PROJECT FOR FOREST CONSERVATION AND
SUSTAINABLE MANAGEMENT OF FOREST RESOURCES
IN SOUTHERN AFRICA

SADC LEARNER GUIDE
FOR
FOREST FIRE MANAGEMENT (FFM)

VERSION 2.0

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SOUTHERN AFRICAN DEVELOPMENT COMMUNITY (SADC)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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PART ONE: INTRODUCTION

1. BACKGROUND

Fire has shaped African landscapes for about 10 million years. The prolonged dry season has allowed fires to occur across vast grassland and woodland areas where, over time, it has profoundly changed the structure and function of ecosystems. Regular fires form a critical component of sound rangeland and ecosystem management in the SADC (excluding tropical rainforests). Nevertheless, wildfires can have economic, social, and environmental consequences.

Kishugu (South Africa), together with SADC forestry delegates, developed a regional guideline for forest fire management (2018) to improve natural resource management and livelihoods. This document serves as a brief learner guide. Please refer to the Guideline for more detail.

2. OBJECTIVES

a. To analyse the nature of FM in SADC
b. To develop common understanding of the role of fire in SADC landscapes
c. To align globally accepted IFM principles to the land-uses, environment and people of SADC
d. To explore guidelines that will improve IFM within SADC

3. APPROACH

This report is compiled relying on the experience of Kishugu and forestry delegates in SADC, as well as literature on fire management in contemporary Africa such as Goldhammer 2004, Teie 2009, Forsyth 2010, Trollope 2015, Fynbosfire 2016 and TerrAfrica 2016.

The study commences with a brief situation analysis in a format that may be useful for local assessments.

Each land-use type in SADC has its own fire management needs, ranging from low-key to highly sophisticated interventions. Therefore, it is expected from the IFM implementer to understand the role of fire in SADC region, and then **use these guidelines to decide on a suite of IFM interventions appropriate for the land-use (risk and scale) and available resources**. In general, it is easier, more effective and cheaper to implement fire prevention. Then follows protection and lastly suppression. Implementers of IFM need to keep in mind that most fires are started by people, and most fires are also successfully suppressed by people.

PART TWO: SITUATION ANALYSIS AND CONCLUSIONS

4. SITUATION ANALYSIS

4.1 Location and topography

SADC comprises a whole suite of landscapes in 12 sub-Saharan countries reaching South Africa in the south to DR Congo in the north, as well as the 4 Indian Ocean island countries of Madagascar, Mauritius, Seychelles and Comoros.

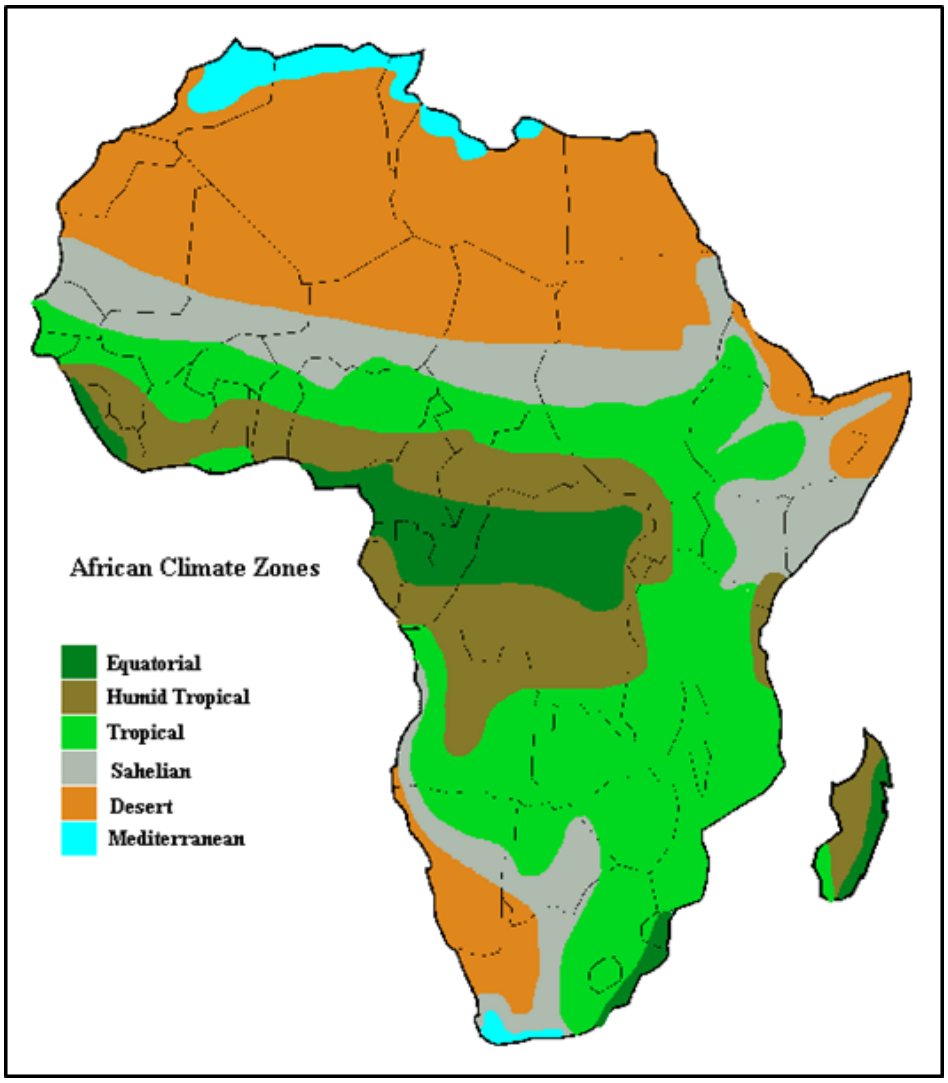
SADC countries

SADC is endowed with diverse topographical features with altitude variation from sea level to over 2000m.

4.2 Climate

SADC incorporates several distinct climate zones:

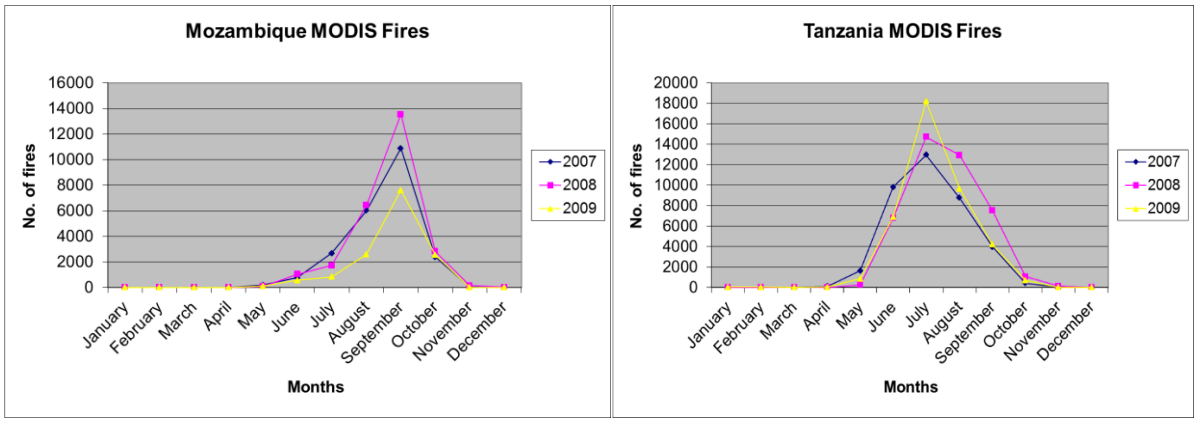
a. SADC Equatorial
b. Humid Tropical
c. Tropical
d. Sahelian
e. Desert
f. Mediterranean.



The tropical zone represents the largest area within SADC. It is prone to frequent droughts and uneven rainfall distribution. This zone has two distinct seasons – a wet season roughly from November to April, and a dry season roughly from May to October

Average annual rainfall in SADC varies between less than 100mm and 3000mm in a pattern that mirrors the climate zones.

Local fire weather is determined by climate zones and influenced by topography, vegetation cover, rainfall and prevailing winds (e.g. during dry season in South Africa from the west, and from the east on the African plateau). The effect of the climate on fire weather can be illustrated by an analysis of the Moderate Resolution Imaging Spectrometer (MODIS) fire point data. For Mozambique, 2007 to 2009 resulted in a higher for occurrence of MODIS fire points in the months of August through to October with the maximum number occurring in September (the higher number of points in these months is an indication of an increase in the fire activity). In Tanzania the peak seems to be one month earlier. These analyses are handy tools to determine local fire prohibition periods as addressed in the guideline section of this report.



4.3 Vegetation

The terrestrial biomes of SADC mirror the climate zones (image above) and include:

a. tropical rainforest
b. moist savanna
c. dry savanna
d. temperate grassland
e. montane
f. semi-desert
g. desert
h. Mediterranean (fynbos).

Zambezian Woodland (also called *dry forest* or *sub-humid woodland*) is the most extensive vegetation formation in SADC and located within the Moist Savanna and Dry Savanna terrestrial biomes. Zambezian Woodland, comprising Miombo, Undifferentiated and Mopane (White 1983), is fire-adapted. It is light-demanding, subjected to the ecological process of disturbance-recovery, and regenerates mostly through sprouting of roots and stems (Geldenhuys 2005).

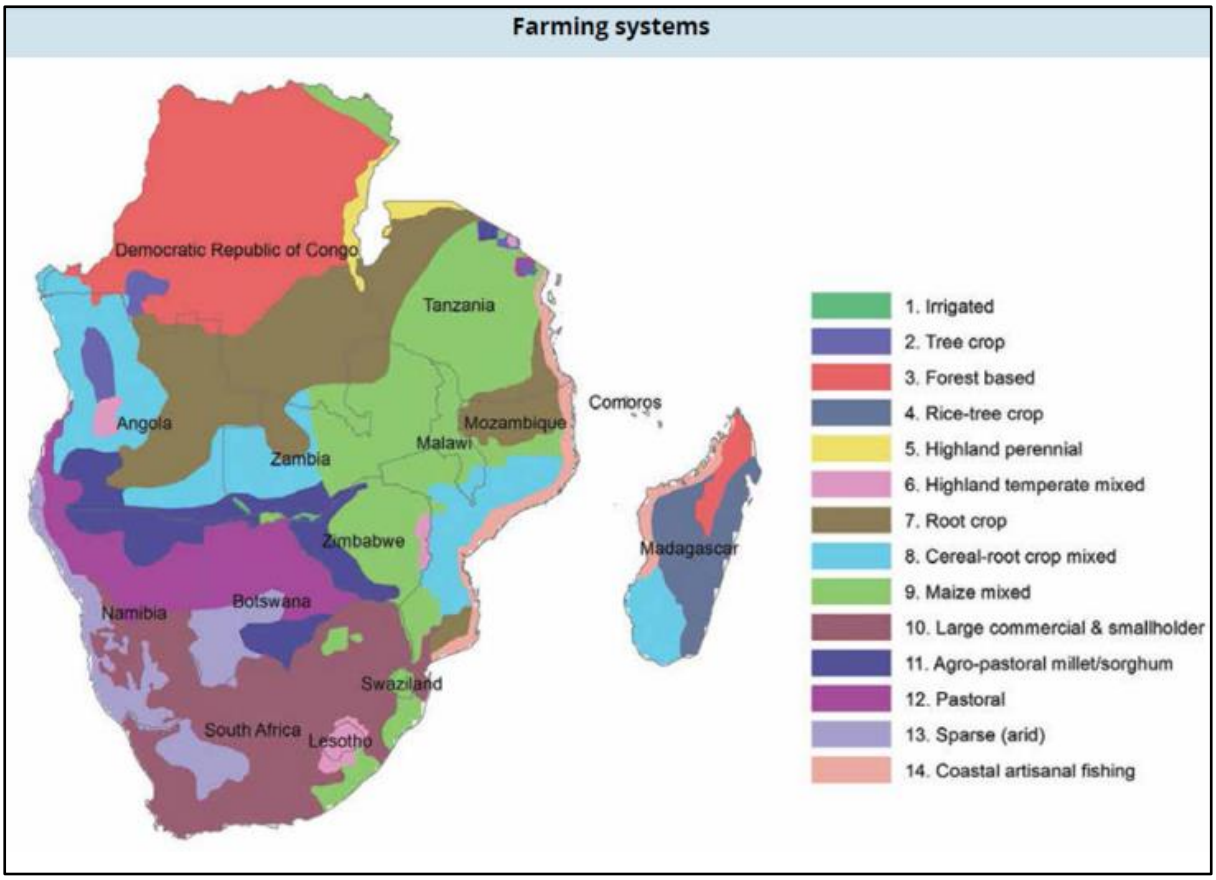
The dry forests in SADC are extensively utilised for cooking energy but have not been managed for multiple-use forest products, which complicates fire management.

4.4 Land-use

Man has introduced various farming systems into SADC as illustrated in the image below (FAO 2001).

There are only about 2.3 million ha plantation forests in SADC. South Africa does not have much natural forests but makes up for it with the largest planted forests, followed by Tanzania. Significant expansion is expected in Mozambique and Tanzania.

The modification of SADC landscapes has led to changes in the natural fire regime and with disastrous wildfire consequence when not properly planned and managed. It is easier and cheaper to introduce FM planning during the initial stage of land-use change, e.g. commercial agriculture & afforestation, industrial & town development and tourism.



SADC farming systems

Two concepts require understanding: Land tenure and Forest ownership. Most ownership of land in SADC vests with the state, however land may be granted to users based on a contract for commercial purposes and on customary rules for purposes of subsistence to local communities. Most of the food is produced by small-scale farmers by means of slash-and-burn traditional farming. This does not pose a challenge to FM where traditional knowledge is recognised, and community-based collaboration supported. Clarity on forest ownership is essential for implementing IFM. In some countries, landowners are not automatically entitled to exploit forest resources, e.g. Mozambique. In other countries such as Zimbabwe land tenure also includes forest ownership.

4.5 Fire ecology

Originally most fires were caused by lightning, but more than a million years ago our ancestors learned to light and manage fires, exploiting and augmenting the natural causes of fires to manage the vegetation for their own purposes. Today, more than 90% of fires are lit by people, either deliberately or accidentally.

Fire is a complex ecological disturbance and has different effects on the vegetation, depending on the type of fire, intensity, season and frequency of burning.

Fire regime is the history of fire in a vegetation type or area including the frequency, intensity and season of burning. Fire regime alteration can be defined as the extent to which the prevailing patterns of fire diverge from the ecologically acceptable ranges of variation in key fire regime elements for that ecosystem type. This creates an ecological hazard that can result in *megafire* episodes.

A fire ecology type is a class of vegetation types that is relatively uniform in terms of the fire regimes (e.g. frequency, season, intensity and size) within the constituent vegetation types.
This classification begins by dividing vegetation types into one of three broad fire-ecology types:

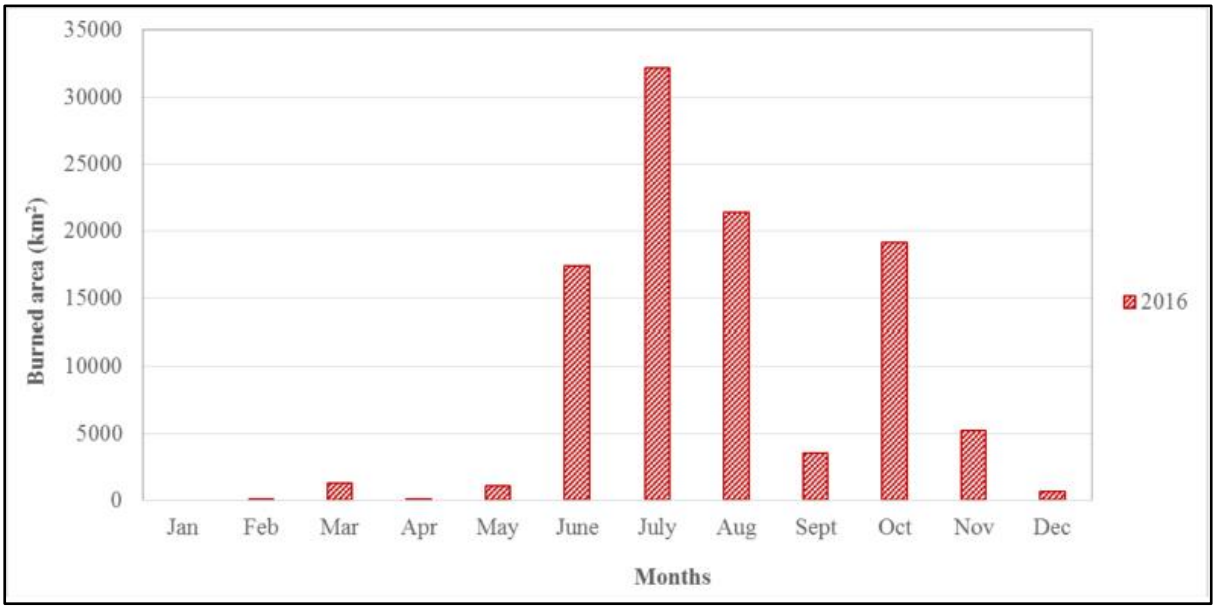
a. Fire-dependent describes ecosystems where fire is necessary for the regeneration of most plant species but where inappropriate fire regimes can alter the species composition, vegetation structure or ecosystem function or a combination of these. E.g. moist grasslands, Zambezian woodlands and fynbos (Mediterranean)
b. Fire-sensitive ecosystems are those that do not require fire for regeneration, but which occur among fire-prone ecosystems and can be adversely affected by the inevitable fires, especially if they are too frequent or severe. E.g. tropical forests, montane forests, forest plantations and agricultural crops
c. Fire-independent ecosystems also do not require fires for regeneration and occur in environments where fires are very rare or absent, usually because there is little or no fuel for fires. E.g. desert and semi-desert. (Forsyth 2010).

There is no benefit in suppressing fire for climate change mitigation in many SADC landscapes, excluding amongst others, tropical forests and peatlands. These areas will inevitably burn and release carbon. It is therefore part of the natural carbon cycle (TerrAfrica 2016).

4.6 Fire history

Fire history can be determined for the whole SADC by means of remote sensing technology, e.g. MODIS, AFIS and others. It can be quantified in area burned or number of fires.

The figure below illustrates 11 years of fire history for the whole of Tanzania (TAFORI 2016).



Peak fire activity is during July and August. Note 1 km2 =100 ha

It is important to understand the causes of wildfires so that both the incidence and impact can be reduced. Most land-use areas experience surface fires and the main cause is typically anthropogenic (human ignited). Wildfires threatening e.g. fire-sensitive plantation forests are generally from outside, caused by farmland preparation, cattle grazing, charcoal burning, hunting, honey harvesting, smoking, cooking, and sometimes arson following land tenure dispute.

4.7 Fire risk

Wildfire risk viewed as the combination of the likelihood (fire ecology-type and fuel load) and consequences (economic, social and environment) of fires in each.

Risk categories are defined as *low*, *medium*, *high* or *extreme*, depending on the combinations of likelihood and consequences. For example, if fires are almost certain, but of minor consequence, the risk is moderate, if they are almost certain and catastrophic, risk is extreme; and if they are rare, but have moderate consequences, the risk is low.

Likelihood Rating	Consequence Rating				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Medium	Medium	High	Extreme	Extreme
Likely	Low	Medium	High	Extreme	Extreme
Possible	Low	Medium	High	High	Extreme
Unlikely	Low	Low	Medium	High	Extreme
Rare	Low	Low	Low	Medium	High

Fire risk categories

Fire hazard classification very useful for resource allocation at national, fire protection association (FPA) and plantation forest levels. This is currently only done in South Africa.

4.8 Traditional knowledge

Traditional knowledge of FM is evident and very useful in SADC. Unfortunately, Eurocentric fire policies and legislation introduced during the last century has suppressed this knowledge in many areas.

4.9 Policy and legislation

Uncontrolled fires are largely prohibited in the SADC countries because of the fire-adverse policies adopted. Most countries have a maze of fire management policies, acts and bylaws within various disciplines/departments. However, it is the informed view of Kishugu that SADC countries should first focus existing resources on piloting basic FM on landscape scale, then simplify/harmonise policies only after successful implementation and adaptation (*learning by doing*).

The National Veld and Forest Fires Act (1998) guides all fire management in South Africa. It requires that landowners take measures for fire protection and that communities should establish Fire Protection Associations (FPAs) to address the need for collaboration and coordination. A national support structure (Working on Fire) provides rapid response and additional resource capacity to rural communities as well as commercial sectors for supressing large fires.

Member States are obligated by the SADC Treaty 1992 (consolidated 2015) which forms the legal basis for, amongst others, cooperation in fire management. Refer to image Chapter 14. Various protocols, programmes and projects supports FM.
Experience over the last 100 years of colonial-era fire policies demonstrates that attempting to suppress fire over long periods of time, other that plantation forests, is usually unsuccessful. Without fire the open grasslands and savanna, which support an abundance of game and cattle, would become landscapes of thorn trees and unhealthy woodlands.

4.10 IFM knowledge gaps

The natural landscapes and land-uses in this report are not unique to SADC. Therefore, the gaps in IFM knowledge are relatively few:

a. Uniform fire ecology-type and land-use maps are not readily available to facilitate interpretation of fire history from remote sensing applications
b. Fire risk classification of SADC in terms of likelihood of ignition (fire ecology-type and fuel load) and consequence (economic, social and environment) will provide valuable guidance to policy makers and planners at regional, country, landscape and land-use levels
c. Dry forests (Zambezian Woodlands) is the most extensive vegetation formation in SADC. However, to align fire management appropriately, the market demand/potential for forest products requires better understanding
d. The fire-dependant dry forests are not managed in SADC. The technical management thereof and the role of fire within requires better understanding, e.g. silvicultural application

4.11 Readiness

In South Africa Working on Fire (WoF), a government-funded, job-creation programme focuses on IFM. The implementing agency for the programme (Kishugu/WoF), makes use of FPAs to distribute resources effectively. The FPAs differ in size, but members all work together with the common objective to manage wildfires.

In most of other SADC countries ongoing IFM is only to be found in high value plantation forest investments.

4.12 Conclusions

a. Readiness. Large areas of SADC landscapes are being transformed into a mosaic of diverse land-use types, including the fast-expanding wildland-urban interface. Each land-use type has its own fire management needs, however readiness for IFM is not evident outside South Africa and commercial plantation forests
b. The fire risk to high value fire-sensitive land-use is mostly from outside. However, there is little evidence of collaboration with adjacent role-players
c. Much attention has been given to FM policies and laws; however, they are very much Eurocentric in nature and there is little evidence of effective implementation
d. Traditional fire management knowledge is evident in rural areas and very useful
e. The lack of basic fire management training and tools is evident
f. Understanding of fire-ecology is not evident at management level
g. Dead grass resulting from the annual dry season is highly flammable fuel that supports frequent and extensive, but low-intensity fires. There is no benefit in suppressing fire in many African landscapes (excluding tropical forests and peatlands) for climate change mitigation as these areas will inevitably burn and release carbon. It is therefore part of the natural carbon cycle
h. The lack of forest management in the dry forests could be a barrier to effective implementation implementing of IFM
i. Change in natural fire regimes may lead to mega fire events (Chapter 4.5)
j. Gaps in IFM knowledge that require urgent research are relatively few (Chapter 4.10).

PART THREE: INTEGRATED FIRE MANAGEMENT

5. IFM DEFINITION

Africa is a fire continent. Every year, between half and two thirds of burned area worldwide is in Africa. Familiarity with fire and its deliberate use as a landscape management tool is deeply embedded traditional knowledge.

Fires are regarded as a natural ecological factor of the environment and have been occurring since time immemorial in the grassland, savanna, woodland and fynbos areas of SADC. The use of fire in the management of vegetation for both livestock and wildlife systems is widely recognised and best summed up by Philips as being a *bad master but a good servant*.

IFM has been described in various ways, including Myers, FAO, De Ronde, Fynbosfire and Kishugu. The SADC guideline uses the series of fire management actions described by Myers: fire prevention, fire protection and fire suppression, as accepted by forest sectors and funding agencies globally to report and allocate resources.

6. IFM PRINCIPLES

The brief situation analysis compiled on SADC, as well as *FM Voluntary Guidelines* (FAO) and *Africa The Fire Continent* (TerrAfrica), enabled the formulation of IFM principles for strategic direction.

6.1 Economic

Understand both the likelihood and consequence of wildfire in different land-uses. The active use of fire as a cost-effective management tool to protect assets and lives should be integrated at landscape scale.

6.2 Environment

Respect the ecology of the natural environment. Recent changes in land-use will affect natural fire regimes resulting in severe fires with negative consequence for ecosystem services and local communities.

6.3 Social

Engage with all stakeholder communities. Use fire responsibly to maintain traditional agricultural practices and livelihoods. Invest fire prevention education for communities, local recruitment and training.

6.4 FM safety

Always implement FM interventions with the safety of firefighters and communities in mind.

6.5 Legal

International Law and binding SADC protocols provide good basis for Member States to simplify, harmonise and overarch national FM policy. It should sensitise the needs of different land-use types and implementation FDI, fire risk classification and FPAs.

6.6 Institutional

Establish FPA-like capacity to address institutional, collaboration and coordination barriers to effective implementation of IFM.

6.7 Enhanced capacity

Fires respect no boundaries. Collaboration and pooling of resources are of the outmost importance to achieve early warning, instant detection, and fast reaction. The proximity of different land-use types within emerging landscapes requires a shift from isolated FM interventions to a coordinated approach at scale. Invest in community-based FM support which includes and empowers women. People start almost all wildfires, and people are also the most effective resource to put out fire.

6.8 Stay informed

Keep abreast of new innovations and development in IFM and landscape programmes. Assess the condition of vegetation and other parameters before fuel reduction burns. Implement FM programmes timeously but monitor vegetation condition and adapt intervention where necessary. Support the use of fire danger index (FDI). Explore and utilise traditional FM knowledge.

PART FOUR: IFM GUIDELINES

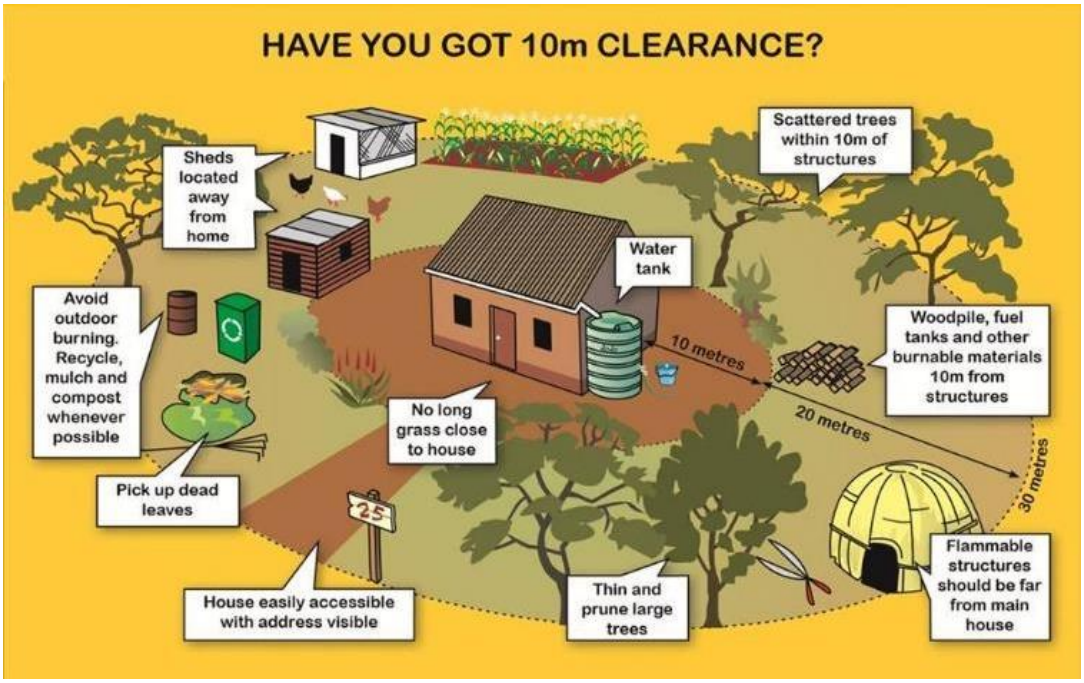
Use these guidelines below to consider a suite of IFM interventions appropriate for the land-use (risk and scale) and available resources (Chapter 3 Approach).

7. PREVENTION

Fire prevention is described as activities directed at reducing unwanted wildfire events. It is the most sensible, cost-effective and least risky component of IFM. In the SADC context, it includes:

7.1 Fire awareness

Establish awareness of good and bad fires by means of public education at village and household levels. E.g. the FireWise approach is well-known.



Basic fire awareness at village and household levels

Align FM education to good traditional practices such as slash-and-burn agriculture and burning for grazing (also known as indigenous knowledge).

Fire is necessary for the functioning of many ecosystems within SADC. Exclusion of fire in fire-dependent vegetation will lead to the build-up of fire fuels which are detrimental to ecosystem health and will increase risk to lives and property.

7.2 Causes of fires

Land-users and communities need to explore the causes of wildfires so that both the incidence and impact can be reduced. Most land-use areas experience surface fires and the main cause is typically anthropogenic (human ignited). Wildfires threatening land-use change of high value, e.g. fire-sensitive plantation forests, are generally from outside, caused by farmland preparation, cattle grazing, charcoal burning, hunting, honey harvesting, smoking, cooking, and sometimes arson following land tenure dispute.

7.3 FM collaboration

Increased collaboration at all levels is the key to effective IFM. E.g. the equipment of local fire brigades in SADC is in general not suitable for wildfire application. However, there are always good opportunities in collaborating, e.g. typical water tanker units below are very suitable for bulk water supply at accessible points.

Typical fire brigade unit suitable for bulk water supply

7.4 Fire Protection Associations (FPAs)

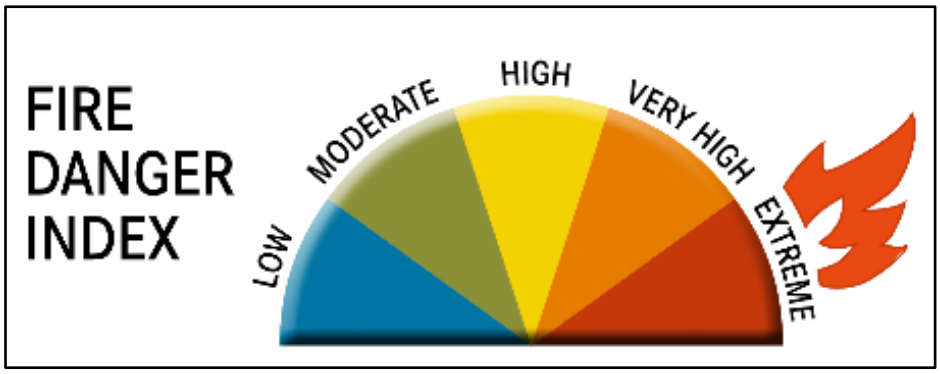
The proximity of different land-uses requires a shift from isolated fire management interventions to a collaboration approach at scale. This can be achieved in short time and cost effectively by means of FPAs, which are groups of land-users that voluntarily collaborate on all matters pertaining to IFM, with the common objective of mitigating fire risk. This includes preventing, managing and suppressing wildfires by means of pooling resources.

FPAs are resourced in different ways. A review of FPAs globally and across South Africa provides a spectrum of options for resourcing FPAs ranging from a lean small management team with the activities of the FPA largely driven by the membership to a large well-resourced institution driven by staff capacity. Given the global and local financial situation, pressures on government resources and the challenges of sustaining the human capital required to drive IFM, leaner FPA structures should be encouraged.

Members in a SADC FPA would typically include a champion (e.g. commercial plantation forest or national park), adjacent land-users, village and district authorities and town fire brigades. FPAs should be of manageable size but must include adjacent land-uses. Utilise existing structures (e.g. government and timber grower associations) and keep current administrative boundaries. A suite of FPA administrative tools is available in the Guideline.

7.5 Early warning system

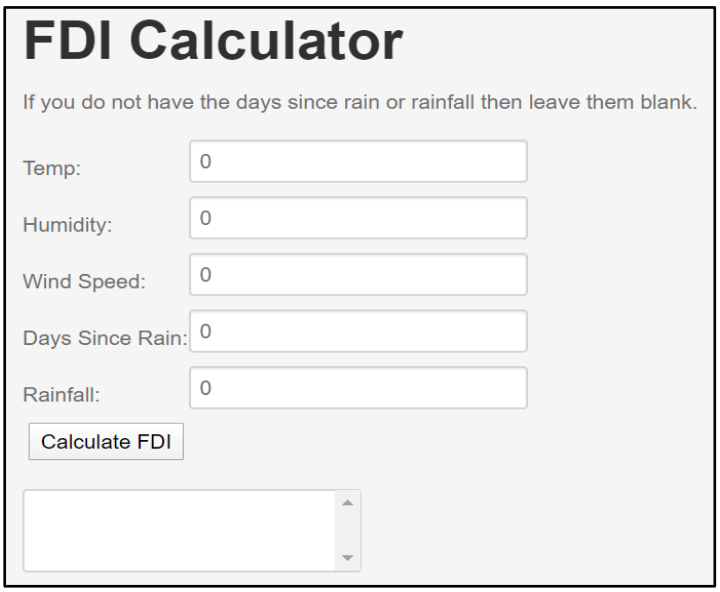
Fire danger index (FDI) is the globally accepted weather talk of foresters and natural resource managers. It is a fire danger rating calculated using temperature, relative humidity, windspeed and rainfall measurements or forecasts. FDI therefore measures fire weather to predict the chances of a fire occurring and the fire behaviour once it has occurred. FDI provides FPAs, land-use managers and foresters with an excellent base for observing trends and developing personalised fire control guides and action plans for each alert stage (refer to Guide).

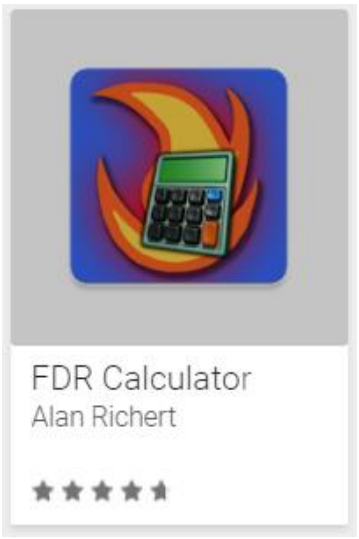


Fire danger index

Place FDI display boards at strategic locations, e.g. forest plantations, villages, community centres, schools etc. Communicate FDI daily to indicate current alert stage status on the boards. Refer to the Guideline for practical application of fire alert stages

Weather readings from a simple handheld Kestrel instrument can be used to populate FDI calculators below.





www.zfpa.co.za

https://play.google.com/store/search?q=fdr%20calculator&hl=en

7.6 Fire prohibition period

Establish an annual fire prohibition period as indicated by fire history results (MODIS in chapter 4.2). This is a simple solution for bad fires during high fire danger period. The annual period can be determined by dates or weather conditions (FDI), compatible with the reasonable requirements of most land-users. Fire prohibition, applicable to all land-users, within the FPA administrative area will enhance fire detection. Burning during the prohibition period is only allowed by permit with conditions (including FDI and resource requirements). Refer to Guideline for more details.

7.7 Safe time of burning

Practice safe burning by changing the time of burning. For most land-users (excluding commercial-scale plantation forests) in the afternoon not more than 2 hours before sunset. Should a fire get out of control, it would present a shorter period of suppression and reaching of dewpoint.

8. PROTECTION

Fire protection is described as actions taken in advance of the dry season to protect assets and lives against wildfires.

It is always more effective to initiate FM planning from the onset of land-use change. Proper planning, in terms of compartment and block sizes, access roads, fire belts (external and internal), natural firebreaks and open areas before and during plantation establishment will make plantation forests safer. This is also true for developments such as commercial agriculture, industrial & town, and tourism.

Well-planned plantation forest

Compiling fire hazard map

Assess the fire risk of the management unit and adjacent areas by means of likelihood of ignition and consequences (economic, social and environment), and compile a simple fire hazard map (classifying low, medium, high and extreme areas). This map will guide protection measures required, which may include:

8.1 Buffer zones

Buffer zones is a system of strategic protection lines with a low fuel hazard, placed in the landscape regardless where property boundaries were situated. Identify and maintain buffer zones in relation to the most dangerous wind direction. Open-ended fire break (utilising safe burning window between late afternoon and dewpoint) are specialised but a quick and cost-effective way to maintain buffer zones in natural landscapes.

Open-ended fire break

8.2 Firebreaks

Make full use of natural firebreaks and infrastructure, e.g. rivers, valley bottom forests, rocky ridges and roads. A very effective fire protection approach within the fire-dependent dry forests is to maintain the natural fire regime and traditional mosaic pattern.

8.3 Fire belts

A fire belt is an artificial barrier from which most flammable material has been removed for the purpose to stop light surface fires and serve as a line of defence to work from. Prepare a 2m tracer in advance on the perimeter before burning a fire belt. Tracer and fire belts can be prepared in various ways, including chemically, grazing, burning, hoeing, slashing, disking and grading. Fire belts can be burned annually or bi-annually in rotation. Place and maintain external and internal fire belts appropriately: wide and long enough to have a reasonable change to stop a fire without causing soil erosion. The width depends on the risks, but 20m free of vegetation for external belts adjacent to plantation forest or grassland, and 10m for cropland are good guidelines. Roads, 5m clear of vegetation, and indigenous buffer zones are recommended for internal belts. The planting of (green) fire belts with tree species is not recommended for SADC. More important is the position of fire belts relative to the local pattern of natural forests. Refer to Guideline for more detail.

8.4 Power lines

Wildfires pose a threat to powerlines, a national asset. Powerlines can also cause fires. The Guideline provides common servitude widths probably applicable to most of SADC.

8.5 Fuel load reduction

Fire needs oxygen, fuel and heat to burn. In the process of growing fire-sensitive trees (e.g. plantation forests), we add fuel to the forest floor which adds to the intensity of any fires which may occur. The more intense the fire is, the more difficult it is to contain and the greater the damage to the growing crop. The critical success factor is to create low fuel load zones inside the plantation from which wildfires can be contained. Fuel loads can be managed as follows:

a. Remove, mulch, rotary slash or burn plantation residue resulting from silviculture, harvesting and sawmilling operations. Burn residue only after 75mm of rain and FDI not exceeding mid-yellow
b. Keep compartments weed free until canopy closure

Weed free plantation forest compartment

c. Maintain ecological fire regime in natural areas by means of appropriate season, frequency, and intensity of burn. The next chapter 8.6 *Role of fire in ecosystems*, as well as Annexure 9 of the Guideline provide more details
d. Small-scale growers to weed and clean all planted areas before start of dry season
e. Under-canopy burning is a useful investment to manage fuel loads in hazardous areas. Unfortunately, days with ideal burn conditions for most commercial species are very limited in plantation forest areas within SADC. Regeneration with thicker bark species, e.g. *Pinus caribaea* hybrids could be considered for these areas.

Under-canopy burning

f. Plan burning for traditional farming practices outside of fire prohibition period and later than 2 hours before sunset
g. Mobile sawmills and charcoal burning. Within plantation forests or natural vegetation, the following minimum requirements are applicable:
    - ✓ Fire belt 10-15m wide around operation if not in burned area
    - ✓ Basic fire suppression tools including minimum of 200l water available on site for fire suppression
    - ✓ FDI reaches orange, stop charcoal burning.

8.6 Role of fire in ecosystems

Many ecosystems within SADC are dependent on fire for regeneration (Chapter 4.5 *Fire ecology*).

The role of fire in grasslands/ savannas and fynbos (Mediterranian) has been extensively researched in SADC and management guidelines implimented. However research into effective forest management of dry forests that includes fire as a silvicultural tool, is still work in progress.

Controlled burn in Serengeti NP

9. SUPPRESSION

Readiness according to early warning (FDI, Chapter 7.5), instant detection, and fast reaction are the key to effective fire suppression. Salient measures include:

9.1 Detection

Spotting a fire early enables you to put measures in place to suppress it or if outside, to prevent it from entering your property. The smaller the fire is when you start suppressing it, the easier to control. Once a fire gets to a certain size you cannot even fight it but must wait until it burns itself out. Fire lookouts can be permanent or temporary (placing someone at high ground during dangerous FDI periods). Most commercial plantation forests in SADC make use of fire lookout towers and medium-scale growers of patrol persons. Digital camera fire detection systems are used in South Africa.

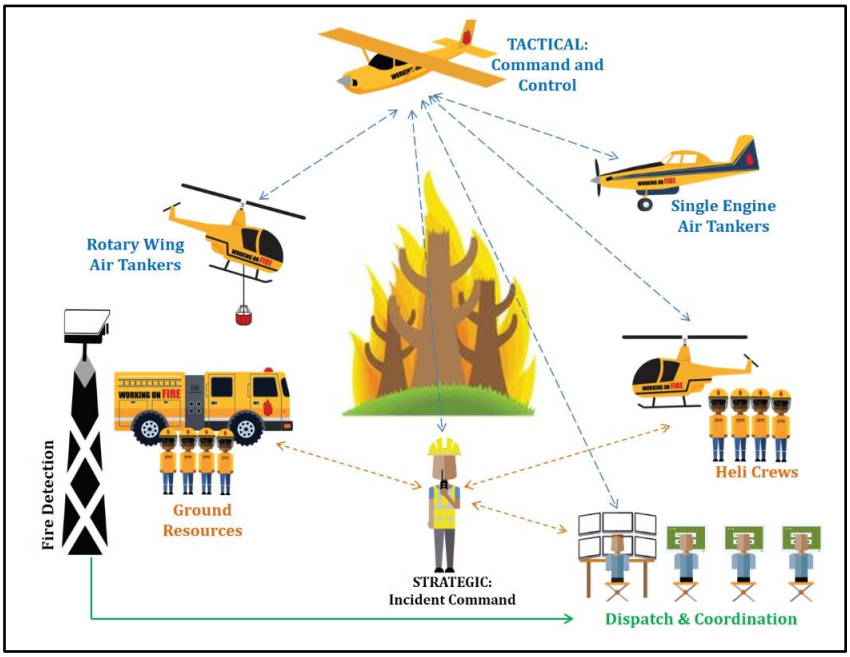
9.2 Communication

The ability to communicate with all role players in the fire suppression process is critical e.g. radio, cell phone or fire alarm.

Each member must have a cell phone available for firefighting operations; this will enable the member to receive the daily fire danger index (FDI) forecasts through an SMS system on his cell phone. The cell phone will enable the member to communicate directly with the ops room. All members, where applicable, require radio communications between the various fire fighting vehicles and ground teams. These radios should be coordinated where possible on common frequencies.

9.3 Dispatch and coordination

It is essential to manage large firefighting resources by means of dispatch and coordination capacity coupled with incident command system (ICS) at FPAs or large plantation forests. South Africa has adapted best Western practices to suit southern African conditions, however the nature of wildfire event and resources dictate the scale of dispatch and coordination function requires.



9.4 Fire response teams

Essential for forest plantations and village authorities. Can ideally be pooled and coordinated by the FPA system. Ideally the firefighters need to be employed. First-world countries make good use of volunteers (with other full-time employment). Unfortunately, the experience in developing countries has not been positive. Volunteers often do not have other employment and are hesitant to fight fires at night (which is the best time to suppress fires safely), or without compensation. Piecemeal compensation often leads to more fires. Firefighting personnel need to be properly trained and in an appropriate state of readiness guided by FDI and management unit.

9.5 Personal protective clothing (PPC)

The following basic clothes will be suitable at wildfire events:

a. ONLY 100 % cotton, including underwear and socks. Overalls with a high synthetic content should be avoided as these will melt in the event of close contact with a fire and result in serious injuries to the fire fighter
b. A cotton T-shirt worn as an under garment will assist in keeping the direct heat off the skin
c. Leather boots. Plastic boots are not recommended as these will melt when in close contact with fire for prolonged periods. Steel tipped safety boots to be avoided as they can get so hot that toes get burned.

9.6 Equipment and tools

Depending on individual land-use risk, a general requirement guideline for land-use of higher value in SADC is as follows:

Equipment	<10 ha	11-25 ha	26-100 ha	101-500 ha	501-1000 ha
Slip-on unit				1	2
Knapsack	1	2	3	4	8
Fire beater	1	4	8	10	15
Rake hoe		1	2	4	6
Drip torch				1	2
Firefighters	1	2	4	6	10

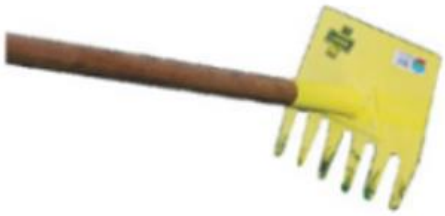
The most basic equipment and tools required for fire suppression are noted below. Firefighters in SADC need to understand and practice how to use them (in terms of the fire triangle in Chapter 9.7 below):

Slip-on unit suitable for single or double cab LDV

Fire beater with wooden handle

Knapsack water pump rigid

or collapsible



Rake hoe

Drip torch

9.7 Fire triangle

Fire is a chemical reaction and can only burn when fuel, oxygen and heat are present at the same time. If one of these elements is removed or missing, then fire will not burn or will be extinguished. This is the key to fire suppression.

Fire triangle

9.8 Critical fire factors

Key factors effecting fire behaviour are:

a. Weather. Temperature, relative humidity and wind. Wind and lack of rainfall are the most important
b. Fuel type. Light/heavy, ground, surface and aerial (canopy). High fuel-loads pose high fire risk
c. Topography. The shape of the land. Fire burns uphill very quickly and slower downhill.

9.9 Types of fire

Wildfires are categorised by where they burn:

a. Surface fires. Just above the surface and the most common fire in SADC. They can burn either as head-fires with the wind or back-fires against the wind. Crown fires. In the canopy of trees under extreme weather conditions
b. Ground fires. In the ground, e.g. roots, peatlands.

9.10 Fire suppression strategies

Initial attack. Plan a direct, indirect or parallel attack and communicate it to firefighters. To suppress a fire, one needs to break the fire triangle, e.g.:

a. Cut a control line to remove fuel (rake hoe in plantation forests)
b. Use water to cool the fire (knapsack or slip-on unit)
c. Remove oxygen by smothering the fire (beater)
d. Use fire to remove fuel (drip torch for burning-out or back burning).

Extended attack. Necessary if fire is not put out in the first hour. Once you have people busy with suppression, assess the progress and any changes, adapt your plan and call in time for more resources and establish incident command system (ICS).

9.11 Mopping up

Always have a small team available right from the beginning to guard the rear and start mopping up as soon as a section has been burned and continue following up as the burn progresses.

9.12 Firefighting safety rules

a. Provide for safety first: be sure that your firefighting teams have the correct skills, protective clothing and tools
b. Analyse fire behaviour and watch for changes – use what you have learned about fire

c. Check the weather forecast and note all changes such as wind speed and direction. Be sure you know what the fire is doing always
d. All instructions and plans must be clear to everybody fighting the fire
e. Communication with everyone at the fire is critical
f. A lookout person is a good idea as this person can report any overall changes in the fire behaviour
g. React quickly and decisively
h. When you are stressed, hungry, thirsty and breathing in smoke you can make irrational decisions, so focus on staying alert and keeping calm
i. Make sure you know where the safety zones are and the escape routes.
j. Never try to outrun a fire uphill, fire moves fast. Rather escape sideways or try to get into the burned area.

9.13 Water

Water is an important part of suppressing fires. Ensure easy access to natural water features and consider manmade water filling points where necessary, e.g.:

a. Dams
b. River crossings with an available suction point
c. Overhead pipes (hydrants)
d. Overhead tanks
e. Pump facilities (borehole/dam).

Always ensure that enough drinking water is available for firefighters.

UH1 helicopters filling Bambi buckets in sea for fire suppression

PART FIVE: ADDITIONAL GUIDELINES

10. TRAINING

Firefighter training includes the following:

Basic Firefighter	Crew Leader
Modules: a. Wildfire legislation b. Fire Danger Rating c. Understanding Fire d. Types of Fire e. Duties and Organization at Fires f. Safety at Fires g. Survival at Fires h. The use of hand tools for Fire Fighting i. Mopping up j. Aerial Firefighting Operations	1. The candidate must have completed the Basic Firefighters Course. 2.The Crew Leader's course must consist of the following modules: a. Fire Terminology b. Wildfire legislation c. Fire Behaviour d. Fire Danger Rating e. Organization at Fires f. Initial Attack Strategies and Tactics g. Fire extinguishing methods h. Aerial Firefighting Methods

Other FM training includes fire investigation, incident command system (ICS), fire awareness for communities, and making FM tools from locally available resources. Refer to Guideline for minimum training requirements recommended for SADC applications.

FM training

11. REHABILITATION

Assess burned areas for possible ecological damage soon after fire events. Regenerate burned areas as soon as possible and erect wind/ water barriers where necessary to avoid erosion.

12. MONITORING AND RECORDKEEPING

The person in control (e.g. fire boss or dispatch and control) of the fire needs to keep chronological notes.

Conduct a post-mortem immediately after fire event to ensure lessons are learned.

Report wildfires and controlled burns as per required format, including fire damage and causes to relevant authority. FPAs will coordinate data for rapid analysis to identify gaps in IFM implementation. Adapt IFM guidelines to address gaps.

FDI record is also simple longer-term monitoring tool to observe changes in local fire weather and climate.

Dispatcher keeping record

13. PRESCRIBED BURNING

Prescribed burning is a fire protection action (Chapter 8), mostly taken in advance of the dry season to reduce fuel loads for the protection of assets and lives against wildfires and in the same time maintaining ecosystem integrity (Chapters 4.5 and 8.6).

Remote sensing technology (e.g. MODIS) can determine fire history for SADC (Chapters 4.2 and 4.6). The fire history of a landscape, together with the spatial distribution of the fire ecology vegetation types, will assist natural resource managers with clear reasons for burning (Chapter 8.6).

14. CROSS-BORDER FIRE MANAGEMENT

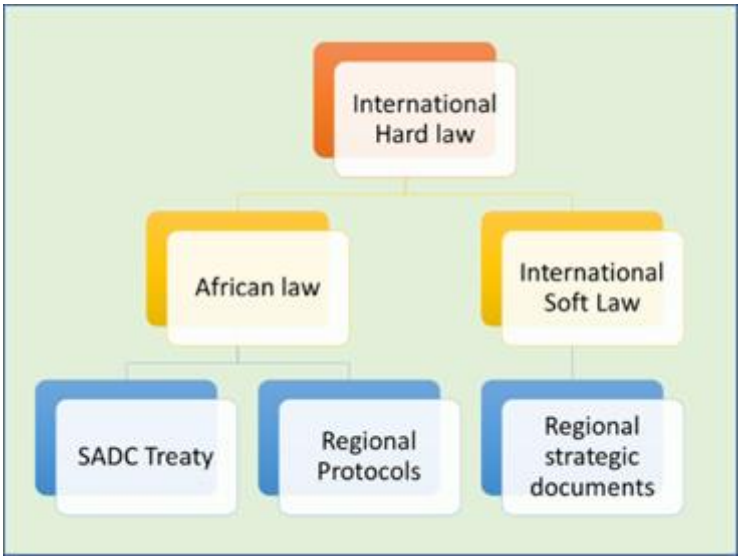
Wildfires do not respect borders. The SADC Treaty presents the legal base for collaboration on FM.

The way forward for cross-border FM is to start implementation within the TFCAs. The legal base is sorted out and objectives are easy to integrate.

Establish FPAs by following the procedures described in the Chapter 7.4. Within SADC only South Africa has legislation supporting FPAs, however it is more practical to agree to implement, adapt and legalise later.

Decide on a suite of basic IFM guidelines suitable for the specific land-use(s), implement as soon as possible and adapt when necessary.

Member states should take care not to negatively alter natural fire regimes with cross-border FM activities.



15. RESEARCH

The natural landscapes and land-uses are not unique to SADC, but some IFM knowledge gaps require research (Chapter 4.10 of the situation analysis).

a. Uniform fire ecology-type and land-use maps are not readily available to facilitate interpretation of fire history from remote sensing applications
b. Fire risk classification of SADC in terms of likelihood of ignition (fire ecology-type and fuel load) and consequence (economic, social and environment) will provide valuable guidance to policy makers and planners at regional, country, landscape and land-use levels
c. Researchers should utilise wildfire statistics and the national fire danger index system to identify real weather and climate change trends. This will be useful for updating fire risk maps and adapting IFM guidelines
d. Dry forests (Zambezian Woodlands) is the most extensive vegetation formation in SADC. However, to align fire management appropriately, the market demand/potential for these forest products requires better understanding
e. The fire-dependant dry forests are not properly managed in SADC. The technical management thereof and the role of fire within requires better understanding, e.g. silvicultural application
f. SADC leadership to collaborate with CSRI Meraka Institute to implement and maintain standard system of early warning and active satellite-based fire detection. Mereka is also well positioned to provide relevant information for researching the relationship between mega fire events (as in South Africa) and natural fire regime change/ fire suppression.

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