
Support of an Environmental Education Network together with several local NGOs	Regular meetings and two provincial workshops were carried out, with fire prevention included as one important item on the agenda.	Progress is slow due to limited funding. The network has set up a secretariat; the network's Internet address is used for discussions among members; more interested parties are getting involved.
Drawing competitions on environmental topics	IFFM supported dozens of such events in major cities and several villages in East Kalimantan.	Often, a Si Pongi costume has been used to attract children; various fire prevention materials were distributed.
Competitions among different villages engaged in CBFiM	Competitions among village fire crews presenting their skills in firefighting or general sports competitions; IFFM has been partly facilitating and sponsoring such events.	Help to motivate village fire crews and support them in their role as a village organization. Huge audiences are ideal for distributing fire prevention materials.
Promotion of the Indonesian fire prevention mascot, "Si Pongi"	In close co-operation with Kak Seto (Mutiara Indonesia Foundation), various prevention materials have been produced, a TV and radio show conducted.	Currently, Kak Seto is running his new TV programme and regularly integrates Si Pongi into the show.
Roadside campaigns	During high fire danger periods, IFFM together with the government conducted several road campaigns in protected forest areas and distributed fire prevention materials.	Proved to be an effective way to reach thousands of people in one day.
Signboards and banners with fire prevention messages	IFFM has been setting up dozens of signboards and banners with fire prevention messages in the most fire-prone areas.	Currently, new signboards and banners are being designed; more than 100 will be installed in 2002.
Fire prevention video clips for TV	Two video clips were produced and aired locally, and partly nationally.	A new video clip to promote "Si Pongi music" is being produced.
Fire prevention information in local newspapers, radio and TV	Letters and comics in local newspapers; TV and radio interviews, talk shows, etc., are being produced.	Regular coverage during "fire seasons"; fire danger-rating index is not published regularly yet.
Display of fire prevention materials and relevant information	IFFM regularly participates in exhibitions in the province (2-3 times per year) and sets up counters displaying prevention materials and fire information.	Proved to be quite efficient by reaching thousands of people; particularly school children can be easily attracted (by Si Pongi!) and provided with information.

8. Conclusions

CBFiM is still in an early stage of implementation in East Kalimantan, although components such as extension and training have been part of fire management involving village communities since the beginning of IFFM. The programme aims at integrating village communities into wildfire prevention and suppression efforts. Its success very much depends on two crucial issues. Firstly, CBFiM has to be part of community development processes that benefit local communities. Secondly, provincial and district governments have to support such community efforts.

The community's interest in protecting their land from fire is the basic entry point for the development of CBFiM in East Kalimantan. Providing training and equipment, and facilitating efforts to establish a village organization strengthen the capacities of village communities in fire prevention and suppression, and therefore, are directed at communities' self-help approach. Various long-term educational measures and campaigns have to accompany and support CBFiM processes as early as possible. CBFiM will commence only after a village organization has been established.

Whether CBFiM can support fire management beyond the protection of community land in the future, i.e. by suppressing fires in concessions or protected forests, will very much depend on the necessary support given to village fire crews from the provincial and district governments, and the private sector. Thus, the co-operation among these three key players will be crucial to prevent large-scale wildfires in the future. It is, however, inappropriate if local communities are only regarded as a source of forest firefighting workers. The success of CBFiM will depend on how the government tries to address the underlying causes of fire such as land disputes that are partly triggered by the national government's neglect of traditional community forest rights in the first place.

Another important aspect is the development of suitable regulations limiting the (mis-)use of fire. Large-scale forest conversion with the use of fire has to be prohibited, while on the other hand, small-scale forest conversion by shifting cultivators should be permitted, i.e. by the introduction of burning permits. Such regulations are part of CBFiM's framework and must be enforced by the government. In turn, village fire crews together with their village administration can introduce a reporting system for fire use in their respective villages, through which they would implement existing government regulations.

CBFiM in East Kalimantan has to build on the willingness and motivation of village communities to contribute to fire prevention and suppression. The approach has already shown some promising results in certain areas. It is hoped that CBFiM might become the key to prevent and suppress wildfires more successfully in East Kalimantan in the future.

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