

# Fire emissions and carbon sequestration responses of miombo woodlands: the context of Integrated Fire Management in Mozambique

By: Natasha Ribeiro

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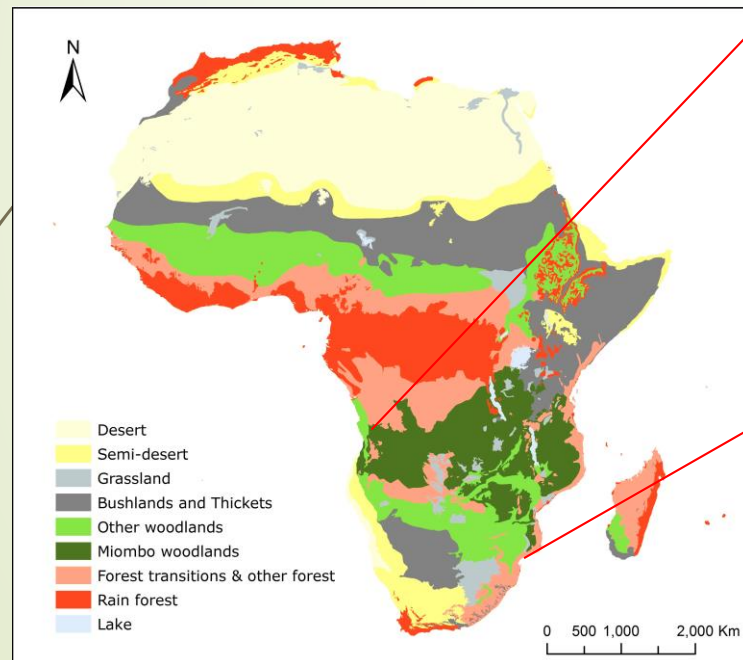
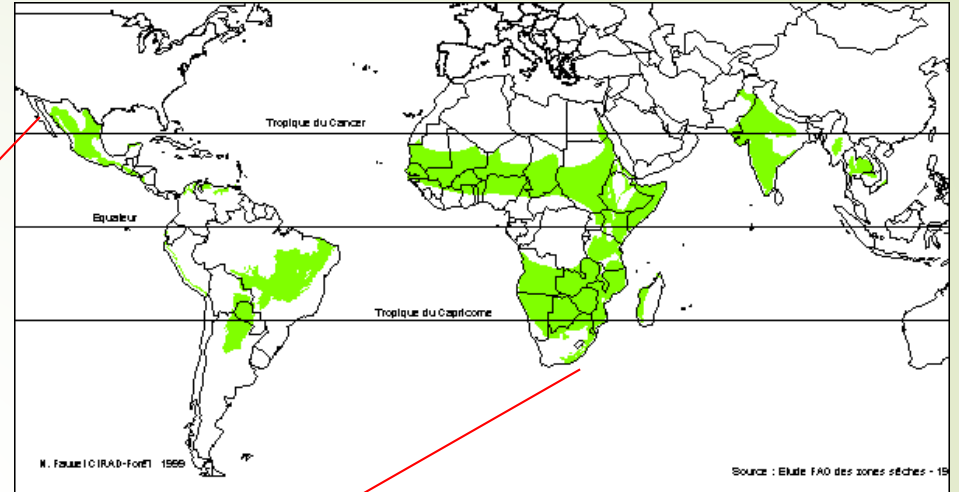
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# Miombo woodlands: distribution



- The largest dry tropical forest ecosystem
- Occupies about 1.9 million km<sup>2</sup> (Dziba et al., 2020) in Southern Africa across 7 countries (Mozambique, Malawi, Zimbabwe, Tanzania, Zambia, Angola and DRC)
- In Mozambique 2/3 of the forest cover (World Bank, 2018)

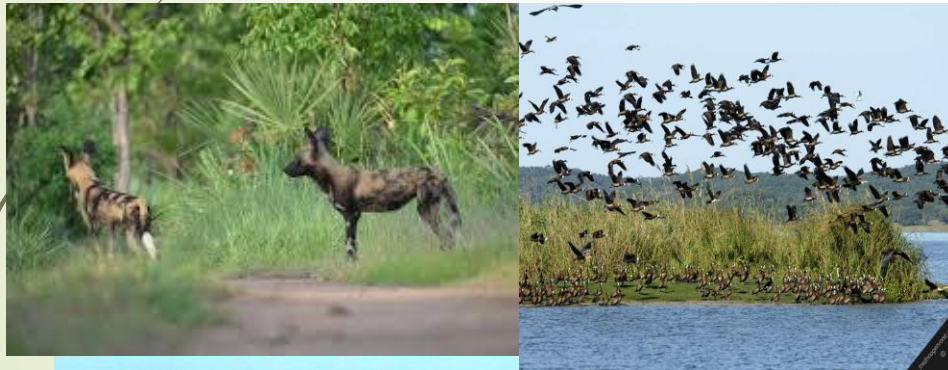
# Miombo Woodlands: ecologically and socially important (social woodlands)

- ▶ about 8,500 plant species, half are endemic of the region.
- ▶ dominated by: *Julbernardia globiflora*, *Brachystegia spp.* and *Isoberlinia angolensis*.
- ▶ Frequent fires and other disturbances (herbivory, slash and burn agriculture).

People's records from 200,000 years ago.

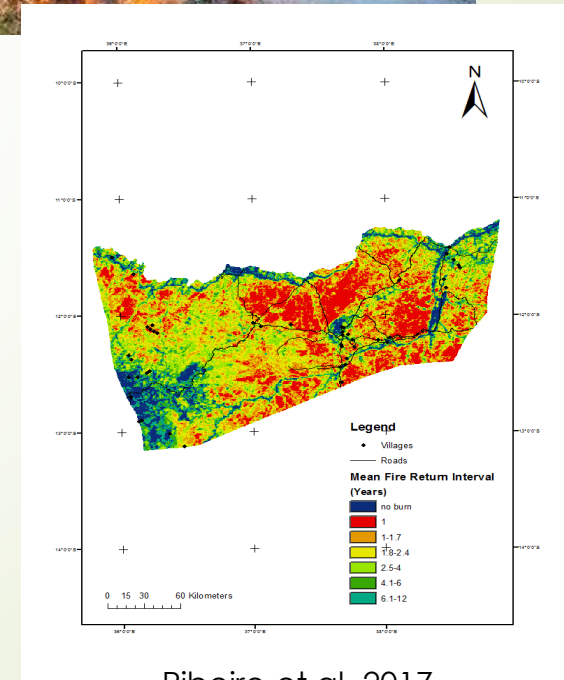
Provide goods and services for 100 million rural people and 50 million urban dwellers (Ryan et al., 2016).

Intrinsic relationships between people and the woodlands.



# Fire is part of miombo ecology

- ▶ Have long existed in MW (probably ~200,000 years ago; Morris, 1970)
- ▶ A major management tool for rural people.
- ▶ Most species are adapted and other depend on fires to survive.
- ▶ Fire regimes are important to maintain the ecosystem, but very few IFM programs exist.



# Fire regimes are important



Tall miombo



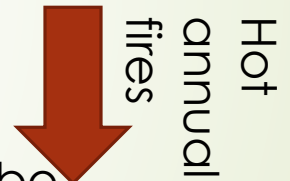
Grass fuels in the understory burn every 2-3 years



Cold fires



Shrub miombo

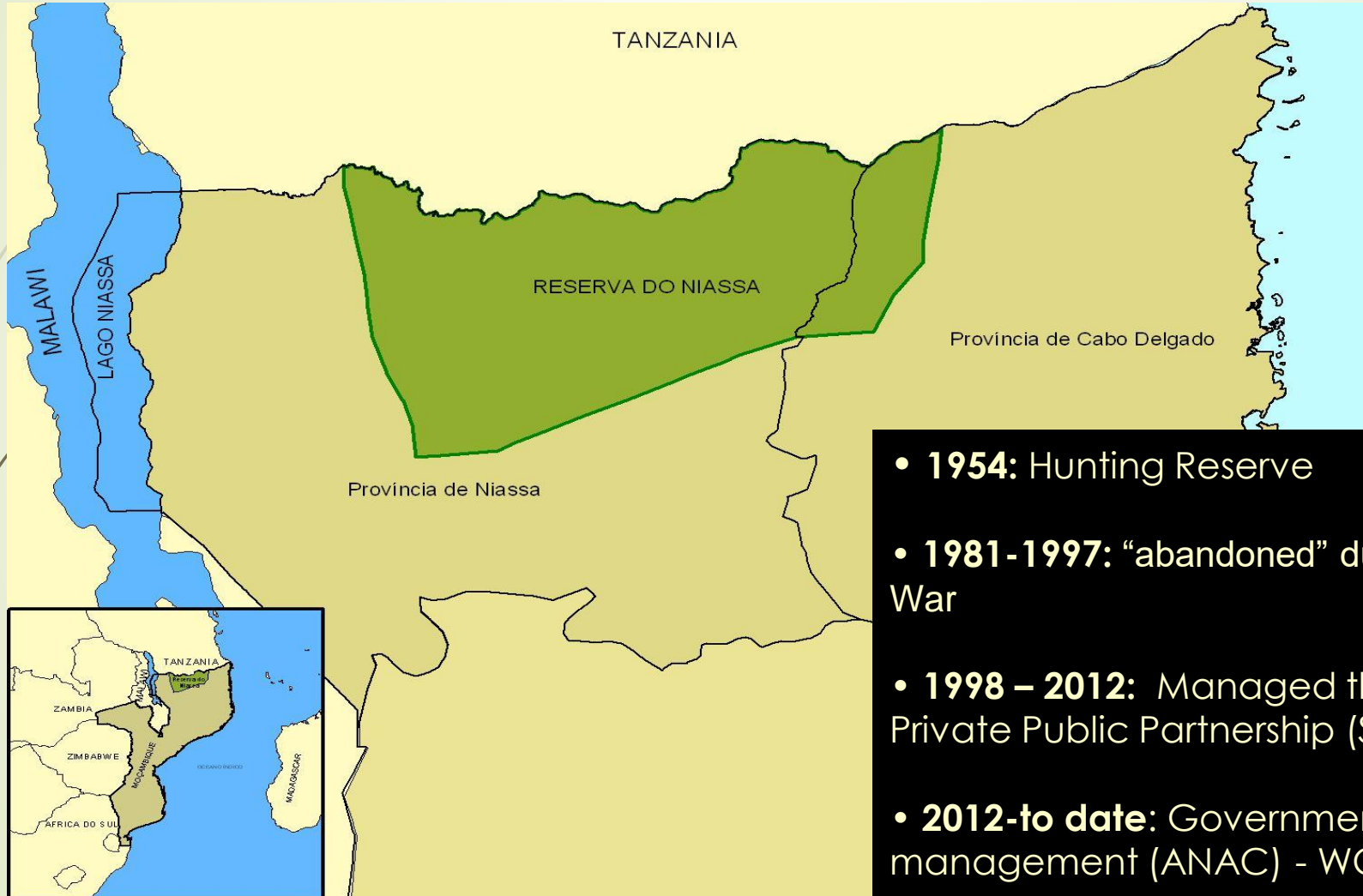


Hot annual fires



# Niassa Special Reserve

(largest conservation area of miombo in the world - 42.000 km<sup>2</sup> - ~16.000 sq. miles)



- **1954:** Hunting Reserve
- **1981-1997:** “abandoned” due the Civil War
- **1998 – 2012:** Managed through a Private Public Partnership (SGDRN)
- **2012-to date:** Government management (ANAC) - WCS.
- **Currently:** new MP in prep



# Fires in Niassa Special Reserve (Ribeiro et al. 2017)

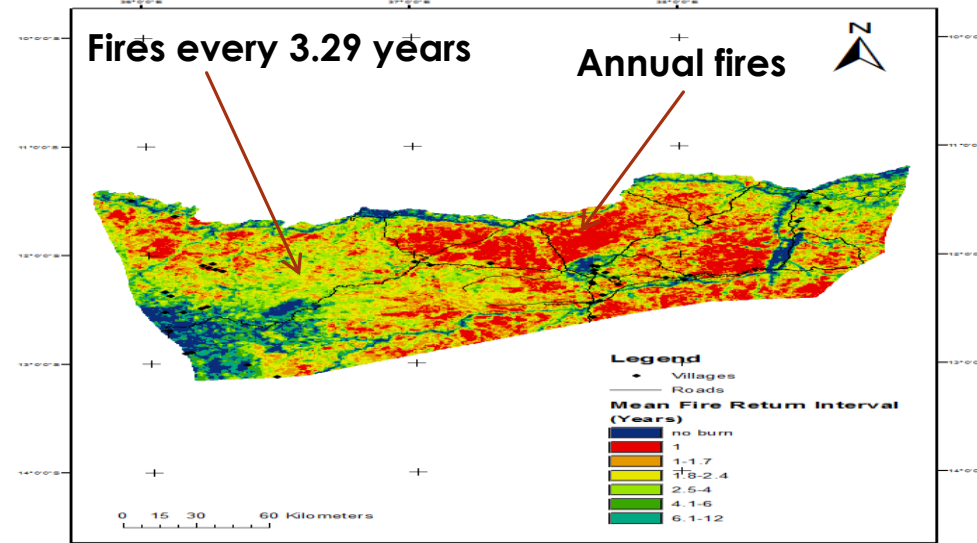


Figure 1. Fire frequency (2000-2012)

45% burns annually  
Fire Season: EDS (Jun-Jul)  
LDS (Aug-Oct)

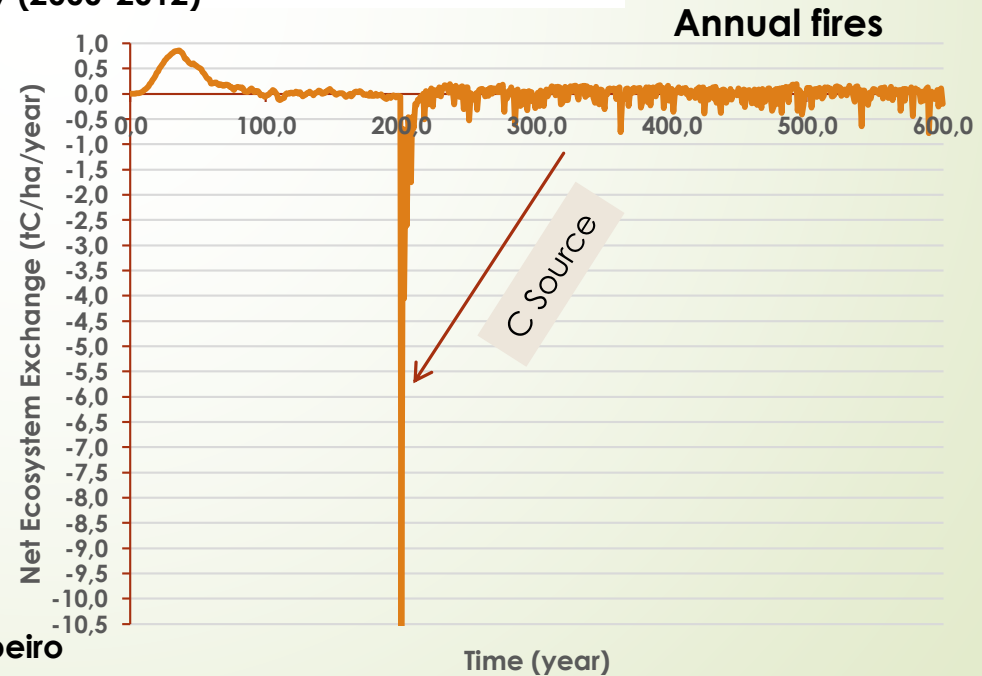
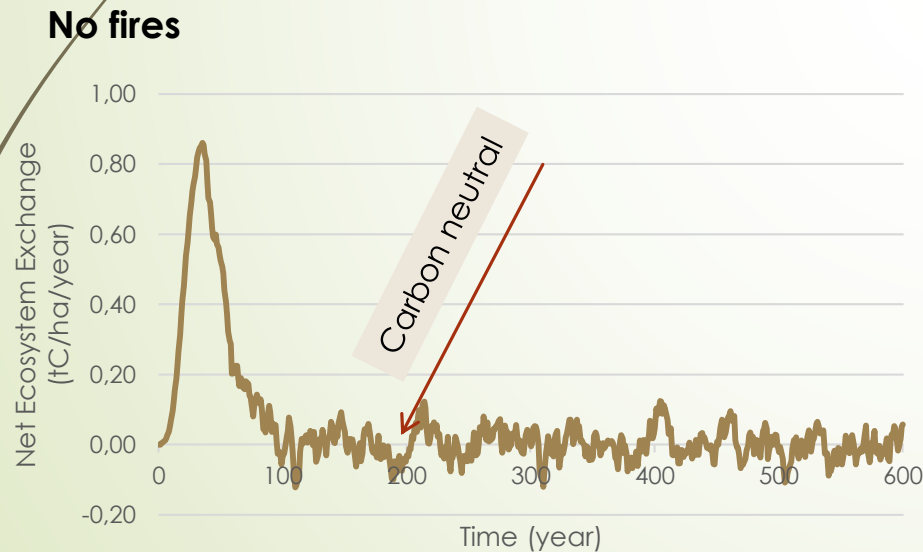
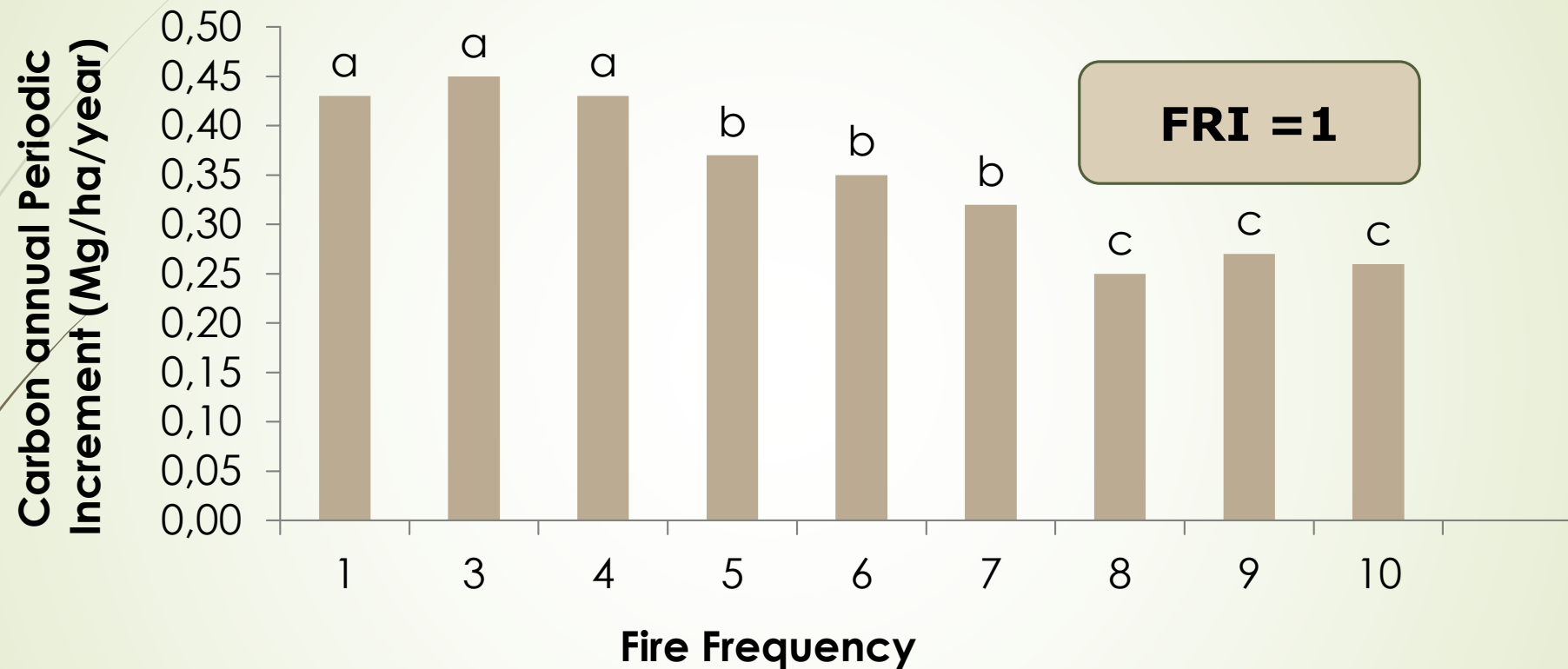


Figure 2: NEE (tC/ha/year) from FORMIND gap model (Ribeiro et al., in prep.)

# Effects of fire frequency on Carbon Annual Periodic Increment (Field data; Amade 2017)

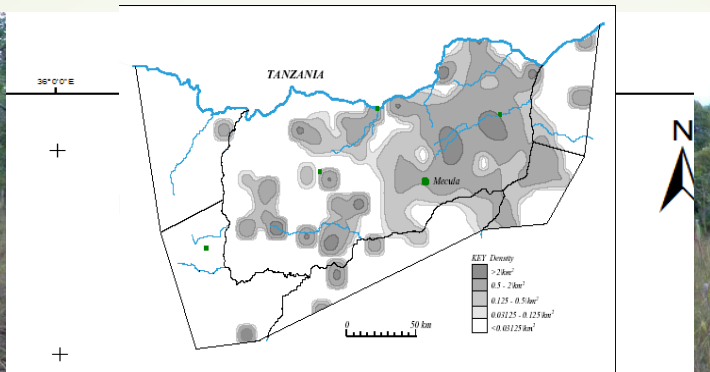


Fire frequency is a strong predictor => NSR may change from a C sink to a C source if fire management is not implemented

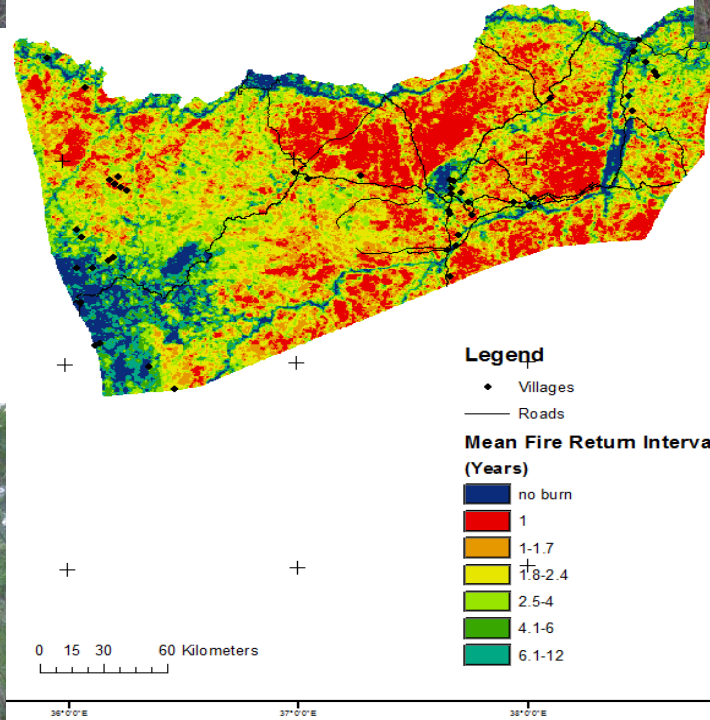
# Woody composition linked to fires (Ribeiro et al., 2008)



Low FF (> tree density < and < Grass biomass)



East (< tree density and > Grass biomass)





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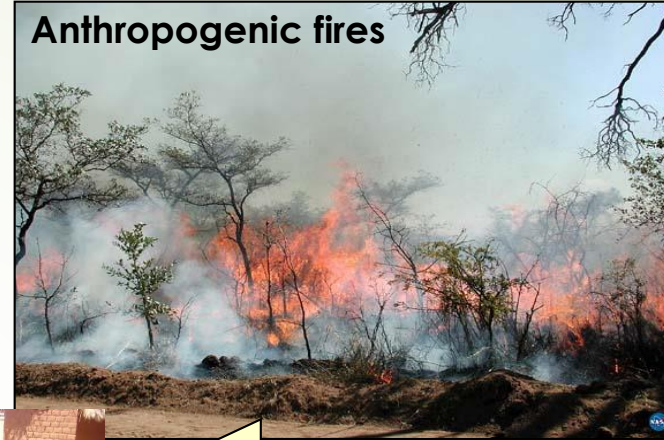
**Understanding interactions between people, elephants and fires in the miombo woodlands of Niassa Special Reserve in support of biodiversity conservation action (2019-2020/21)**

**GOAL:** To understand the interaction between people, fires, elephants and habitat in support of management actions

**Elephants: keystone species**



**Anthropogenic fires**



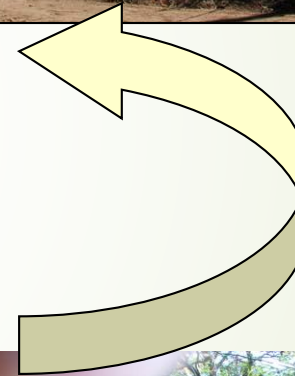
**People's livelihoods**



**Exposed inner tissues**



**Increased fuel load (grass and dead trees)**



# Fire Management in Mozambique

## Legal framework:

- ▶ Forest Law (#10/99): **under revision**
  - ▶ Article 24 prohibits fires as a hunting tool
  - ▶ Article 36 mention “Fire **Prevention** program” as an instrument to implement the Law.
  - ▶ Article 40: states forest fires as a crime.
- ▶ Forest Regulation
  - ▶ Article 106: prohibits fire and institutionalize fines and jail measures for fire related action
  - ▶ General guidelines for fire management actions (firebreaks, etc.).
- ▶ Forest Policy (2019)
  - ▶ States the need to create specific regulation with **coercive** measures to avoid fires; and
  - ▶ To develop participatory plans to **prevent, control and combat** fires.
- ▶ Moz action plan to prevent and control fires (2008-2018):
  - ▶ Actions to reduce fires to 10%
  - ▶ Prohibitive in all matters
  - ▶ No mentioning of **fire management**

# Mozambique INDC (MITADER, 2015) and IFM

- ▶ Mozambique communicated its mitigation contribution in the form of actions (policies/programmes) and also included an adaptation component in its INDC.
- ▶ Id 8 strategic actions aimed at creating resilience and reducing the climate risk in the communities, ecosystems and national economy.
- ▶ The country updated its NAP (2015-2030) that includes ~14 strategic actions (**none directly linked to FM**)
- ▶ National Strategy on REDD+ includes fires under SO6 (forest restoration): ...  
**” include fire control in regeneration protection”**

# Fire emissions abatement from fire management in NSR–GapFire model (VM0029) – prelim results (FFI, 2020)

	Baselin e	Y1	Y2	Y3	Y4	Y5
pEarly	0.082	0.33	0.33	0.33	0.4	0.6
pLate	0.71	0.57	0.57	0.57	0.2	0.2
	Y6	Y7	Y8	Y9	Y10	Y10+
	0.5	0.4	0.2	0.4	0.5	0.399
	0.1	0.2	0.8	0.4	0.05	0.366

Biomass strata (MgC/ha)	Total (TCO2eq) BAU	Total (TCO2eq)- increasing EDS fires	Emission reductions	% reduction
5-10	1,040.56	347.22	-693.34	-66.6
>10-15	59,665.76	20,849.49	-38,816.27	-65.06
>15-20	341,257.04	126,553.51	-214,703.53	-62.9
>20-25	939,000.68	342,964.31	-596,036.37	-63.5
>25-30	1,441,643.07	561,397.85	-880,245.22	-61.06
>30-35	1,697,757.29	737,379.81	-960,377.48	-56.61
TOTAL	4,478,283.28	1,789,492.17	100	-60%

# Key aspects to sustain miombo woodlands in Mozambique

- ▶ The REDD+ system is a pathway to mitigate the effects of CC and woodland restoration, but there should be a balance between C and non-C benefits (other ES) and consider IFM.
- ▶ Forest policies and governance should be revised to take into consideration the ecological and silvicultural knowledge of the miombo (e.g. Resprouting, light dependency, role of fires, etc.)
- ▶ Implement IFM programs (e.g IFM program for NSR is being developed)
- ▶ Research activities should be better coordinated and aligned with decision-making.



## Miombo Network of Southern Africa

Natasha Ribeiro (Moz), Judith Kamoto (Mal), Sally Archibald (SA), Alfian Rija (Tz) and Stephen Syampungani (Zam)

(MN steering Committee)

<http://miombonetwork.org/>

# Role of the Miombo Network

## (i) Promote collaborative research action

- Analysis of the regional legal and policy framework for miombo woodlands (2017/2018).
- Socio-Ecological Observatory of SA Woodlands (SEOSAW), collate and analyse existing plot data in the MW and associated woodlands (**on-going**)
- Invasive Alien plants (IAPs) for eco-friendly energy: from environmental problem to economic asset (**recently approved**)

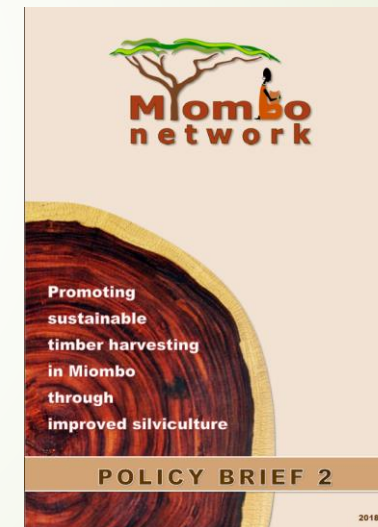
## (ii) Liaison with Southern Africa Fire Network (SAFNET)

- Joint meetings
- Joint projects and fire action
- Training

## (iii) Dissemination of information

- **Policy briefs (4)**
- **Scientific publications**
- **Miombo Book (Ribeiro NS, Katerere Y, Grundy IM, Chirwa PW (eds) (2020) Miombo Woodlands in a Changing Environment: Securing the Resilience and Sustainability of People and Woodlands. SpringerNature, Switzerland.**

<https://doi.org/10.1007/978-3-030-50104-4>



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Paxie W.C. Chiriwa  
Isla M. Grundy *Editors*

**Miombo Woodlands  
in a Changing  
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....+20 students

An aerial photograph of a vast Miombo woodland landscape. The terrain is covered with a dense canopy of trees, showing a mix of green and brownish-yellow foliage, indicating a dry season. The trees are scattered across a hilly or uneven terrain. In the center of the image, the words "THANK YOU!" are written in a large, bold, black, sans-serif font. The text has a subtle reflection effect below it. On the left side of the image, there is a vertical decorative element consisting of a light green background with a dark red arrow pointing right at the top and several thin, dark green lines that resemble grass or reeds extending downwards. The overall scene is a natural, open landscape with a mix of vegetation colors.

**THANK YOU!**

Miombo woodlands in Niassa Special Reserve (Photo Credit: N. Ribeiro)