Forest fire fighting using hand tools. Photo: Pak Doni

Fire management – the dynamics of organizations and people

Brett Shields

"Extreme wildfire events can be analyzed, understood and better managed by learning from the past, to enable fire organizations and people to take positive steps forward."

Introduction

The growing number of wildfires around the world is an indication that something has upset the balance of nature. Climate change is one driver, but human fire management and decision making across the landscape is a larger and stronger influence. Wildfire occurrences cannot be passed off as being purely driven by climate change. Humans are responsible, and must play a role in finding and implementing solutions, and quickly.

The impacts in both developed and developing countries alike are obvious — large tracts of land burned by wildfires, smoke pollution, and lives and housing lost. Climatic factors that drive extreme wildfire events are not a surprise to land managers, as they are cyclical and predictable. Coupled with this is the influence of mass media and politics, searching for alarmist headlines rather than stories of low-profile or long-term planning that drives solutions. This can create negative feedback loops by encouraging

politicians to seek quick wins rather than considered, longer-term decision making; this can exacerbate fire disasters. Furthermore, land and disaster agencies are applauded for their heroic response efforts, and rightly so, but often within those same agencies there remains inadequate emphasis on preventing fire disasters in the first place. Such imbalances, and the human choices behind them, show that something is wrong, although we have the capacity to make positive changes.

The fire historian Stephen Pyne eloquently places the global perspective into what he calls the "pyrocene," which we have created and must learn to live within. His concept includes three paradoxes (Pyne 2021). The first is that the more humans try to remove fire from landscapes that have coevolved with fire, the more violently fire will return. The second is that even as wildfire disasters gather more media attention, the total area of land burned is actually diminishing. Third: while striving to reduce carbon emissions, the planned and intentional burning of some landscapes will have to increase.

There will undoubtedly be more large-scale wildfires if the status quo prevails (Kurvits et al. 2022). This article assesses what can be done by land managers, communities and politicians to make better decisions that reduce fire risk and impacts. It does so by discussing the 'how' and the 'who' of fire management – organizations (institutions or agencies, formal or informal) and people (impacted by fire or those working in of such organizations).

From past to present

The drivers of wildfire in any place and at any point in time result from the combined influence of climate and vegetation and fire ecology, coupled with the influence of humankind in all its manifestations, and the use, or not, of prescribed fire. To understand landscapes today, it is useful to differentiate fire in human history in three approximate periods: the Holocene epoch (~11,000 to 250 years BP), the industrial period (~250 to 20 years BP), and the present day (~20 years BP to present).

Considering a landscape, its vegetation and its natural- or human-induced fire occurrence over time helps to reveal the interactions of humans and ecology. This allows for an understanding of the impact of circumstances on wildfires in the past as compared and contrasted to today, when something is clearly amiss (Figure 1). History does not tell the story of wildfire disasters as we see and feel them today. Records do not tell of communities ravaged by wildfire, but of those that worked with fire and lived with fire in order to manage their needs and the wider landscape. So, what has changed from the past to today, and what is it that we cannot see or seem to grasp.
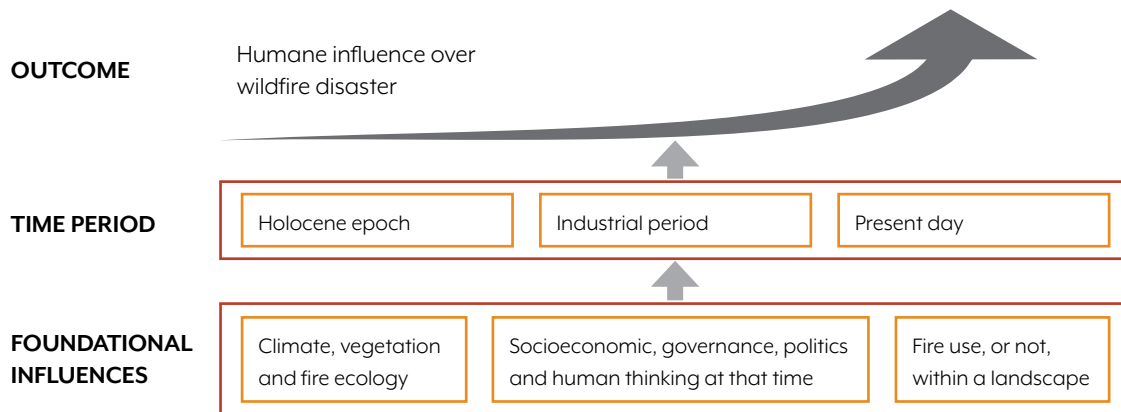

OUTCOME	Humane influence over wildfire disaster
TIME PERIOD	Holocene epoch	Industrial period	Present day
FOUNDATIONAL INFLUENCES	Climate, vegetation and fire ecology	Socioeconomic, governance, politics and human thinking at that time	Fire use, or not, within a landscape

Figure 1: Factors that influence wildfires over time

In Australia, for example, indigenous culture and the practice of burning were almost wiped out under European dominance and influence. However, there is now a resurgence of indigenous cultural awareness that also includes the reintroduction and use of prescribed and traditional fire techniques (Firesticks Alliance n.d.). In Indonesia, some indigenous Dayak communities still use prescribed fire in a manner akin to that used 400 years ago. They prepare land by creating firebreaks, and light a planned and controlled fire to clear an area for planting. However, prescribed fires in this context still create dangers from smoke pollution, and cannot and should not be used in certain ecologically sensitive areas or on soil types such as peatlands.

Every place across the globe has its own story to tell in terms of the use, misuse, understanding and misunderstanding of fire within and across the

landscape. Land managers need to successfully navigate that knowledge and understand and characterize their landscape and situation, no matter how appropriate or inappropriate the use of fire seems at that time, to comprehend it in terms of balance within the local ecology. Only once this is understood can the next steps be taken to better manage fire with a landscape.

The "how" and the "who" of managing fire

It is usual to refer to the "who" first and the "how" second, but considering the evolution of fire management and events to the current day, this normal order is reversed. In the past, when discussing organizations, their policies, plans and practices, the core facet of 'the people' was often overlooked. More frequently today, however, people are included as an integral component of community-based forest management, indigenous fire management and 'living with fire'. Such 'people discussions' can be devoid of organization to a certain level, and as such, are presented afterwards.

Assessing "who" manages fire attempts to describe the group of people or stakeholders involved in decision-making processes and fire management practices. Assessing "how" people manage fire and attempts to describe the organizational models (formal or informal) involved. When considering these two facets, there is also a multitude of influencing factors to think about, such as the landscape context (fire tolerant, fire intolerant or fire interdependent), economic development of the country/region, and presence (or not) of institutional structures to manage fire.

The split into these two categories, organizations and people, is not clear in the literature. There are elements of overlap, but dividing the discussion, however, allows for a more structured thought process for making better management decisions regarding the implementation of fire management practices across a landscape. Three different management approaches are introduced: local; landscape; and territorial (or jurisdictional). See Table 1.

Table 1. The "how" and "who" of fire management

How	Who
Organizational measures that address fire management activities (prevention, suppression, etc.).	*The group of people who discuss and decide on fire management activities within their various settings.*
Local approaches	
These include community wildfire protection plans (CWPPs) and community protection plans (CPPs).	CWPPs and CPPs are often used in developed countries and in the wildland-urban interface (WUI), e.g., in the US and Australia. They are mainly used to organize local people with activities and possibly equipment to help protect and defend against wildfires. Community-based fire management (CBFiM) is predominantly a process to engage people, often used with developing agrarian societies. It is not an organizational process, but an engagement approach.
Landscape approaches	
These include integrated fire management (IFM) and integrated forest fire management (IFFM).	IFM and IFFM are holistic approaches to manage wildfire using prevention, preparation, suppression response and recovery. They involve people from institutions or organizations that have legal or regulated jurisdictions, such as forestry companies, government, and conservation or fire agencies. They can also benefit from improved community engagement processes.
Territorial approaches	
This includes fire-smart territories (FSTs). It must be noted, however, that this concept is theoretical at present, and its practical application still in the trial phase.	FST includes a people-empowerment approach, but has not yet been applied in the field. *Living with fire* (see Stoof and Kettridge 2022) is a relatively new approach that involves the breadth and diversity of inclusion needed to better manage complex fire situations. This author has aligned that concept to the increasingly wider requirements of the FST approach, but this could be constrained at a landscape scale, or even at local levels.

Organizational models – the "how"

Fire management organizations and institutions can be local or national; formal (regulatory or statutory) or informal (community or locally determined); involve paid or volunteer staff; and include land management agencies (public or private) or civil protection/disaster management agencies (public or NGO). No one size fits all, but there are common principles, practices and pitfalls. The need to be both specific and adaptable in terms of management and organization in any one landscape cannot be underestimated. Also, simply transplanting an organizational approach from one location to another has repeatedly been shown to fail.

The following questions should be asked:

1. What is the scale being considered? Is it community scale, one that encompasses a village, a landscape type such as a peatland hydrological unit, or a jurisdiction such as a district or province?

2. What regulated institutions or unregulated organizations are currently working on fire management? Do they have legal mandates, are they bounded by regulations to perform only certain activities, do they address the needs of the whole landscape, and do they meet the needs of local communities? Note that although it is often perceived that only a large or regulated organization can manage fire well, history has shown otherwise.

3. What are the gaps in and local needs for fire management? Is it support to prevent fires igniting; to mitigate the spread and impact of unwanted fire on human or ecological values; for firefighting and suppression; to reintroduce fire to a fire-tolerant or fire-dependent ecology; and/or to develop more fire-resilient infrastructure and livelihoods?

Local approaches

These include community fireguards, community wildfire protection plans, and land management plans (which usually require people to undertake actions in their region). Usually applied at the household, village or suburb level, they are often supplemented by professional fire services that support fire management activities in the surrounding landscape, including firefighting if a wildfire does occur. These approaches are common in regions where property and lives have been lost as a result of fire. They are also common in places where professional fire services have difficulties protecting high-value assets such as houses adjacent to vegetated areas, often referred to as the wildland-urban interface. This tends to occur in locations where people do not make their living from the land.

In rural areas, there are fewer professional fire services to support or participate in planning, and when a fire does occur there is also limited capacity for government fire service response. Local approaches are often governed by community interactions with an NGO or local company, who develops a fire management plan with the community. This may incorporate components such as participatory mapping, use of a local fire-danger scale to monitor when it is appropriate to ignite a fire, and various kinds of suitable firefighting equipment. These types of planning constructs are often informal, and are used to varying degrees across other tropical countries.

Landscape approaches

Initially known as integrated forest fire management, this was introduced in Indonesia in the early 1990s as part of a project supported by the German government (Schindler et al. 1996). The range of activities across the spectrum of fire management was not as complete as it is today, but did include facets of prevention, pre-suppression, suppression and prescribed or controlled fire. However, a literature review of national wildfire management capabilities in Thailand in 2000 could not find an effective institutional design of a land management agency that was appropriately balanced to build or guide fire-management capabilities (de Mar et al. 2000).

In response to this gap, a structured basis for integrated fire management was developed, borrowing the concepts of prevention, preparedness, response and recovery from the emergency management sector, and adding a problem-analysis stage. This stage is a crucial first step to understand the fire context within a landscape; it is needed to guide the development and implementation of activities to improve the situation. Frameworks of IFM as an organizational construct emerged in the 2000s (Arbor Vitae 2003; Myers 2006) (Figures 2 and 3). These were designed to lead to ecologically and socially appropriate, as well as organizational, approaches to managing fires and to address fire-related issues.

Myers (2006) added an adaptive management feedback loop (Figure 3), and expanded the approach to be relevant at local, national and even multi-national scales. Arbor Vitae's five-step framework later became the 5Rs of fire management: review, risk reduction, readiness, response and recovery (FAO 2011).
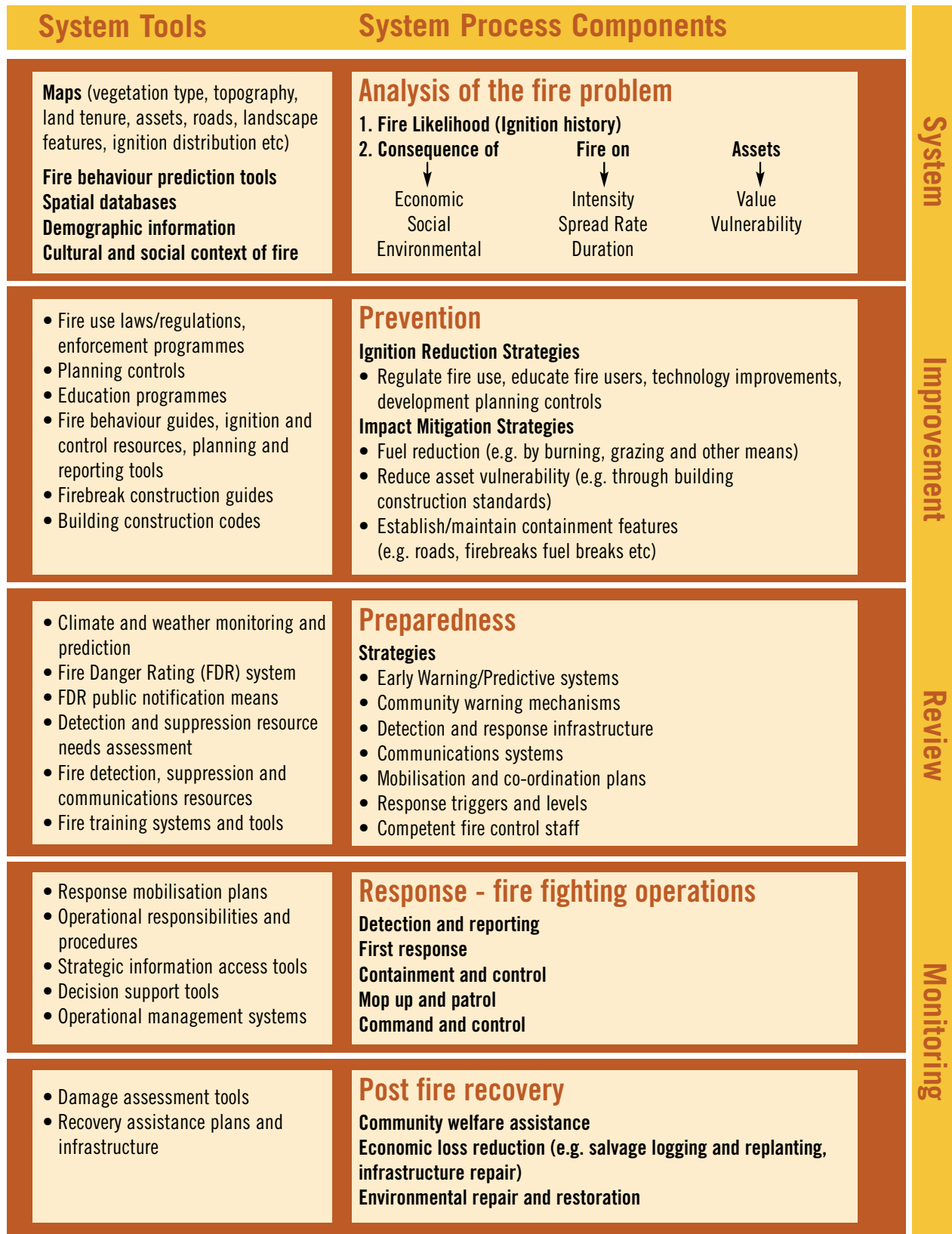
A Framework for Fire Management

System Tools	System Process Components	

Maps (vegetation type, topography, land tenure, assets, roads, landscape features, ignition distribution etc)
 	
Fire behaviour prediction tools
Spatial databases
Demographic information
Cultural and social context of fire
	Analysis of the fire problem
	1. Fire Likelihood (Ignition history)
	2. Consequence of **Fire on** **Assets**
	      ↓ ↓ ↓
	  Economic Intensity Value
	  Social Spread Rate Vulnerability
	  Environmental Duration
		System

• Fire use laws/regulations, enforcement programmes • Planning controls • Education programmes • Fire behaviour guides, ignition and control resources, planning and reporting tools • Firebreak construction guides • Building construction codes	**Prevention** **Ignition Reduction Strategies** • Regulate fire use, educate fire users, technology improvements, development planning controls **Impact Mitigation Strategies** • Fuel reduction (e.g. by burning, grazing and other means) • Reduce asset vulnerability (e.g. through building construction standards) • Establish/maintain containment features (e.g. roads, firebreaks fuel breaks etc)	**Improvement**
• Climate and weather monitoring and prediction • Fire Danger Rating (FDR) system • FDR public notification means • Detection and suppression resource needs assessment • Fire detection, suppression and communications resources • Fire training systems and tools	**Preparedness** **Strategies** • Early Warning/Predictive systems • Community warning mechanisms • Detection and response infrastructure • Communications systems • Mobilisation and co-ordination plans • Response triggers and levels • Competent fire control staff	**Review**
• Response mobilisation plans • Operational responsibilities and procedures • Strategic information access tools • Decision support tools • Operational management systems	**Response - fire fighting operations** **Detection and reporting** **First response** **Containment and control** **Mop up and patrol** **Command and control**	**Monitoring**
• Damage assessment tools • Recovery assistance plans and infrastructure	**Post fire recovery** **Community welfare assistance** **Economic loss reduction** (e.g. salvage logging and replanting, infrastructure repair) **Environmental repair and restoration**	

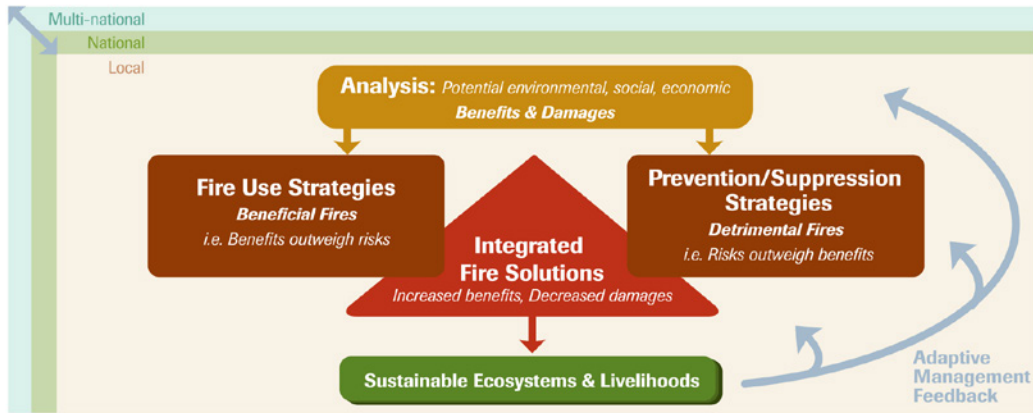**Figure 2: A five-step framework for fire management. Source: Arbor Vitae (2003)**

Figure 3: Schematic of an ecologically driven integrated fire management solution. Source: Myers (2006)

The European Fire Paradox project introduced IFM as part of its aim to simultaneously consider actions to both reduce the damage caused by fire and promote the benefits of fire use, and to achieve this using a balanced approach called integrated fire management (Rego et al. 2010; see Figure 4). European adoption of IFM is targeted to rebalancing fire use within landscapes as a traditional and ecologically appropriate tool, and to reintroducing fire as a firefighting tool, such as using a backfire to stop the spread of a wildfire.

Figure 4: Schematic of the process to reintroduce prescribed fire in Europe using integrated fire management. Source: Rego et al. (2010)

IFM is valuable to different people in different contexts, but there does not appear to be a singular defining use. However, when looking at the four different versions of IFM — a project design concept (Schindler et al. 1996), an organizational design tool (Arbor Vitae 2003), an ecological balancing approach (Meyers 2006), and a reintroduction of prescribed fire (Rego et al. 2010) — each seeks a holistic balance and an appropriate use (or absence) of fire in a landscape, and adopts an approach that is more than just suppression-based. IFM uses inclusive language and approaches that can be adapted to integrate all aspects of fire management in a landscape.

Territorial approaches

More recently, the fire-smart territory (FST) approach was developed as a new construct for the organizational management and appropriate use of fire, alongside the need for inclusive dialogue (Tedim et al. 2016). This approach explicitly works to understand fire management by coupling human and natural systems to find a balanced way to integrate the use of fire into landscapes, and to reinforce the need for consultation with and within communities. In broad terms, FST aims to bring together facets of IFM and community engagement.

FST is defined as "a territory with a shared governance model, in which empowered communities with high levels of knowledge and skills are able to decide and manage wildfire risk to keep it very low, through economic and social activities that not only can contain (in the end eliminate) wildfire hazard but promote the benefits of fire use" (Leone et al. 2020). FST offers an encompassing approach that includes organizational, ecological and social components. However, its use may create concern within communities that do not (or may not be

able to achieve) high levels of knowledge or skill in fire management decision making, or that may not consider the elimination of fire to be an appropriate end outcome.

The FST construct is certainly comprehensive. However, bringing together so many moving pieces, driving forces, operational principles and targets for efficiency and economic effectiveness (Tedim et al. 2016) makes it difficult to apply in field-level programmes. Also, its foundational concepts and approach are focused on addressing extreme wildfire events, as defined by Tedim et al. (2018), and thus would need to be adjusted to be implemented in landscapes that do not face events of such magnitude, intensity or complexity. Further consideration and analysis of FST within tropical landscapes is needed to better understand its potential areas of utility, and where it may be applicable.

The people and organizations to be involved — the "who"

The interactions between landscapes, people and fire are clear. Furthermore, in the same way that landscapes are not homogenous, neither are the people living in them. Determining who should be involved in fire management must include not only who the managing authority is, but who is affected.

However, it has taken time to acknowledge this important aspect. At a community-based fire management conference in Thailand almost 25 years ago, some participants argued that communities had almost no role to play in managing forest fires, and were only causes of fires. Authors of a paper presented there (Jackson and Moore 1998) also discovered that relevant, high-quality information on community involvement in fire management was difficult to find. In addition, early IFM constructs did not articulate the "who" facet or how to engage with people. The more recent concept of FST is beginning to involve these elements through its combined "human/natural system" approach, but this has yet to be applied in the field.

There are three aspects of "who" — people, institutions and communities — and various ways to engage them. Within these groups are different motives that drive their behaviour.

People
Engagement processes with people living in vulnerable conditions are significantly different from those for people who are more secure. So as part of the problem analysis (review) stage at the beginning of a wildfire programme,

the analysis of the people within a landscape must include a consideration and understanding of differences in wealth, health and education, all of which could affect engagement methods.

Institutions
The institutions that undertake fire management are as varied as the landscapes themselves, within three primary types:

- formal organizations and settings: governments and regulatory bodies working on behalf of a jurisdiction, such as a district, province, conservation area or forest reserve;
- semi-formal organizations and settings: private companies on private land (which may or may not be regulated), or NGOs/conservation groups working on private lands or public conservation land; and
- informal organizations and settings: individuals, community or volunteer groups, whose activities may extend to areas beyond their home jurisdiction.

Defining the characteristics and drivers of each of these types of institutions is complex, but three aspects are notable. First, whether people are managing fire inclusively with wider society or exclusively — not all landscapes can be managed one way or the other, however, and the distinction may not be important. Second, accepting that politics and governance are not the same — governance is a non-ideologically-driven process that aims to improve the health, wealth and well-being of all people and the landscapes they live in; politics is an ideological approach that favours only some people. Third, the balance of technologically-driven or traditional techniques — a need for both is likely, and it may include prescribed fire skills from the past that have been lost.

Communities
Characterizing communities allows for a better understanding of how fire management concepts and practices may be differently treated by different members:

- communities that are dominantly agrarian or forest-oriented, or those that have livelihoods not specifically connected to the land;
- whether communities have secure land tenure, a key factor being not just the type of tenure, but whether people feel secure with the arrangements and their rights — an informal traditional tenure system may be stronger than formal tenure, which

Fires lit by the community, that are intended to be beneficial, but that may also increase risks to health. Photo: Pake Imam

can removed by an authoritarian government at any time; and

• community resilience and vulnerability, which are two sides of the same coin — the ability of a community to resist the negative impacts of landscape-scale wildfires, its reliance on landscape assets for livelihoods, and its ability to recover from wildfires that negatively affect those assets.

Community-based fire management

CBFiM is sometimes misunderstood, often thought to be similar to integrated fire management (IFM). IFM is predominantly an organizational construct and process for "how" to manage fire, whereas CBFiM is focused on "who" undertakes activities, not the activities themselves. It is useful to separate these aspects in order to better understand fire management. There is no clear separation of these notions in the literature, but understanding them is the intent of this article.

CBFiM as an engagement process originated in 1998 at an international community forestry workshop in Thailand. The Regional Community Forestry Training Center (RECOFTC) brought together experts to discuss how to more widely engage with communities in tropical countries, using tools, techniques and practices similar to those then in use in community forestry. It was at this workshop that Jackson and Moore (1998) noted the lack of information on, or belief in, community involvement in fire management. Several years later, in 2002, RECOFTC organized the first international workshop on

community-based fire management, to build on the understanding of CBFiM through case studies from Africa, Latin America, Europe and Asia. CBFiM was then defined as "a type of forest management in which a locally-resident community (with or without the collaboration of other stakeholders) has substantial involvement in deciding the objectives and practices involved in preventing, controlling or utilising fires" (Ganz et al. 2003).

As noted, there were some early misconceptions that CBFiM was an organizational construct, but in practice it is a concept of how to include people; i.e., "who" should be engaged in managing fires. The concepts of CBFiM are focused on the people who live in and derive their livelihoods in the same landscape. The concepts also address people who are more vulnerable to negative fire impacts and who may face food insecurity after large fires. The growth and use of CBFiM has a strong link to tropical, agrarian and developing countries, and the approach is clearly a useful and important component in engaging with communities. Initiating CBFiM in landscapes, creating the foundation for inclusion, and then adding other approaches is a path to broader engagement, increased chances of success and more positive outcomes.

Indigenous fire management

The histories of indigenous and traditional cultures include the loss of many applications of fire. In some places the indigenous use of fire continues, but is often changing due to increased populations and changing

land dynamics. Engaging in indigenous fire management requires engaging with people, and understanding the techniques they apply in using fire in a contextually appropriate way. What is apparent for indigenous fire applications is the limited literature on engagement processes and possible ways to re-establish these practices within landscapes. Discussions of indigenous fire practices, such as the fire sticks forum in Australia and similar initiatives in the Americas, are enlightening for those open to these practices, but are confronting for those who are not yet prepared for the change.

What is clear in the context of increasing global wildfires is articulated by Pyne (2021) in his third paradox. If people reduce the consumption of fossil fuels and move to a low-carbon economy, they must simultaneously reintroduce fire to fire-tolerant and fire interdependent landscapes. The wildfire management community needs to actively consider the urgent need to reintroduce traditional and indigenous fire practices across large swaths of the world. This requires considerable added work and understanding to avoid further extreme wildfire events, which will occur if the ecological context is not considered.

Living with fire

The concept of living with fire is a recent, people-centric, cross-disciplinary approach. People who live in areas where extreme and overwhelming wildfires occur may not know that the landscapes that they live in have

been changing as a result of a focus on fire suppression and on reduced use or prohibition of prescribed fire. Conversations must focus on living with fire as part of a process of re-education.

The need for inter-disciplinary, cross-sector and social-diversity approaches to understanding and dealing with fire management issues in complex situations has now emerged (Stoof and Kettridge 2022). These approaches examine "who" should be engaged during the design and development of fire management efforts, and includes conversations with people who are not strongly connected to their surrounding landscape; i.e., who do not create their livelihood from the landscape. Living with fire thus reinforces the need to analyze both what the fire problem is and who will participate in managing it. The concept requires people with a diversity of skills beyond wildfire management.

It focuses on the appropriate use of fire within communities and landscapes to manage risks and hazards from extreme wildfires, or from the lack of prescribed fire. It respects gender diversity in thinking and management, and incorporates inter-disciplinary approaches to complex situations surrounding fire management. Thus, living with fire is not a management construct, but an inclusive approach with great potential for successfully engaging people. See Figure 5.

Figure 5: Visualization of living with fire. Source: Stoof and Kettridge (2022)

Conclusions

This article reviews how historical landscape contexts have influenced fire management, and the reasons that circumstances are different today. It reviews how institutions are organized and how people are engaged, both within institutions and within communities. There is a clear need to look at each situation carefully before making decisions on landscapes and people and on what is right to implement at any one location and point in time.

The "how" section presents a working supposition that to better manage fire situations anywhere in the world, two steps are required. First: appreciate the landscape context and history, including: (i) climate, vegetation and fire ecology, (ii) socioeconomic, governance, political and human thinking, and (iii) fire use (indigenous or prescribed). Second: determine what the fire problem is, not just superficially, but by fully appreciating the underlying causes, components, drivers and related issues. This will highlight activities that can be conducted in a harmonized way in landscapes affected by fire.

The comparison of organizational structures for fire management plans and taking action in the field suggests a deeper consideration of IFM as the foundational construct, while integrating more community engagement approaches. IFM offer the greatest opportunity in a practical and coherent manner using the 5 Rs: review, risk reduction, readiness, response and recovery.

Regarding the "who," methods of engagement require thoughtful consideration. CBFiM and some indigenous fire engagement concepts are appropriate for communities who depend on landscapes for their livelihoods and can be well served by using these concepts as the basis of activities. However, urban edge and peri-urban communities in fire-prone landscapes may not be well served by CBFiM techniques, and the living-with-fire approach may be more suitable for them.

This review proposes three fundamental requirements for improved fire management.

1. Evaluate the natural and ecological aspects of fire in the landscape. What is the vegetation, climate and fire ecology (fire tolerant, fire sensitive, fire interdependent)? What is the socioeconomic, political and governance context? Do existing management agencies use fire appropriately, and does that fire use align with the landscape's natural fire ecology?

2. Look at the institutions in charge of fire management, for prescribed fires or wildfires. Do they assess the natural state of vegetation, climate, fire ecology and use of fire (or not) within a landscape? Are they capable of meeting the needs of the landscape, or are they single-minded and less adaptable in their approach?

3. Work with communities, listen to them and understand how they interact within the landscape before developing engagement methods. How much does a community depend on a landscape for its livelihood, or do people only reside there? Is there security of tenure? What is the relative wealth, health and education of the people who live and work in the landscape?

The simplicity of a proposition that considers just three areas of understanding before making fire management decisions gives a false impression, however. The reality is of course much more complex, with a variety in the mix of people, institutions, politics and landscapes involved. Nonetheless, a generic structure for analysis is proposed (Figure 6), although its complexity is likely to confound or complicate the identification of the balanced pathways needed to move forward.

It is clear that large parts of the world remain in the grip of the fire suppression mindset, and must reconsider the folly of that approach in the face of recurring extreme wildfire events, human suffering and lives lost. Land managers, conservation managers, farmers and communities work on lifelong projects with long-term goals. Pressures from the media and politics, however, have short perspectives and timeframes that influence the direction of appropriate fire management. Finding the right balance and techniques requires people to take the time to look carefully at the situation they face and to think through the steps outlined.
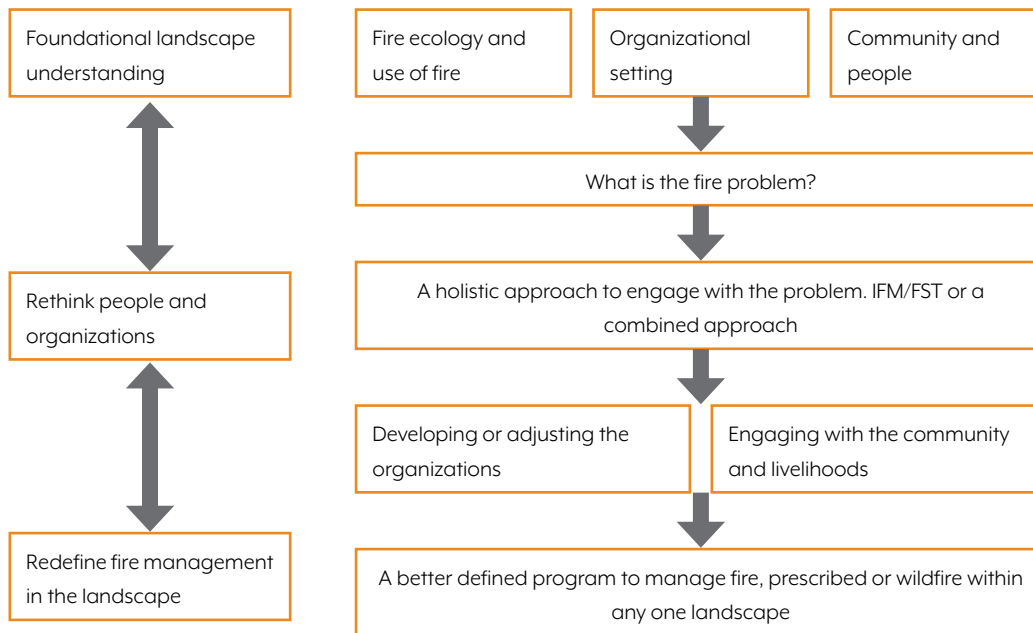
Figure 6: A schematic for fire management analysis

References

Arbor Vitae. 2003. *Future fires: Perpetuating problems of the past*. IUCN and WWF. https://www.iucn.org/resources/publication/future-fires-perpetuating-problems-past.

de Mar P, Moore PF and Shields BJ. 2000. *Aide memoire and project design document for AusAID*. Fire Management Review of the Royal Forest Department, Thailand. Unpublished.

FAO (Food and Agriculture Organization). 2011. *Community based fire management: A review*. FAO Forestry Paper 166. Rome: Food and Agriculture Organization. http://www.fao.org/3/i2495e/i2495e.pdf.

Firesticks Alliance. n.d. Cultural burning, healthy communities, healthy landscapes. www.firesticks.org.au.

Ganz D, Fisher RJ and Moore PF. 2003. *Further defining community-based fire management: critical elements and rapid appraisal tools*. Regional Community Forestry Training Centre (RECOFTC), Bangkok, Thailand. http://www.tssconsultants.com/Files/340.pdf.

Jackson WJ and Moore PF. 1998. *The role of indigenous use of fire in forest management and conservation*. International seminar on cultivating forests: alternative forest management practices and techniques for community forestry. Regional Community Forestry Training Centre (RECOFTC), Bangkok, Thailand.

Kurvits T, Popescu A, Paulson A, Sullivan A, Ganz D, Burton C, Kelley D, Fernandes P, Wittenberg L, Baker E, et al. 2022. *Spreading like wildfire – the rising threat of extraordinary landscape fires*. A UNEP Rapid Response Assessment. United Nations Environment Programme Nairobi. https://www.unep.org/resources/report/spreading-wildfire-rising-threat-extraordinary-landscape-fires.

Leone V, Tedim F and Xanthopoulos G. 2020. Fire Smart Territory as an innovative approach to wildfire risk reduction. In Tedim F, Leone V and McGee TK. eds. *Extreme Wildfire Events and Disasters: Root Causes and New Management Strategies*. Elsevier, 201–215. https://doi.org/10.1016/B978-0-12-815721-3.00011-4.

Myers RL. 2006. *Living with Fire - sustaining ecosystems and livelihoods through integrated fire management*. The Nature Conservancy, Global Fire Initiative.

Pyne SJ. 2021. *The Pyrocene – How we created an age of fire, and what happens next*. University of California Press.

Rego F, Rigolot E, Fernandes P, Montiel C and Sende Silva J. 2010. *Towards Integrated Fire Management*. EFI Policy Brief 4. European Forest Institute.

Schindler L, Bird DM and Yurda Z. 1996. Forest fire management approaches in East Kalimantan (Borneo), Indonesia. *In Proceedings, 13th Conference on Fire and Meteorology*, Lorne, Australia. http://hdl.handle.net/102.100.100/227873?index=1.

Stoof CR and Kettridge N. 2022. Living with fire and the need for diversity. *Earth's Future* 10(4): e2021EF002528. https://doi.org/10.1029/2021EF002528.

Tedim F, Leone V and Xanthopoulos G. 2016. A wildfire risk management concept based on a social-ecological approach in the European Union: Fire Smart Territory. *International Journal of Disaster Risk Reduction* 18:138–153. https://doi.org/10.1016/j.ijdrr.2016.06.005.

Tedim F, Leone V, Amraoui M, Bouillon C, Coughlan MR, Delogu GM, Fernandes PM, Ferreira C, McCaffrey S, McGee TK, et al. 2018. Defining extreme wildfire events: difficulties, challenges, and impacts. *Fire* 1(1):9. https://doi.org/10.3390/fire1010009.

Xanthopoulos G, Athanasiou M and Kaoukis K. 2022. Suppression versus prevention – The disastrous forest fire season of 2021 in Greece. Wildfire Quarter 2, 2022:18–24. https://www.iawfonline.org/article/suppression-versus-prevention-the-disastrous-forest-fire-season-of-2021-in-greece/.

Author affiliations

Brett Shields, Director Asia Pacific, Spatial Informatics Group, Singapore (bshields@sig-gis.com)