Vegetation Fire Management

Basic knowledge

Vegetation fire management contributes to SDGs:

Welcome to the Vegetation Fire Management Module. This module is intended for forest and other land managers aiming to reduce the negative impacts of vegetation fires, such as through fire prevention, preparedness and suppression and the rehabilitation of fire-affected areas.

The module provides basic and more detailed information on fire management, as well as links to fire management tools and case studies of effective vegetation fire management.

Fire is an important factor in the management of many forests, woodlands and other vegetation types. It can be an efficient management tool for clearing land, removing debris and reducing fuel loads, although alternatives should always be considered. Fire can also play an important ecological role, such as in Australian eucalypt forests. Uncontrolled forest wildfire, however, can have severe negative impacts on human health, livelihoods, assets, air and water quality and biodiversity. An estimated 350 million ha of land was affected by fire in 2000, much of it forest and woodland, with a wide range of negative impacts on people and the provision of forest products and environmental services.

Humans are thought to cause more than 90 percent of wildfires, either on purpose or out of neglect. Moreover, increasing temperatures and drought due to climate change are expected to lead to increases in the incidence and intensity of, and the area affected by, vegetation fires. In turn, the greenhouse gas emissions caused by increasing vegetation wildfires may exacerbate climate change.

There is increasing recognition that fire management should involve an integrated approach (**"integrated fire management" – IFM**) **with five key elements** (**also known as the five Rs**): review (monitoring and analysis); risk reduction (prevention); readiness (preparedness); response (suppression); and recovery. In all these elements, forest managers have important roles to play.

Often, wildfires do not stop at the edges of forests, and they may also originate outside forests. IFM, therefore, should encompass other, non-forest land uses and vegetation types, such as agriculture, rangelands, savannahs, peatlands, protected areas and wildland–urban interfaces. Fire management should be integrated in a broad landscape approach that applies the five elements of IFM. In regions where fire is an important management tool, forest managers should use it in a responsible, controlled manner so as to avoid damage to human lives, assets and ecosystems.

Many communities have used fire as a management tool for centuries and have developed considerable traditional fire knowledge and management practices. Such knowledge and practices are valuable resources for IFM and should be the base for Community Based Fire Management Approaches. Searching and applying alternatives for the use of fire, especially in environments with high fire risk can also contribute to fire prevention. In general, all stakeholders should be actively involved in the planning and implementation of IFM strategies, and fire prevention and suppression should be undertaken jointly. Stakeholders include policymakers in the forest and other relevant sectors, forest and other land managers, forest owners, communities living in and close to forests, civil defence services, and fire services.

Local communities are crucial actors; their daily decisions can have major influences on the prevention or occurrence of fires, and they can act quickly to suppress a wildfire. Most IFM activities and efforts, therefore, take place at the local level, requiring what is known as a community-based fire management approach.

Related modules

- Climate change adaptation and mitigation
- Forest inventory
- Forest management planning
- Forest restoration
- Management of planted forests
- Participatory approaches and tools for SFM
- Silviculture in natural forests
- Wood harvesting

In more depth

IFM aims to address the underlying causes of wildfires and seeks long-term, sustainable solutions that incorporate the five essential elements (the 5Rs) that constitute the globally adopted approach to dealing with disasters. Each of these elements is described below.

1. Review: analysis of the fire issue and identification of options for positive change

In an integrated approach to fire management, an understanding of the causes of fire will help focus prevention and preparedness activities. Data on fires should be recorded over time to determine the main causes and identify trends. The main questions to be answered in a fire investigation are: How do fires start? Who is involved?

The European Union's harmonized fire causes classification scheme has six categories:

1. unknown – wildfires with no cause found;
2. natural – wildfires of natural origin, with no human involvement;
3. accident: wildfires that were unintentionally and indirectly caused by humans without the use of fire;
4. negligence – wildfires unintentionally caused by humans using fire or glowing objects;
5. deliberate (synonyms: intentional, voluntary) – wildfires caused intentionally by human with the use of fire; and
6. rekindle: wildfires caused by the re-ignition of a previous fire, due to latent heat or embers.

Table 1 provides more detail on these broad categories.

Table 1. Classes, groups and categories of the European Union's harmonized fire causes classification scheme.

Category	Group	Class
Unknown	Unknown	Unknown
Natural	Natural	Lightning
		Volcanism
		Gas emission
Accident	Accident	Electrical power
		Railroads (railways)
		Vehicles
		Works
		Weapons (firearms, explosives, etc.)
		Self-ignition (auto-combustion)
		Other accident
Negligence	Use of fire	Vegetation management
		Agricultural burnings
		Waste management
		Recreation
		Other negligent use of fire
	Use of glowing objects	Fireworks, firecrackers and distress flares
		Cigarettes
		Hot ashes
		Other use of glowing object
Deliberate	Responsible (arson)	Interest (profit)
		Conflict (revenge)
		Vandalism
		Excitement (incendiary)
		Crime concealment
		Extremist
	Irresponsible	Mental illness
		Children
Rekindle	Rekindle	Rekindle

It is important to review and understand existing fire management knowledge and practices. Societies that use fire as a tool often have considerable knowledge on how to use fire effectively and how to respond if it gets out of control. Traditional and local laws might also play a role in preventing unwanted fires.

2. Risk reduction: focusing resources on the underlying causes of fires

Based on an understanding of the causes of wildfire in a given area, and where possible using local knowledge and practices, a range of

actions can be taken to prevent wildfires or reduce their impacts. These include:

- better controlling fires when used as a land management tool in and outside forests, including by burning at the appropriate time of the year and on days with suitable weather conditions, and taking necessary precautions;
- using alternatives to fire as a land management tool – for example, conservation agriculture and climate-smart agriculture provide alternatives to the use of fire as an agricultural land preparation tool. Appropriate grazing regimes can also help reduce the use of fire for stimulating pasture regrowth in rangelands and savannahs and also reduce fuel loads;
- reducing fuel loads (such as dry shrubs and grasses) around houses and villages, and constructing buildings with materials that retard fire, with the aim of reducing the vulnerability of property to wildfire;
- raising awareness among target groups of the risks associated with fire use and on how to avoid wildfires – an important target group (among many) is youth, to ensure that the next generation of forest and other land managers has a good understanding of the risks of wildfire and the options for fire management;
- taking measures within forests that help avoid the spread of fires by reducing fuel loads such as dry grass and bushes in forest areas, creating and maintaining firebreaks (such as through mechanical methods, livestock grazing or controlled burning), using fire-resistant species in plantations, and installing fire towers or other means of observing fires, such as regular patrolling and the use of phone alarm numbers;
- promoting economic alternatives to deforestation – fire is often used to create new agricultural land, and creating forest-based employment and income-earning opportunities for local people as an alternative to agriculture could therefore help reduce forest fires; and
- creating policy and legal frameworks that enable the above-mentioned activities – for example, rules related to the use or non-use of fire should be consistent, and they should encourage greater interaction on fire management between relevant sectors.

3. Readiness: preparing to fight fires

Communities and government agencies should be prepared to act when wildfires start. Because many groups may be involved in firefighting, it should be clear who is responsible for coordinating action. In many countries, coordination authority is vested in local entities if the fire is smaller than a certain size. The fighting of larger fires may require subnational or national coordination mechanisms; in some cases, international coordination may be needed. A widely used tool is the Incident Command System, which helps organize and coordinate fire suppression.

Part of fire readiness is ensuring that adequate numbers of people – in local communities as well as in specialized subnational or national agencies – are trained in fire suppression and control techniques and have sufficient coordination skills.

Adequate fire readiness also requires that everyone involved in fire suppression, such as foresters, members of local communities, civil defence personnel and professional firefighters, are equipped with the right tools (e.g. hand tools such as fire rakes, fire swatters, hoes, and more complex tools, such as fire trucks and water bombers) and are trained in how to use them. All personnel should be taught safety procedures and have at least basic skills in first aid.

Fire danger rating systems use basic daily weather data to calculate wildfire potential; they are commonly used to determine the level of fire danger and to provide early warnings of the potential for serious wildfires. By using forecasts, fire danger warnings can be issued many days in advance of severe fire weather. Such early warnings, particularly if delivered with high spatial and temporal resolution and when they incorporate measures of uncertainty and the likelihood of extreme conditions, enable forest and land management agencies, landowners and communities to implement fire prevention, detection and preparedness plans before fire problems begin.

Locally generated early warning information may be useful because it will reflect local weather and vegetation conditions. The active involvement of local communities in collecting fire-weather information and disseminating warnings creates ownership of, and increases local responsibility for, the fire management process, and it improves the efficiency of early warning systems.

4. Response: ensuring appropriate responses to damaging fires

Fire detection, communications and dispatching. Various means are available for the detection of forest fires, such as satellite imagery, fire observation towers, aerial surveillance, lightning detection systems, and monitoring and reporting by local people. Local residents who understand the risks posed by wildfire and participate in community-based fire management programmes can be highly effective fire-detection agents.

Once fires are detected, effective communication is needed to provide firefighters and managers with information on the location of the fire and its size and burning conditions. In an ideal system, dispatch centres, equipped to operate with backup energy sources, receive information on fire ignitions and locations, alert fire suppression personnel and dispatch them to individual fires. Dispatch centres also

provide firefighters with regular information on changes in weather forecasts, fire behaviour, strategies and the incident command structure. They monitor the fire situation and receive orders from the incident controller or commander for additional and backup resources. Effective, real-time communication with the general public is essential to ensure that people are adequately informed of the status of fires and to assist them in avoiding life-threatening situations. Local media – such as radio, television and the press – as well as other traditional methods and emerging information dissemination technologies may need to be part of communication plans.

Initial attack. The initial attack is the first phase of fire suppression and a key determinant of the success or failure of an entire fire management programme. If the initial attack is successful, most other programme elements will also be successful. On the other hand, without adequate planning, policies, prevention, fuel management, community involvement and detection, the initial-attack phase will not succeed.

Initial-attack strategies and tactics should be designed to fit local situations. Strategies based on local conditions, objectives and budgets will determine the number, type, kind and location of resources, such as personnel, fire trucks, aircraft and other mechanized equipment. The fire management plan will provide firefighters with instructions on how fires are to be fought, the conditions (if any) when fires should be permitted to burn for environmental or other reasons, and the tactics and strategies to be used to protect ecosystems.

The tactics used for individual fires should be compatible with local policies and objectives and be part of the fire management plan. Each firefighting action should be based on expected fire behaviour and the difficulty encountered in controlling the fire, as well as on the availability and effectiveness of local firefighting resources. This is both strategically important and critical for the safety of the firefighters and the general public.

There are several ways to provide an initial-attack capability. Individuals, either by choice or because of the lack of other fire protection services, may take responsibility, using their own assets. Groups or agencies can be formed, funded, staffed and equipped by a government or other organization. Members of local communities may establish response groups and be trained as first responders to fires (this approach can be effective and efficient). Firefighting organizations may comprise both volunteers and a core of permanently employed staff. No matter how initial-attack crews are formed, they should have adequate training and planning, and safety should be the first consideration in all plans and actions. Initial-attack crews should use an operational system – such as the Incident Command System – that is flexible and can expand if fires become larger and more complex.

Large-fire suppression and management. A low-intensity, slow-spreading fire that is easily suppressed can transform quickly if environmental or meteorological conditions change. If an initial attack fails, it may need to transition to an extended attack and then, as the fire spreads, to large-fire suppression.

A large-fire event is not defined so much by the size of the fire as by its duration and complexity. A grass fire can spread very quickly, but the techniques for suppressing it as it grows may not differ from those used to suppress it when it is very small. A fire that burns out quickly and does not exceed the capability of the organization responsible for the initial or extended attack may not require a change in strategy or tactics.

While the complexity of the situation may require that fire suppression personnel shift from an initial or extended attack to a large-fire event, the coordinating agencies should develop approaches that do not require complete changes of management and organization. The Incident Command System was designed for use in any type of incident and at any level of complexity; it is an effective fire management tool.

Crews and supervisors involved in large-fire events may be required to use unfamiliar strategies and tactics and to implement logistics and planning at larger scales than usual. Their efforts will be further complicated if communities and resources are threatened or destroyed and if people are forced to evacuate.

5. Recovery: community welfare, repairing infrastructure and restoring fire-damaged landscapes

Recovery involves the redevelopment of lost assets and livelihoods as well as ecological restoration. Rebuilding houses, creating new employment and helping communities restore their farms and forests may all be part of the recovery process after wildfire.

The replanting and reseeding of ecologically sensitive areas can help prevent invasive alien species from establishing in the large expanses of exposed soil created by wildfire. In planted and natural forests in which commercial activities are planned, it may be possible to salvage timber from fire-killed trees, and an extensive reforestation plan may be required.

Further learning

FAO. 2007. *Fire management global assessment 2006*.

GFMC. 2013. *Vegetation fires and global change.* Kessel Publishing House, Germany.

Myers, R.L. 2006. *Living with fire.* The Nature Conservancy.

Vélez, R. (ed.) 2009. *La defensa contra incendios forestales. Fundamentos y experiencias.* 2nd edition. Madrid, McGrawHill.

Web links

http://www.fao.org/forestry/firemanagement/en/ Fire management. Last accessed 01.10.2021.

https://earthdata.nasa.gov/data/near-real-time-data/firms/active-fire-data NASA EOSDIS, Active fire data. Last accessed 01.10.2021.

Credits

This module was developed with the kind collaboration of the following people and/or institutions:

Initiator(s): Pieter Van Lierop - FAO, Forestry Department