Miombo network

Promoting sustainable timber harvesting in Miombo through improved silviculture

POLICY BRIEF 2

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The Miombo Network with contributions from

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Key Policy Pointers

The Timber harvesting in the Miombo region involves selective harvesting of preferred timber species (such as *Pterocarpus angolensis, Afzelia angolensis, Dalbergia melanoxylon*) without opening up of the woodland. Selective harvesting decreases the likelihood of conspecific replacement and increases the risk of collapse of the natural successional pathway.

This method is unsustainable in that it does not support recruitment of timber species, as these species are light demanders. This has the ability to result in total collapse of the population that are being harvested if the situation persists for a long time as there would be no recruitment with time into the higher size class when individuals die.

To ensure sustainable harvesting, policymakers across the region must take into account a number of factors, including:

- Development and implementation of woodland management plans based on growth rates of timber species. This should provide for regulation of initial harvesting and subsequent cutting cycles.
- Silvicultural prescriptions for major vegetation types and species based on their functional traits and disturbance factors.
- Integrated silvicultural systems that accommodate different commercial applications (e.g charcoal, timber, honey).

The Miombo Network: Science in action

The Miombo network (***http://miombonetwork.org/***) is composed of scientists and policy makers from across east and Southern Africa working on Miombo woodlands. The network also comprises scientists working on Miombo woodland from outside the Miombo ecoregion. It aims to provide science-based information on management policy and practice in the region through the use of field-based approaches, remote sensing and other geospatial information technology. It aims at contributing to achieve effective and appropriate management policies and practices by providing science-based information produced through the use of field-based approaches, remote sensing and other geospatial information technology which is currently missing in Miombo woodland management.

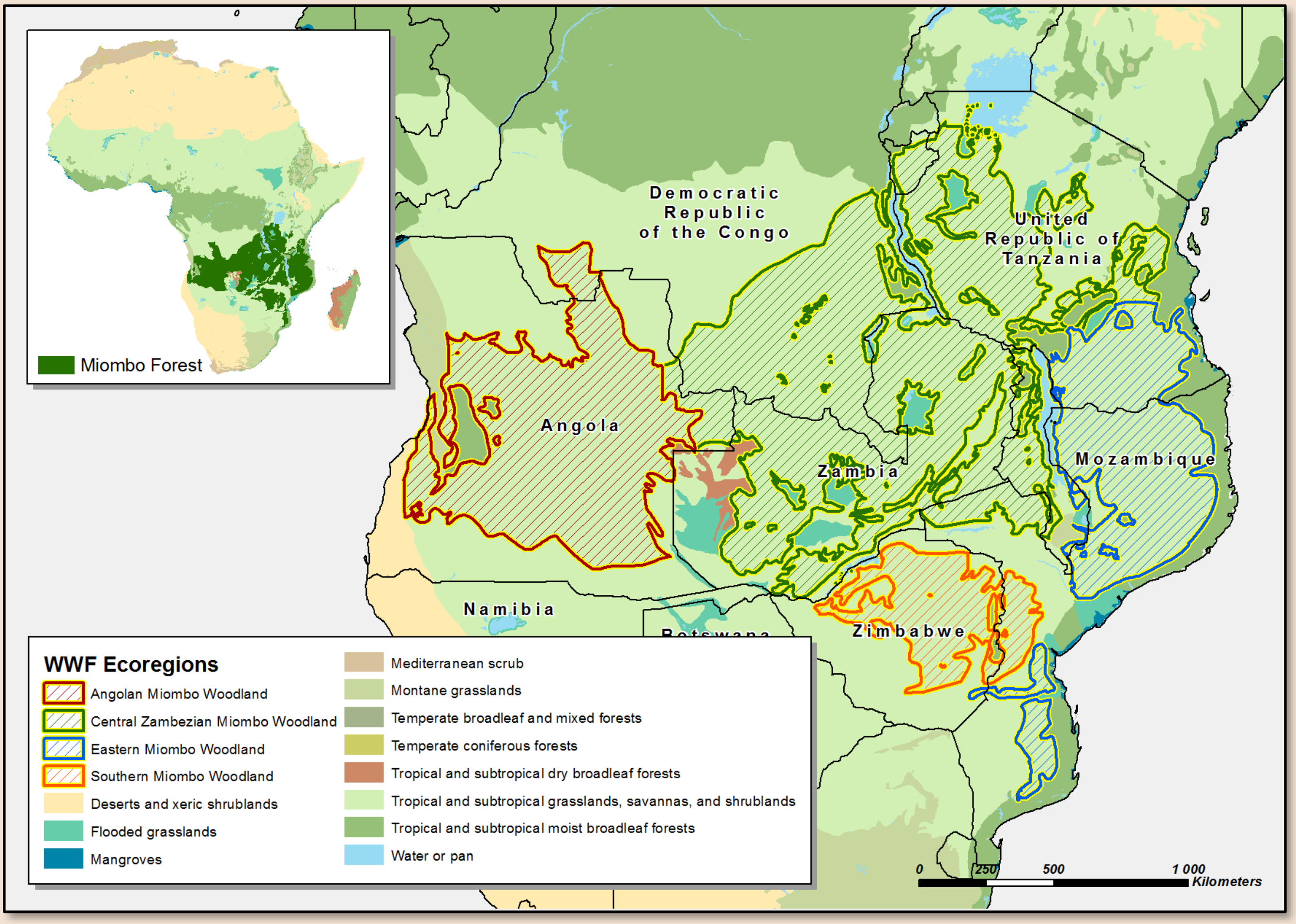

Figure 1: Map depicting the Miombo Ecoregions

The woodland is mainly composed of *Brachystegia spp*, *Isoberlinia angolensis* and *Julbernadia spp* as dominant species. Miombo woodland is a significant biome covering 10% of the Africa land mass (ca. 2.5 km^2). It is the most extensive woodland in Africa covering Angola, Zimbabwe, Zambia, Mozambique, Malawi, Tanzania and southern parts of the Democratic Republic of Congo. Miombo supports livelihoods of over 150 million people through the provision of many products including wood and its related products. Miombo woodland is rich in valuable timber species that are widely traded both locally and internationally. Regional trade in natural forest timber has grown over the last 10 years and has reached hundreds of millions of USD (USD162, USD10 and USD186 million

Tanzania, Zambia and Mozambique, respectively[1]). China is the main importer overseas, with Mozambique being Africa's fourth-largest timber exporting country to China and is the largest exporter in the east and southern Africa region. The domestic consumption in natural forest timber (e.g. *Pterocarus angolensis*, *Afzelia quanzensis*, *Dalbergia melanoxylon*) in the region, although not properly monitored, is estimated to be more than 10 times the amount that is exported internationally[1]. In addition, timber from Miombo is largely important to sustain local livelihoods and small enterprises. Poles are harvested by cutting down small trees selectively, based on their height, diameter and straightness[2]. Small-sized poles have been observed to be more preferred as they work in both fencing and roofing, although bigger poles provide house support[3].

Unsustainable use: current timber harvesting in Miombo

Despite the economic importance of the timber industry in the region, there are several factors that undermine its sustainability namely political, silvicultural and institutional issues. Political and institutional factors have been largely analyzed in the literature[1,4,5,6,7]. In this brief we analyze the silvicultural aspects of timber production and its implication for the sustainable management of Miombo woodlands in the region.

Even though a few examples of sustainable harvesting exist (e.g. TCT Dallman in Caia, Mozambique), logging in the Miombo woodland is unsustainable for a number of reasons namely: i) It does not involve developing woodland management plans or their implementation, if they exist ii) Lacks pre-logging inventories and silvicultural prescriptions for major forest types and species; iii) Lacks regulation of initial harvesting and subsequent cutting cycles and management of transition from first to second cutting cycles; iv) Non availability of clear and official harvesting rules; and v) Inadequacy of monitoring of residual growing stock after logging. Consequently, most of the timbers species are becoming extinct economically.

Overview of Miombo ecology: a resilient ecosystem

Domestic markets within the region target a few species such as *Pterocarpus angolensis*, *Khaya anthotheca*, *Erythrophloeum africanum* and *Afzelia quanzensis*, whereas international destinations, such as China, target heavy timbers with a reddish hue, such as *Swartzia madagascariensis, Baphia kirkii*, *Pterocarpus tinctorius* and *Baikiaea plurijuga*. For instance, in 2008, 90% of the licensing in Mozambique belonged to only 9 species (*Millettia stuhlamanii*, *Afzelia quanzensis*, *Pterocarpus angolensis*, *combretum imberbe*, *Brachsystegia spiciformis*, *Swartzia madagascariensis*, *Guibourtia conjungata*, *Pericopsis angolensis*, *Bridelia micrantha*, *Dalbergia melanoxylon*, *Colophospermum mopane*, *Sterculia quinqueloba*, *Julbernardia globiflora*, *Androstachys Johnsonnii*, *Acacia*

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[1] Lukumbuzya, K. and Sianga, C. 2017. Overview of the timber trade in East and Southern Africa: National Perspectives and Regional trade linkages. TRAFFIC/WWF. 66p.

[2] Sitoe, A.; Salomao, A. and Wertz-Kanounnikoff, S. 2012. O Contexto de REDD+ em Moçambique: causas, actors e instituições. CIFOR 76. Bogor

[3] Abbot, P. G. & Lowore, J. D. 1999. Characteristics and management potential of some indigenous firewood species in Malawi. Forest Ecology and Management 119:111–121.

[4] Dewees, P. A. 1994. Social and Economical Aspects of Miombo Woodland Management in Southern Africa: Options and Opportunities for Research;

[5] Bloomley, T. and Iddi, S. 2009. Participatory Forest Management in Tanzania: 1993 – 2009 - Lessons learned and experiences to date. Ministry of Natural Resources and Fisheries, Tanzania;

[6] Salomao, A. and Matose, F. sine die. owards community-based forest management of miombo woodlands in Mozambique;

[7] Schaafsma, M.; Burguess, N.D.; Swetnam, R.D.; Ngaga, Y.M.; Turner, R.K. and Treue, T. (2014). Market Signals of Unsustainable and Inequitable Forest Extraction: Assessing the Value of Illegal Timber Trade in the Eastern Arc Mountains of Tanzania. World Development Vol. 62, pp. 155–168;

nigrescens and *Amblygonocarpus andongensis*)[1]. This situation imposes a major pressure over a few species, which already have major silvicultural limitations.

Some of the silvicultural limitations of Miombo timber species include low individual densities, slow growth especially if not properly managed (~0.24 cm/year; Ribeiro et al., in prep.), dieback of new shoots, sensitivity to fires in the young stages and low seed dispersibility associated with low germination rates. ***Table 1*** presents the regional average values of those silvicultural traits for some Miombo timber species.

Table 1: Average regional values of silvicultural traits of some Miombo timber species

Species	Density of trees (stems/hectare)	Growth	Germination rate in the field (%)
Pterocarpus angolensis	3.7	0.35 cm/year	25
Afzelia quanzensis	32	50-60 cm/year*	88.4
Millettia stuhlmannii	-	0.33 cm/year	-
Dalbergia melanoxylon	7	-	

** In height while the rest are in diameter, cm*

Despite the silvicultural limitations, Miombo timber species have evolved with disturbances such as slash and burn agriculture, fires and herbivory and can resprout vigorously, and recruit from clonal root suckers[8]. Thus, global initiatives to create sustainable harvesting are particularly likely to be effective in Miombo woodlands but they need to be adjusted to species silvicultural needs as well as, seen in the context of disturbances occurring in this ecosystem.

The key attributes of Miombo woodland include its adaptation to the long dry season and associated fires and also the clonal nature of most of the woodland species. Other major attributes include the following[9,10]:

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[8] Miombo Network. 2016. Using and restoring the Miombo woodlands: needs for an integrated and holistic approach in ecosystem management for long –term sustainability. Policy Brief.

[9] Geldenhuys J. C., 2015. Ecological Basis for Integrated, Multiple-Use Management of Mozambique Forest and Woodland Areas: SESA Report to deal with REDD+. Report Number FW-04/15

[10] Syampungani, S., Geldenhuys, C.J., and Chirwa, P.C. 2015. Regeneration dynamics of miombo woodland in response to different anthropogenic disturbances: forest characterisation for sustainable management. *Agroforestry Systems.* **DOI**10.1007/s10457-015-9841-7

- Most species sprout (re-grow vegetatively, or coppice) from a persistent underground rootstock, or the stem base, as an adaptation to a variety of browsers (fire as non-selective browser, and mammals, insects and people as selective browsers). This allows them to persist on site through vegetative regrowth from underground rootstocks and cut stems to produce fast-growing shoots after a fire, (***Figure 2***) or when damaged or harvested;

Figure 2: Coppice regrowth is fast from the underground rootstocks, also of species that were not part of the cleared stand but that were dormant in the rootstocks, thereby increasing above-ground species richness (Photo source[9]).

- Most species need good light conditions for their regeneration from seed or sprouting, and to grow fast in height and stem diameter, i.e. they cannot grow well under the canopy of other trees. Opening up Miombo woodlands results in exposure of stumps to sunlight, which enhances coppicing effectiveness of most of the Miombo woodland species;

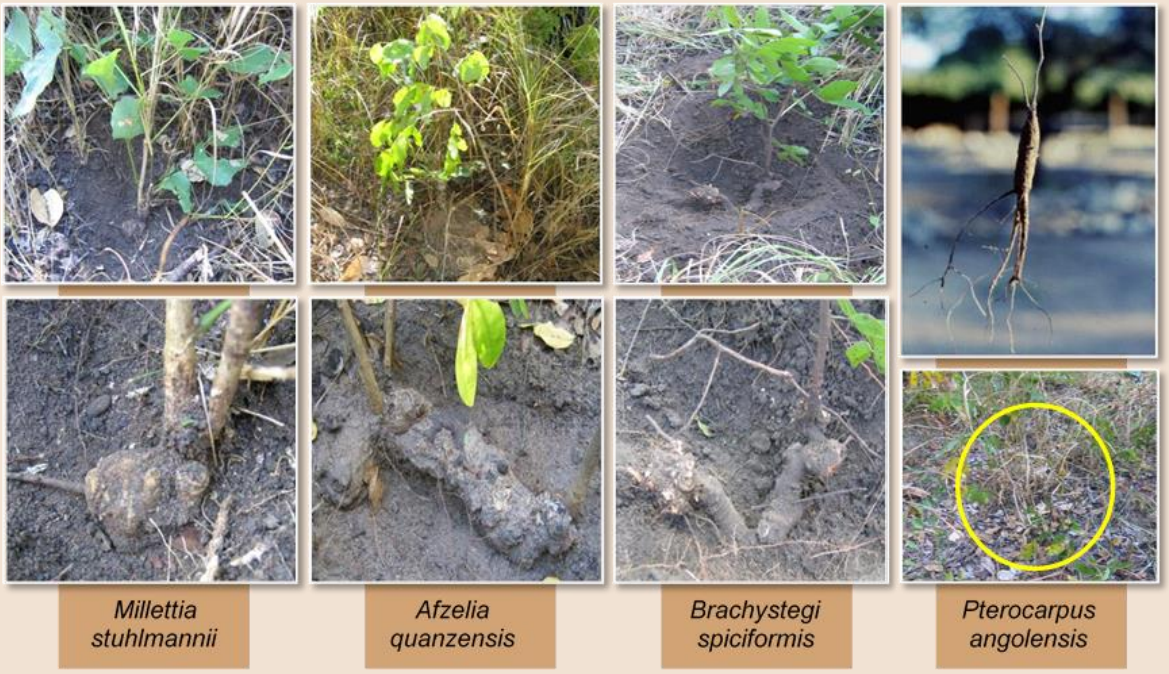

Figure 3: Miombo woodland species persist on site through vegetative regrowth from root stocks & seedlings (Photo source: Geldenhuys).

- Additionally, opening of the Miombo woodland stimulates germination and seedling establishment of the soil seed reserves of most preferred timber species (***Figure 3***, next page) as the temperature an d light intensity reaching the woodland floor increase;

- Extensive horizontal root systems and clonal reproduction from root-suckers (***Figure 4***) facilitates rapid recuperation after cutting. New individuals may get recruited several meters from the parent tree;

Figure 4: Horizontal root system of Brachystegia spiciformis (Photo source: Syampungani)

- The majority of species are semi-deciduous to deciduous because of the long dry season, and regeneration strategies are associated with the seasonal changes in rainfall, soil moisture and temperature;
- Low vulnerability to xylem collapsing of some Miombo species (*Julbernardia* and *Brachystegia*), which allow them to survive under drier and warmer conditions[11]; and
- Although young saplings and coppice resprouts are susceptible to fire, larger trees are fire-resistant as they are protected with a thick bark.

The above key attributes of the Miombo woodland ecology and species has direct implication on developing a sustainable silvicultural system for the Miombo woodland.

Improved silviculture: an option for sustainable use and management

Understanding the key attributes of Miombo can inform and improve silvicultural practices to address unsustainable timber harvesting. The key attributes of the Miombo woodland ecology and species have direct implication on developing a sustainable silvicultural system for the ecosystem. A silvicultural system that integrates utilization aspects that opens up the woodland and timber harvesting can be developed. Since opening up of the woodland results in enhanced seedling recruitment of timber species on cessation of the disturbance impacts over an area, their regrowth stands may be managed for selected trees of timber to grow into good-sized trees.

Because different commercial applications (e.g charcoal, timber, honey) require different stem sizes, a mixed-use system could be developed, where thinning to enhance the stem size of timber species is used for other aspects such as for fuelwood and poles. Coppice stumps need to be protected from fire, but fires could be

[11] Vinya R (2010) Stem hydraulic architecture and xylem vulnerability to cavitation for Miombo woodland canopy tree species. University of Oxford, Oxford, p 220.

applied effectively in stands with larger stems to reduce competition. Adhering to optimum diameter classes[12] within which particular species have high coppicing effectiveness can enhance coppicing of such species. Additionally, increased stump heights during felling as observed by Grundy (1995)[13] can enhance the survival of stumps and coppicing. In implementing such a management system it is key to integrate other factors such as: population growth, unsustainability of charcoal production practices and existing policies, through appropriate land use planning.

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[12] Handavu F., Syampungani S., Chisanga E., 2011. The Influence of stump diameter and height on coppicing ability of selected key miombo woodland tree species of Zambia: A guide for harvesting foe charcoal production. *Journal of Ecology & the Natural Environment* 3 (14): 461-468.

[13] Grundy, I., 1995. Regeneration and management of Brachystegia spiciformis and *Julbernadia globiflora* in Miombo woodland. Unpublished DPhil Thesis, University of Oxford