

Miombo woodlands – opportunities and barriers to sustainable forest management

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1 Introduction

Miombo woodland is the most extensive tropical seasonal woodland and dry forest formation in Africa (perhaps even globally), covering an estimated 2.7 million km² in regions receiving more than 700 mm mean annual rainfall on nutrient-poor soils (Frost 1996). It covers substantial portions of South and Central Africa: Angola, Zimbabwe, Zambia, Malawi, Mozambique and Tanzania, and most of the southern part of the Democratic Republic of Congo (DRC) (Fig 1). Rough estimates a decade ago suggested that 40 million people inhabited areas covered, or formerly covered, by miombo woodland, with an additional 15 million urban dwellers relying on miombo wood or charcoal as a source of energy (Campbell et al. 1996).

While there are some “good news stories” from the field, they remain few-and-far-between, and deforestation and poverty figures are sobering. Statistics on woodland cover in the miombo countries continue to show a decline in cover, both nationally (Table 1 – FAO 2007) and in many case study areas (e.g. Luoga et al. 2005; Mwase et al. 2006). Woodland loss is largely driven by two major processes: land clearing for agriculture, and wood extraction for energy. In many cases these forces work in tandem, wood extraction is followed by use of the land for agriculture.

Roads pose both opportunities and challenges for miombo woodland use and conservation. They improve access to markets for agricultural products as well as timber and non-timber resources (plants, fungi, bush meat). By improving market opportunity, roads increase the proportion of household income from woodland use. As a result, the incentive to conserve woodlands, for example for beekeeping, is increased. Ironically, the state of disrepair of infrastructure caused by warfare in DRC, Mozambique and Angola offers an opportunity to re-plan road locations to the benefit of national economic development and the sustainable use and management of miombo woodland.

Unfortunately roads can also provide easier access to “resource rich frontiers”, often accompanied by an influx of outsiders whose interests undermine local practices and weaken local tenure systems. Road access catalyses land settlement, land clearing and changing anthropogenic disturbance patterns. In northern Zambia, for example, Sprague and Oyama (1999) suggested that rotation times for miombo woodland *chitemene* may have been long enough to be sustainable under traditional *chitemene* cultivation, but with the tendency of *chitemene* farmers to settle closer to roads, rotation times may have become too short to maintain both the *chitemene* system and the woodlands along the roads.

Poverty reduction in the miombo countries remains problematic. In a number of countries, the macro indicators of poverty such as per capita income show high levels of poverty (Table 2). Life expectancies are low as a result of the HIV/AIDS epidemic and Secondary school enrolments remain generally low. Some countries have demonstrated impressive growth (e.g. Angola, Mozambique and Tanzania). In the case of Angola, a period of economic growth after the lengthy civil war which devastated the economy is driven mainly by oil production and in Mozambique by Aid. While in the other countries,

a deeper look at the figures indicate that rural poverty is not going away. In Tanzania, 80% of the population lives in rural areas. As the rural poverty rate is higher than the urban one, 87% of the poor are found in rural areas (Shepherd et al. in prep.). The average annual growth rate in the natural resource sector over the past decade (1991-2001) has been 3.3%, whereas the annual growth rate in trade, manufacturing and services has been 7-9%. Yet, the modern sector has absorbed no more than some 40,000 people per annum, compared with an annual labour force growth of 650,000. The remaining 610,000 people are left to make a living in the informal and subsistence sector, probably many based on natural resource activities in rural areas. Various authors (e.g. Ellis and Mdoe 2003, for Tanzania) call for more attention in Poverty Reduction Strategy Paper (PRSP) processes to address disjunctures between macro-level goals and debilitating local-level contexts, if real gains in rural and urban poverty reduction are to be realized.

Rural poverty must be seen in the context of the available resources including woodland resources. Woodlands resources can play a major role in bolstering livelihoods and in poverty mitigation (*sensu* Sunderlin et al. 2003). This is illustrated by Cavendish (1999) with Zimbabwean data. The inclusion of environmental income¹ was found to reduce poverty rates in one Zimbabwean ward by 50% or more, while for the total income (i.e. with environmental income included) was 20-30% more equally distributed than non-environmental income. Using similar methods in two other wards in Zimbabwe, Campbell et al. (2001) also demonstrated the role of forest resources in livelihoods - nearly 30% of income is woodland-based in the lowest wealth quartile, but is less than 10% in the top wealth quartile. Similar conclusions were arrived at by Fisher (2004) for three villages in Malawi, where the addition of forest income to the household accounts leads to a 12% reduction in measured income inequality. Thus, in many rural settings, environmental income is a quantitatively large and significantly equity-promoting and poverty-mitigating income source. Consequently, loss of woodland resources potentially has large repercussions if income flows from alternative land uses are less than from woodland-based activities. .

The above figures and trends do not paint a glossy picture. Some trends, nevertheless, give room for optimism, notably community-based approaches of miombo management in Tanzania (Wily and Dewees 2001) and cases of forest enterprise development from Southern Africa (CIFOR 2004; le Breton 2006; Odera 2004), as outlined in Section 2. Section 2 gives a bio-physical background to miombo, showing how the bio-physical context has led to some peculiar uses for miombo, with consequences for economies and management.

The remaining opportunities from miombo woodlands can be harnessed to improve livelihoods. Section 3 examines the opportunities to manage and benefit from miombo woodlands. We consider the opportunities to be: (a) Forests are still a valuable resource base; (b) Resource rights are shifting to local people; (c) New approaches to integrating

¹ Cavendish (1999, 2000, 2002) used 'environmental income' to cover woodland income plus non-woodland income. In using his data we have excluded the major sources of non-woodland income.

conservation and development are emerging; and (d) New markets are emerging and expanding.

For poverty to be reduced barriers must be reduced. Section 4 examines the barriers to increasing the value of miombo woodland resources to livelihoods. We identify six key Economic Barriers: (a) Miombo woodlands have low inherent productivity, so returns to management tend to be low; (b) Elite and external actors frequently capture the bulk of values when they occur; (c) Restrictive regulations for forest extraction and trade reduce access and increase transaction costs of producers and traders; (d) Limited support is given to local forest enterprise development; (e) Weak local organization to engage in markets, and (f) A legacy of armed conflict (plundered stocks, landmines) restricts resource use.

For the miombo woodlands to remain important for society it is insufficient to look only at current economic contributions, one also needs to scrutinize the environmental sustainability of present modes of use. In Section 5, we therefore examine the barriers to sustainable use. We identify six key Sustainable Use Barriers: (a) Roads are significant drivers of woodland clearance; (b) Resource rents may be too low and the transaction costs of control and management interventions may be too high to justify management efforts; (c) Local institutions for NRM management are often weak; (d) “Forestry” is marginalised, leading to few resources to support sustainable management, develop appropriate technical information and enforce forestry regulations; (e) As soon as particular products achieve higher value they are domesticated and natural forests become less important; (f) Cash constraints push towards high preferences for rapid exploitation.

Section 6 concludes. This review is a prelude to a further paper that will examine the policy options needed to capture the opportunities and, where possible, to remove the barriers.

2 Opportunities for miombo product use are strongly determined by biogeography and evolutionary history

Resource availability and opportunities for new natural resource enterprises in miombo woodlands are strongly determined by the biogeography, evolutionary history, and geomorphological and climatic factors influencing miombo soil-fertility and biomass production. The underlying bio-physical conditions have led to some particular uses of miombo, with economic and management implications.

Miombo woodland is characterized by the three Caesalpinoid genera: *Brachystegia*, *Julbernardia* and *Isoberlinia*. The species of these genera all produce hard timber, and many have fibrous, tannin-rich bark. In contrast to the low diversity of tree species, a high diversity of shrubs, trees, vines and perennial herbs (some with underground tubers) in the

legume sub-family Papilionaceae dominate the herbaceous layer.² In addition, grass genera which produce useful thatch³ are abundant. The third legume sub-family, the Mimosaceae, on the other hand, represented by fine (rather than broad) leaved trees (*Acacia*, *Faidherbia*) are concentrated on more fertile sites on more recent land surfaces (such as alluvial soils of river systems and the Rift valley). Patchy occurrence of resource-rich vegetation types (forests), *Terminalia* patches on deep sands, edible orchid patches along wetlands ('dambos') within the miombo also need to be taken into account. Resource-rich patches also result from human influence. Good examples are dispersal of edible-fruit tree species⁴ and nutrient rich soil patches with their characteristic vegetation due to dung accumulations at old homestead sites or the historical effects of 19th century demand for woodfuel for iron-smelting which are still evident in the miombo of north-western Zambia.

This biogeographic history has important consequences for value-adding and sustainable use of miombo woodlands in several ways.

Firstly, one should note the abundance of wood for fuel, charcoal and housing construction (though timber values are much less than those of tropical forests). This is significant for some 50 million people. In some countries such as Malawi, wood resources are no longer abundant, primarily due to woodland loss through agricultural clearing followed by large scale use for charcoal production and building timber.

Secondly, there is a relatively low proportion of high quality commercial timber species, most of these are in the Leguminosae⁵. The national forest inventory of Mozambique indicated that out of the total standing wood volume, only 7% is commercially valuable as timber (Marzulli et al. 2007).

Thirdly, apart from a few exceptions (such as several *Eriosema* and *Vigna* species with edible tubers), the unpalatable and toxic characteristics of Papilionaceae have led to a diversity of interesting uses.⁶

Fourthly, the easy availability of fibrous bark for construction, weaving (with bark from *Brachystegia boehmii* particularly favoured) as well as for bark beehives (*Brachystegia spiciformis* and other species); During the civil war period in Mozambique, populations in very remote areas used *Brachystegia*'s bark to weave clothes.

Fifthly, in contrast to the high availability of wood and bark products, there is a relatively low availability of edible-fruit producing species in miombo woodland. Most Caesalpinoid

² This includes a high diversity of *Crotalaria* (300 species) and *Indigofera* species (Rodgers et al, 1994) as well as the genera *Tephrosia*, *Eriosema* and *Aeshynomene*. Wild relatives of the cowpea, an important crop, also have their centre of diversity in the miombo woodland region.

³ Such as *Eragrostis*, *Loudetia*, *Hyparrhenia*, and *Hyperthelia*

⁴ E.g. *Adansonia*, *Sclerocarya*, *Strychnos*, *Trichilia*, *Berchemia*.

⁵ Genera include : *Azelia*, *Baikiaea*, *Dalbergia*, *Guibourtia*, *Milletia*, *Pterocarpus*, *Pericopsis*. There is also *Faurea saligna* in Proteaceae.

⁶ Such as potent fish poisons (tubers of *Dolichos kilimandscharicus* and all *Neorautanenia* species), dyes (*Indigofera arrecta*, *I. tinctoria*) and traditional medicines, with one species, *Tephrosia vogellii*, commonly domesticated as an agroforestry species in Zambia for use of its crushed leaves as a fish poison.

trees in the miombo produce small, hard, explosively dispersed seeds. None of the seeds of these dominant genera are edible.⁷ As a result, a higher diversity of gathered plant foods comes either from:

(a) **three categories of fruit sources:** (i) species growing on clay-rich soils (termitaria and riverine areas) where there is a high diversity of fleshy-fruited species⁸; (ii) two major fruit producing species occurring in large stands are in the Euphorbiaceae (a plant family more commonly a source of latex or herbal medicines), namely fruits from *Uapaca kirkiana*, *Schinziophyton rautanenii* or (iii) species formerly at low densities now increased due to human dispersal⁹;

(b) **underground storage organs** (tubers, bulbs) from woodland on Kalahari sands (Caesalpinaceae (*Tylosema*), Cucurbitaceae, Asclepiadeceae); roots of *Boscia salicifolia* (Capparaceae), growing on termite mounds within miombo woodlands (eaten during the hanger periods in Central Mozambique, FAO 2005); and

(c) **edible leafy vegetables** growing as "weeds" on land cleared for farming (particularly Amaranthaceae, Capparaceae, Tiliaceae), which are more abundant on densely settled sites with eutrophic soils.

Sixth, the ectomycorrhizal characteristics¹⁰ of miombo woodland Caesalpinoid tree species as well as with *Uapaca kirkiana* (Euphorbiaceae), which dominates some freely-drained escarpments in the ecoregion (Cunningham, 2006; Frost 1996; Lowore and Boa 2001). Coupled to the extensive area covered by these woodlands, this evolutionary association has resulted in a remarkable diversity of associated macrofungi, many of which are edible. In Malawi, for example, 362 species of macrofungi are recorded, 14% (53 species) of which are edible (Morris, 1994). Significant differences between different vegetation types within the miombo are also important.¹¹

Seventh, the dominance of *Brachystegia*, *Julbernardia* and *Isobertinia* provides the basis for beekeeping as a highly significant (culturally, socially and economically) form of land use in miombo woodland.

Eighth and finally, consistent with the hypothesis that plants growing in monocultures experience high levels of herbivory, miombo woodlands dominated by *Brachystegia*, *Julbernardia* and *Isobertinia* experience high levels of insect herbivory. Some of these, such as the scale insect *Aspidoproctus glaber* are a threat, resulting in die-back. Others are a culturally important food resource, the best known being the Saturniidae, a family of giant silk moths, whose caterpillars are an important source of protein and cash to local people.

⁷ Exceptions are the arils of *Guibourtia coleosperma* and seeds of the understory shrub *Bauhinia petersiana* which both provide important food sources to !Kxwe San people in the Angolan and Central miombo woodlands.

⁸ *Berchemia*, *Carissa*, *Ficus*, *Garcinia*, *Diospyros*, *Pappea*, *Syzigium*, *Parinari*

⁹ *Sclerocarya*, *Strychnos*, *Adansonia*, *Berchemia*

¹⁰ Fungal associations with the roots

¹¹ Macrofungi genera which are a major source of edible species in miombo and *Uapaca* woodlands, for example, are conspicuously lacking in *Baikiaea* dry forest (Pierce, and Chitempa, 1984).

3 Opportunities to manage and benefit from miombo woodlands

3.1 Forests are still a valuable resource

Globally, field studies show income from forest resource extraction accounts for 17-45% of total income for rural households in countries as diverse as Bolivia, Honduras, India, Malawi, and Zimbabwe (Cavendish 2000; Fisher 2004; Godoy et al. 2002; Reddy and Chakravarty 1999); see Vedeld et al. (2004) for an overview. The situation is unlikely to differ in the miombo region. Campbell et al. (2003), Cavendish (1999a, 2000), and Fisher (2004) all record high levels of forest dependence in miombo woodland. All these studies also show that it is the poorest of the poor that depend most on woodlands. Using seasonal household data for rural Malawi, Fisher and Shively (2005) found that households experiencing an income boost had lower forest extraction, compared to normal households. Shackleton (2006), Kayambazinthu et al. (2005), FAO (2005) and Barany et al. (2004) point to the importance of forest resources to households afflicted by HIV/AIDS. This suggests that forests have a role to play as natural insurance (e.g. see Pattanayak and Sills 2001; Takasaki et al. 2004; McSweeney 2004, for insurance values of forests).

If we turn to individual products, the importance of forests is outlined even more clearly. Arnold et al. (2006) point to the continuing importance of woodfuel in Africa, citing the International Energy Agency (IEA) (2002) that estimates that biomass energy will still account for an estimated three quarters of total residential energy in Africa in 2030, and that the absolute number of people using woodfuel and other biomass fuel will rise by more than 40% during 2000-30 to about 700 million. In Tanzania, it is estimated that the apicultural sector at the national scale generates some US\$1.7 million per year from sales of honey and beeswax, and provides income to about two million people (Mwakatobe and Mlingwa 2005). The trade in medicinal plants in South Africa was worth some US\$60 million in 1998, and is thought to be considerably more today (Mander 1998; Mander and le Breton 2006). The growing timber sector of Mozambique reached export value of US\$65 million in 2005, representing 4% of the total exports (FAO Policy Briefing 2007). Numerous such examples, demonstrating the significant contribution made by individual or groups of forest products to national and regional economies, can be found in the literature.

3.2 Resource rights are shifting to local people

Until relatively recently, forestry in many parts of the world largely took the form of top-down government approaches that centred on the introduction of new technologies (Roda et al. 2005). Frequently, especially in developing countries, this involved establishing village woodlots, planting fast-growing species, and the demarcation of protected forest areas from which local people were excluded. Indigenous species, local agroforestry systems, and traditional resource management practices, as well as institutions for communal forest stewardship, were often ignored. Typically, decisions about forest management were taken in centralized government offices, far from the people affected by the policies. In the last few decades, social issues and the need for communities to

assume more active roles in resource management have come to the fore, and there is a global trend towards devolving responsibility for natural resources management to local stakeholders (White and Martin 2002). A wide range of studies on devolution processes are now emerging, with both positive and negative experiences (e.g. Balint and Mashinya 2006; Kayambazinthu et al. 2003; Mutimukuru et al. 2006; Nemarundwe 2004; Songorwa 1999; Virtanen 2003). In many parts of the world local people are becoming better organized and have greater political influence.

For the Africa context, Wily (2000, 2003) captures some of these trends. She concludes that policy or legal commitment to decentralization in the land and forestry sector is very widespread (see also Anderson et al. 2006). Shackleton et al. (2002), drawing on case studies from the miombo region and elsewhere, note that devolution has brought a number of advantages: recognition of local people previously considered poachers, criminals and squatters as legitimate resource users; new channels for rural dwellers to communicate their priorities to government decision-makers, and in some places improved community-government relations; contributions to villagers' organizational capacity and political capital by encouraging local people to join new networks and forge new relationships; in areas where devolution has been in place longer, local populations demand greater autonomy, thus bringing about reforms that promote local interests; addressing equity issues and making inroads to enhancing participation of marginalized groups and women in decision-making. In documenting the devolution process in Tanzania, IUCN (The World Conservation Union) found that over 500 villages had declared new forest reserves (Wily and Mbaya 2001). Wily and Dewees (2001) record nearly 350,000 ha of forests and woodlands under some form of community or local management in Tanzania. Most efforts have taken place in non-gazetted, non-reserved forests, that is, outside of Central Government or Local Government Forest Reserves. They note that management and protection of woodlands improved remarkably: private nurseries were fostered and produced large numbers of seedlings; and improved stoves saved thousands of tons of wood each year. In Mozambique, the forest regulation establishes that 20% of the taxes resulting from the extraction and use of forests and wildlife should be returned to the communities living within or close to the forest areas. As a result of that measure, in 2006, US\$422,000 was handed to 956 communities (Sitoe et al. *in prep.*)

3.3 New integrated conservation-development approaches are emerging

The miombo ecoregion and neighboring areas is the centre of a range of innovative attempts at integrating conservation and development. The conservancy model in Namibia (just on the edge of the miombo ecoregion) is the prime example where win-win outcomes for people and nature have been fostered (Bandyopadhyay et al. 2004; Anderson et al. 2006). The interest in the poverty-conservation relationship has taken on global significance (e.g. Naughton-Treves et al. 2005) and thus there is critical thought on what works and what does not. There is also an expanding range of studies emerging from miombo countries (Gulinck et al. 2001; Virtanen 2003; Wolmer et al. 2004; Songorwa 1999; Frost and Bond 2007).

3.4 New markets are expanding and emerging

New niche markets. Globalization is creating niche markets for forest products. Consumer demand for “green” and “fair trade” products can improve the competitiveness of small-scale producers (Shackleton 2007). New emerging export markets for wild natural product ‘derivatives’ such as fruit oils (e.g. marula oil and melon seed oil), which are also often tied to fair trade initiatives, are increasingly being demonstrated as having high potential. PhytoTrade, a trade organization based in southern African, has estimated a potential regional value of US\$3 billion for eight oil-producing wild fruit species, provided reliable markets can be established. The opportunities presented by potential markets for these and other products such as organic teas and food additives are believed to be nowhere near fully exploited (le Breton 2006). An increasingly aware market for “green, clean” products is emerging for art products (such as carvings from miombo hardwoods), timber, honey and edible mushrooms.¹² Organic certification already applies to several miombo products. In Zambia, for example, wild mushrooms harvested and exported by Mpongwe Coffee and Organic Stallholder Cooperative are certified as such (de Boer, 2003) as is honey and beeswax exported to the UK and Germany by North Western Bee Products.

Payments for environmental services. Interest in the idea of paying others, such as communities on forested land, to provide environmental services on a sustained basis, is growing (Wunder 2007). As tropical deforestation progresses, forest environmental services – formerly provided for free as a “subsidy from nature” – also become scarcer. The debate focuses on payments for four types of services: carbon sequestration, watershed protection, biodiversity maintenance, and aesthetic qualities of the landscape related to tourism in particular. The underlying principle of such payments for environmental services (PES) is that forests provide valuable positive externalities to off-site beneficiaries, but that these may not be taken into account by on-site landowners or users unless the beneficiaries pay for them. If the potential gains from forest conservation or restoration are large enough, the winners should be able to afford to compensate those on the land who, because where they are being asked to adopt a non-preferred land-use practice they might be losing something. Likewise, those wishing to use land in a way that diminishes environmental services elsewhere should be prepared to compensate those who depend on those services for that loss. Beyond achieving the objectives of conservation proper, PES can potentially provide important additional and regular income flows, or other material benefits, for cash-poor forest-dwelling communities. PES schemes thus have the potential to create “win-win” situations for people and the environment.

A key question is whether there are buyers for environmental services in the miombo region. There are some nascent schemes in miombo countries, e.g. for carbon sequestration. As an illustration of these emerging markets, we draw on an example from Northern Australia in an eco-region similar to miombo. Savanna burning regimes contribute significantly to Australia’s greenhouse gas emissions. Recently an Aboriginal community entered into a 20-year agreement with one oil and gas company, the latter

¹² However, the growing Chinese timber market prefers unprocessed logs, and does not currently seem to care about the certification process, therefore fuelling illegal logging (MacKenzie 2006).

putting up AU\$1 million per year for the community if the community undertakes fire management. The fire management will improve biodiversity outcomes, reduce carbon emissions and provide a source of income (Whitehead et al., 2005).

In Mozambique, two initiatives are ongoing within miombo woodlands, in which local communities are engaged in native tree species planting and fire protection. The British company, Envirotrade, and the University of Edinburgh are monitoring the activities and paying for the carbon sequestration in agroforestry systems. One of these is the EU-supported Nhambita project, centered around villages in the buffer zone of Gorongosa National Park, which is also where one of the socio-economic case studies of this project has been undertaken (Hegde, undated). Local communities receive conditional payments if they adopt various tree-planting initiatives, in the medium run this should raise their incomes and diversify their livelihood options, but in the short run households may not adopt these measures without payment, due to liquidity shortages and risk aversion. From a PES conceptual perspective, the bulk of payments to farmers are front-loaded – disbursed in the first years after planting. Therefore carbon buyers have relatively little leverage on ‘permanence’ – unable to determine what the farmers do with the trees at a later stage, thus reducing overall conditionality. The project also includes a number of activities allowing for local value-adding to the wood, through for example carpentry. It can thus be seen as an initiative at the borderline of PES with many features of an integrated conservation and development project (ICDP).

The well-known Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) in Zimbabwe actually also satisfies the five basic features of PES: it is a voluntary, conditional transaction between at least one buyer (tourism operators) and one seller (communities and Rural District Councils - RDCs) over a well-defined service-producing land use (conservation of wildlife areas important for biodiversity and aesthetic landscape values) (Frost and Bond 2007). Over one and a half decades, communities using land under communal tenure and RDCs (the lowest local government level) have marketed hunting and wildlife-viewing rights to safari operators; in turn they have carried the opportunity costs of setting aside the corresponding wildlife areas for conservation. During 1989-2001, CAMPFIRE generated more than US\$20 million for the participating communities, 89% of which came from sport hunting (Frost and Bond 2007).

For CAMPFIRE, it is also worth noting that the contributions from external donors, like USAID, in monetary terms exceeded the value of the actual wildlife incomes. CAMPFIRE was seen by the donors as an entry point to broader rural development investments and governance initiatives. In other words, CAMPFIRE had a large component of development and conservation superimposed on its PES-like structure, while the conditionality of land-use changes and conservation was not equally explicit in all cases. This is similar to the Nhambita case. We are yet to see the development of a ‘pure’, fully commercially-oriented PES initiative in the miombo region. But it is also possible that the particular pre-conditions, weak local governance structures and poor prospects for developing service markets, imply that these mixed initiatives stand the best chance of success in terms of both conservation and poverty-alleviation impacts.

Expanding domestic markets. Some emerging market trends offer promising opportunities for poor people. Urbanization is increasing and growing populations have greatly increased the demand for charcoal, medicinal plants, wild meat, construction wood, among other products. Arnold et al. (2006) conclude that persistently low incomes in Africa are reflected in continued strong growth in urban consumption of woodfuels, and refer to surveys demonstrating positive income elasticity for woodfuel at low income levels. The Stockholm Environment Institute (SEI) (2000) estimated that consumption of charcoal grew during 1990–2000 by about 80% in both Lusaka and Dar es Salaam, with the proportion of households in the latter reporting charcoal as their principal fuel increasing from about 50 to 70% over the same period. The rapid growth in urban demand for charcoal has enabled very large numbers of people to engage in its trade (Arnold et al. 2006). The towns of Maputo and Matola in Mozambique, with a combined population of about 1 400 000 people in 2001 were reported to have 76% of households relying partially or exclusively on woodfuels for cooking. Household consumption represents the biggest share (90%) of total urban woodfuel consumption. The per capita woodfuel domestic consumption ranged from about 0.92 to 1.00 m³ as compared to 0.82 m³ in 1988. Charcoal making has been an important source of income for rural households. Households in the Licuati forest region, in Southern Maputo, have been earning more than 65% of their income from charcoal making (Pereira 2001).

There has also been a massive expansion of medicinal plant trade over the last decade (Botha et al. 2004; Williams et al. 2000). In Malawi, Lowore (2006) suggests that sale of many forest products is on the increase due to two main factors: the rise in urban population, and an increased alienation between urban people and forests. Krog et al. (2005) found 198 medicinal plant traders in three markets in Maputo, up from 10 in 1980. The traders were selling over hundred plant species and some animals, all of them obtained from the native forests and fallow land. *Hypoxis hemerocallidea* (the African potato), used in treatment of several ailments, including those related to HIV/AIDS, is indicated as the most important species sold in these markets.

New buyers of old products. The economic growth of China has already had some repercussions for forest product markets. It can be hypothesized that this trade is still in its early days, and that trade with China could rise dramatically in the future. And it could be further hypothesized that other Asian countries will also enter these markets as their economies boom. China has formed strong links throughout the miombo woodland region. In a repeat of the 1960's, when Tanzania's most valuable hardwoods were exported to China after construction of the TanZam railway, hardwoods are a major focus today. The fast growing Mozambique log-export to China has fueled a national debate on the sustainability of the forest operations and illegal operations involving Chinese firms connected with politicians (see for example MacKenzie 2006). In 2005, timber exports to China amounted to US\$9.6 million (about 15% of total timber exports).

It is not only Asian markets that are expanding; even within Africa new trade links are being established. One notable example is the woodcraft market, where markets in South Africa are now selling large numbers of products from other countries (Shackleton 2005a).

New technologies opening up market possibilities. Considerable advances in communication technology (e.g. cellular phones) are providing new opportunities for improved flow of information and better linkages between small-scale entrepreneurs and the markets (Duncombe and Heeks 2002; Souter et al. 2005; The Economist 2005). This surmounts a major hurdle people encountered in the past. In Africa, the mobile telecommunications sector has grown by an average of 78% per annum over the last 10 years with far-reaching economic and societal impacts. The positive benefits of this technology for small-scale entrepreneurs have been well demonstrated. A study from Ghana, for example, concluded that access to cellular phones had decreased informal traders' transaction and transport costs, created a higher profit margin for them, increased their efficiency, and enhanced trust building within trade networks (Overa 2006). An IFAD project in Tanzania has shown the effect of mobile telecommunications on the bargaining power of smallholder farmers. In the past they had been hood-winked by truck drivers about the market price of their products, but with the arrival of mobile phones they can now independently verify this information. Additionally, small farmers have been able to link up directly with buyers in Dar es Salaam and secure more favorable prices (IFAD 2006).

4 Economic barriers to increasing the value of miombo woodland resources to livelihoods

4.1 Economic Barrier #1: Low inherent productivity

The limited data on biomass and basal area increments for miombo suggest that growth rates in miombo are low. Estimates range from 0.9 – 4.8 m³ per ha per year. A yield figure of 0.9 m³ per ha per year for woodlands in Malawi represents less than 1% of the growing stock (Openshaw 1977). This, according to Openshaw, is unrealistic and translates into sustainable cutting cycles of about 200 years. This yield figure appears to be a serious underestimate as cutting cycles for woodlands are often between 30 and 40 years (Openshaw 1977). Nevertheless miombo woodlands are lower in productivity than many other forest formations, given that they are characteristic of some of the poorest soils in Africa. Data on productivity has been comprehensively compiled by Frost (see Table 2.7 in Frost 1996). Dry miombo coppice plots in Zambia had yields of about 2 m³ per ha per year. Expressed in biomass terms, yields varied between 1.4-2.0 Mg per ha per year in dry miombo woodland, and between 2.1-3.4 Mg per ha per year in wet miombo. Marzolli et al. (2007) estimated forest yield in Mozambique from 2.0 to 4.8 m³.ha⁻¹ for all species. The lower yields refer to open woodlands in the drier regions, while the higher yields refer to wet miombo woodlands of northern Mozambique. Using these values, and an average diameter increment of 2.5 mm per year, an average cutting cycle of 40 years was estimated.

But, miombo woodlands have other resources which make them valuable particularly at the local level. For example, there is a predominance of *ectomycorrhizae* in miombo woodland (see Section 2) (largely a result of the poor soils), many of which produce mushrooms, making miombo woodlands one of the prime 'mushroom biomes of the world'. This has given rise to a culture of mushroom gathering which is widespread among people in miombo woodland but largely absent in other tropical African dry

woodlands. Another feature is the widespread presence of large-bodied, charismatic mammals that support significant tourist and sport hunting industries (WWF-SARPO 2001). Another characteristic is the predominance of edible insects, making the woodlands an important source of insect protein (Cunningham, 1996). One further well-known characteristic of miombo woodlands is that they are ideal for bee-keeping (Cunningham 1996; Fisher 1993; Mickels-Kokwe 2006). This has led to some countries having ministries of ‘forestry and beekeeping’, or at least having divisions of beekeeping.

But these special characteristics don’t take away from the fact that fundamentally the woodlands are of low productivity, thus returns to active management will generally be low. In terms of future carbon markets, the woodlands have lower wood carbon storage levels than tropical forests. There could also be trade-offs between wood and non-wood management. An example of a trade-off is given by Mickels-Kokwe (2006), citing an example from Eastern Province of Zambia, where beekeepers hung hives in the forest but a timber concession license was given to a prominent businessman, who proceeded to cut down a significant number of big, flowering trees. Honey production levels reportedly decreased and the beekeepers incomes were affected.

4.2 Economic Barrier #2: Elite and external actors capture values

When some productivity creates more-or-less significant values and economic rents there may be widespread contestations over resources, which often leads to capture of the benefits by elites and local leaders (Campbell et al. 2002; Kajembe and Monela 2000; Nemarundwe 2003). Kajembe and Monela (2000) working in a relatively successful community-based scheme in Tanzania note that elites tend to ‘hijack’ processes and forcefully occupy the political space opened by decentralization. Elite capture or capture of value by external actors constitutes a disincentive for local collective action towards woodland management as many of the resources originate in the commons. Elsewhere evidence suggests that broad-based benefits have accrued. For example, Friis-Lund and Treue (2007) found that forest decentralization in Tanzania’s Iringa district had overwhelmingly positive livelihood effects, including in terms of well-functioning local governance and value-distribution systems.

Monela et al. (2000) record that economic hardships in Tanzania led to a breakdown in traditional gender roles particularly in peri-urban and intermediate sites, rather than remote sites. Campbell et al. (2002) record similar phenomena in Zimbabwe. Women are increasingly expanding their roles, away from traditional domestic activities to income generating activities such as forest product exploitation and sale, casual labor and petty business. Men are gradually taking up activities which have traditionally been in the domain of women, especially those that are lucrative.

Where resources are of high value, external players may become important in terms of capturing resource rents, with the state often supporting the external players. The example cited earlier from Mickels-Kokwe (2006) of the beekeepers who lost their resources to a timber concession licensee demonstrates this. In this context social and political networks are particularly important in shaping the distribution of benefits. In this

case, the beekeepers had no means of influencing the allocation of licenses or the behaviour of the concessionaire, who was a prominent businessman.

The big players tend to dominate even more when international trade is involved, as this tends to be associated with higher economic rents. Domestic, as opposed to export markets, often require only modest investment to develop and expand. Export markets, on the other hand, are much more complex and the numerous legislative barriers, standards and quality controls effectively restrict local participation (Shackleton 2007; Tieguhong and Ndoye 2006; Wild 2006). In the marula trade¹³ of Southern Africa, foreign companies have a dominant and growing share of total incomes in the value chains, often due to their monopolistic position in the market (Wynberg 2003).

There are also examples of the state dominating rent capture and control. In State Forests, the state has often been reluctant to devolve rights and responsibilities to local people, given that the timber resources generate significant rents. This continues to be the case even in forests subject to shared state-community management. For example, in Mafungabusi State Forest in Zimbabwe, the state has entered into resource sharing agreements with local people but these cover only non-timber forest species (e.g. thatching grass) and not timber (Mapeza and Madondo 2000; Mapeza 2004). Further in these shared forest management regimes access by local communities is often insecure as the State continues to be the land owner and thus the ultimate authority.

Kajembe and Monela (2000) point to nascent conflicts between local people and government officials, even occurring in relatively successful community-based schemes in Tanzania. Shackleton et al. (2002) reviewing sites across southern Africa note that devolution of authority has often not yielded the benefits that were expected. In many instances, the state provided benefits as an incentive to encourage people to support activities that met government revenue or conservation interests rather than local livelihood needs. Thus, although access to some subsistence products improved, access to other important local resources such as timber and wildlife often continued to be restricted. There was often a bias towards products and species favoured by forestry departments (e.g. timber) at the expense of species valued by poor people, such as for medicine, fodder, craft materials and wild foods. In most cases, the lack of authority to make decisions locally was a major area of local discontent. Income distribution shares were generally decided at the central level, but governments often failed to deliver on these promised shares, with the returns being far less than anticipated by communities maintaining local enthusiasm proved challenging. In cases where financial benefits accrued from revenues, licenses, permits, and leases, a disproportionate amount of this income was retained by the state at district or higher levels, or it was captured by local and outsider elites. Only in a few cases did communities receive substantial financial benefits. For example, in 2002 Mozambique introduced forest regulation specifying that local communities would accrue 20% of the revenues generated from forest and wildlife use or extraction. This rule was not implemented until 2006 (Siteo et al. *in prep*).

¹³ Marula *Sclerocarya birrea*, is used for making a traditional beer as well as an internationally marketed and well-known liqueur, Amarula.

4.3 Economic Barrier #3: Restrictive regulations reduce access and increase transaction costs of producers and traders

A range of policy and regulatory instruments – designed to prevent over-exploitation of forest resources and to raise income for resource management (see a range of chapters in Kowero et al., 2003) – inadvertently undercut livelihood opportunities for local producers and traders. For example there are many policies that prohibit the harvesting of forest products for commercial purposes from state owned forests. Ironically, these restrictive institutions have not been very successful in preventing resource degradation; in many cases they have had the opposite effect by removing the responsibility for management from the actual users.

Openshaw (1977) discusses the ban on charcoal-making that was introduced in Malawi to curb deforestation. This ban made charcoal production illegal but it did not stop it. Charcoal became more costly to produce and to get to market, as authorities had to be bypassed, usually with bribes – consequently the price increased. With production pushed out of the legal domain the forestry department no longer had any control over this process. It could not collect stumpage fees even if charcoal was made in forest reserves, nor could it advise or train charcoal producers on woodland management and charcoal production.

A plethora of regulations does little more than act as a means by which petty officials extract informal payments. Such informal taxation results in lower profit margins to producers and traders. Awono et al. (2002), working in Cameroon, concluded that regulations increased the load of “semi-official” taxes and bribes paid by traders. In the Mozambique timber market, Mackenzie (2006) in an impassioned report concluded that official agencies were presiding over and colluding with abuses that makes a “mockery of the notion of governance: taking bribes for issuing licenses, approving management plans, concessions and export permits, getting timber through checkpoints and through personal involvement in the sector.”

4.4 Economic Barrier #4: Limited support for local forest enterprise development

Forest enterprises have largely been left off the agenda for private sector development in the miombo region. Throughout the region the private sector has invested in technologies and products directed at the small agricultural producer but not at forest product development. State extension services mirror this. For example, all countries have agricultural extension service, but forest extension services are either missing or extremely limited. The state provides almost no support to forest product development, in terms of transport or market infrastructure, market information systems, credit or small enterprise development services. Consequently, poor producers have to shoulder the costs of transport, credit, and lack of market information. The limited attention to forest products by the state feeds through to numerous other potential actors. For example, investors will not be alerted to forest-based investment possibilities given the lack of attention by government. Lack of market information and marketing skills can also

hamper the potential to add value to products by improving quality and packaging (Shackleton 2007). This may be because producers, processors and traders do not know the requirements for a product to qualify for a higher valued category (e.g. organic certification), or because they lack the skills to produce or sustain a product of better quality. There has been little or no investment in technologies that add value to local resources or develop analytical capacity which links processing, quality control and bargaining power in the value-chain. One way of improving research and development (R&D) or analytical capabilities is through public investments that leverage partnerships between local entrepreneurs and appropriately skilled private-sector investors, as Phytotrade Africa has done in the natural products sector, through its focus on cosmetic oils derived from indigenous plants.

Local communities often have no access to formal credit provision, and interest rates are extremely high for loans provided by local lenders (Schreckenberget al. 2006). Even where opportunities exist, people engaged in small-scale forest-based enterprises are often unaware of the availability of credit and means to access it. In general the micro-financing sector remains poorly developed despite the increasing global acknowledgement of the value and opportunities created by such approaches.

Certification can provide a means to improve values and returns, if its transaction and production costs can be minimized (Shanley 2005). However, at present, certification receives extremely limited recognition and support from governments in the region (Mickels-Kokwe 2006). A common problem is that certification is costly, and initial investments require donor support. In addition, certification standards are usually not tailored to local circumstances.

4.5 Economic Barrier #5: The lack of strong local organization

Local enterprises in miombo woodlands produce some excellent quality products, such as honey and edible mushrooms, for which there are significant export markets in Europe and North America. To tap into such markets requires sufficient quantity of product, delivered on time, at the right price and with the appropriate quality. Harvesting from the wild certainly offers opportunities for organic or FairTrade marketing, but harvesting sufficient quantities is labour-intensive requires hundreds – or even thousands – of rural harvesters to collect these products. In the North West Province of Zambia, for example, an estimated 15,000 beekeepers own an average of 73 hives each, with some beekeepers maintaining up to 1000 hives each (Clauss, 1992; Fischer, 1993). In Malawi, around 8000 beekeepers annually produce 1000 and 150 tonnes of honey and beeswax respectively. In Mozambique, there are estimated to be 20,000 traditional beekeepers producing 360 tonnes of honey and 60 tonnes of beeswax annually (Nhantumbo and Soto, 1994). Numerous small producers also make brand recognition, quality control and market growth very challenging.

Although access to cell phones is growing rapidly – improving social and economic links between businesses and opening opportunities for micro-enterprises within miombo woodlands – there continue to be major barrier for e-commerce as internet development and access has been slow. Potentially, e-commerce can improve marketing opportunities

and deal with distance from markets although numerous challenges hinder success. In a recent study of businesses in South Africa which had moved beyond the basic stage of e-commerce, Molla and Heeks (2007) found that over 80% of the 92 businesses surveyed had not been able to take advantage of the strategic benefits of e-commerce, namely: market access, customer/supplier linkages and cost savings. Other countries within the miombo region lag even further behind.

To ensure market participation well-established and effective local organisations to coordinate 'bulking up' of resources, reduce transport costs, maintain quality standards, improve market recognition and improve supply chain capability are required. These organisations can use communications technologies such as cell phones and e-mail to improve market engagement. In general such organizations are lacking. There are some exceptions. For example, in Namibia, Eudafano Women's Cooperative, which produces marula seed oil, has over 5000 members, coordinating collection and oil pressing to get high value cosmetic oil to the European market. Similarly in Zambia, North Western Bee Products (NWBPP) has invested in quality control training along the supply chain as well as honey certification and is able to coordinate supplies to get them to export markets in Europe. In southern Africa, the eight country network PhytotraderAfrica operates as an umbrella body for smaller member businesses.

4.6 Economic Barrier #6: A legacy of armed conflict

Over the past 30 years, warfare has been a major barrier to both generating income from miombo woodlands and to managing them sustainably in Angola, the DRC, Mozambique, and Namibia. Income from natural resources has financed many conflicts. For instance, in Angola revenue from poached ivory, rhino horn and *Pterocarpus angolensis* timber was used to buy arms by UNITA during the 1970's and 1980's (Peleman, 2000). Illegal timber logging and poaching for ivory, rhino horn and bush meat flourished. Similarly, in the section of the Rift Valley running through Mozambique, previously large numbers of buffalo, wildebeest, hippopotamus, elephant, zebra, lion, waterbuck, sable, eland, reedbuck impala, kudu and nyala were decimated by ivory and bush meat poachers between 1983 and 1995 (Zolho and Dutton, 1997). Conflict continues in the DRC, but even in Angola and Mozambique the legacy of warfare continues to be an economic barrier, where depleted stocks and existing landmines undercut management and livelihood activities. Forest management is just not possible in woodlands strewn with landmines, such as in Kuando-Kubango province, Angola (Zweede et al, 2006).

5 Barriers to sustainable use

The previous section has outlined the barriers to improving economic returns from miombo woodlands to poor and marginalized producers and traders of forest products. But even if most of these barriers were removed, sustainable forest management would not automatically follow. Creating the terrain for sustainable management is infinitely more complex. By removing these barriers, one element of the incentive system (higher value) would be in place for management. Yet, higher value alone could, for many

miombo uses, lead to overuse and deforestation, and thus also endanger future value returns.

In this section, we examine barriers to achieving sustainable forest resource use.

5.1 Sustainable Use Barrier #1: low resource rents – high management transaction costs

Active management of miombo can improve resource productivity. For example, by reducing numbers of coppice shoots after extraction of poles, productivity can be enhanced (Frost 1996). Many studies focus on the need to raise the value of the product, in order to generate a larger margin available to fund more intensive and effective mechanisms to exercise control and management (for woodfuel: Arnold et al. 2006; World Bank, 2002; for woodcarving: Standa-Gunda et al. 2007).

Given the barriers discussed in the previous section, we conclude that margins may be too low to generate resources to be used in sustainable forest management. To raise margins is not simple when there are low cost alternatives, and prices of alternatives are not rising (Arnold et al. 2006). Higher margins could have negative impacts on the consumers, many of whom are poor urban dwellers. Additionally, higher margins could attract better funded and skilled participants, undermining the comparative advantage poor people have in many forest-based enterprises. After examining the margins achieved by woodcarvers in southern Zimbabwe, Standa-Gunda et al. (2007) concluded that there was very little room for adding a resource management tax. Any addition of a tax could drive producers out of business, as margins and returns to labour were already low.

The transaction costs of control and management mechanisms by regulators are likely to be high relative to the low value of many resources (Arnold et al., 2006). For many forest products, markets are transient and dispersed, making regulation and enforcement difficult (Hofstad 1997; Shackleton 2005b, 2007). Questions have been raised as to whether the benefits of control and management mechanisms outweigh the costs of enforcing such regulations. Existing natural resource policies in all the countries include fees for removal, transportation or trade in forest resources. SEI (2002) argues that the collection of these fees for woodfuel would result in substantial amounts that could be used for management. They note, however, that the fiscal system is inadequately enforced and revenue collection is but a fraction of what it should be. In Mozambique it is estimated that in the Maputo area, a mere 1% of the potential fees and licenses were actually collected. In Zambia the estimate is about 10% and in Tanzania about 25%. We doubt that collecting these resource rents would benefit forests as it is unlikely that the revenue will be used for woodland management.

5.2 Sustainable Use Barrier #2: Weak local institutions

The complexity of the commons is well established. Rural households usually derive multiple goods from their environmental resources. Far from being the provider of a single good, miombo woodlands offer rural households a wide variety of (and most often freely-provided) goods, which are diverse in economic and management terms. Resource heterogeneity has implications for the design of common property resource management.

Many countries are grappling with decentralization, and are putting in place more community-based approaches. In many places initiatives are still at the planning and experimental stage, and often are of top-down design (Wily 2003). System design is often awkward, unrealistic, expensive and overly complex and thus lacking the simplicity essential for widespread adoption and real involvement of local communities in woodlands management. It is important to guard against the domination by elites in newly created institutions, as commonly happened in India's joint forest management program (JFM) (Kumar 2002).¹⁴

Existing local institutional capacities are often weak and local actors are unable to enforce control mechanisms to prevent the overuse of resources and effectively intervene in the management arena;

Firstly, the lack of local capacity and appropriate institutional contexts prevents effective conflict resolution. Diverse conflicts between local traditional institutions and modern institutions exist (e.g. Namarundwe 2004). One common outcome is de facto open access (Campbell et al. 2001; Kayambazinthu et al. 2003; Luoga et al. 2005; Monela et al. 2000).

Secondly, the lack of moral and political legitimacy undermines the effectiveness of local institutions (Kayambazinthu et al. 2003). The work of Kayambazinthu et al. (2003) draws on case studies from four miombo countries.

Thirdly, various studies suggest a correlation between open access situations and declines in biodiversity. Mwase et al. (in press) found a direct causal relationship between the two in Malawi.

Fourthly, evidence from diverse settings suggests that the absence of local resource rights negatively impacts on sustainable management. For example, Sauer and Abdallah (2007) in a study in Tanzania identify to the need for clear rights and responsibilities for local people to enhance management.

Fifthly, poor leadership threatens sustainable management. Balint and Mashinya (2006) found that local failures of leadership combined with the withdrawal of outside agencies responsible for oversight and assistance were to blame for this demise of community-based wildlife and tourism ventures in southern Zimbabwe.

It may be challenging to bring about major improvements ahead of emergence of stronger local institutions in rural areas, and effective transfer of rights and responsibilities over the resource to these local institutions (Arnold et al. 2006). Community organizations, state departments, and the private sector are encouraged to join efforts for sustainable management of woodlands (Matakala and Mushove 2001), but Matakala (2004) notes that the power imbalances results in unclear definition of the role of each partner. The

¹⁴ It is interesting to note that India's monodominant *Shorea robusta* woodlands bear several ecological similarities to miombo woodlands.

result is local community members becoming employees, therefore weakening their position as partners.

5.3 Sustainable Use Barrier #3: 'Forestry' is marginalized

In many circumstances forest resources play crucial roles in poverty mitigation, and may, for many households, contribute as much as dryland crop production to livelihood security. In other cases forest resources contribute significantly to national economies (Box 1). However, forestry is marginalized with few resources to support sustainable management, develop appropriate technical information and enforce regulations. In contrast, agriculture gets the bulk of the national resources allocated for rural development.

The extent of marginalization, given the economic and environmental significance of forests is staggering. Forestry has remained second to agriculture in the debates about poverty alleviation and the subsequent poverty reduction strategies (Barany et al. 2004; Mlay et al. 2003). Forestry does not feature to any extent in the premier African development agenda of NEPAD (Fakir 2003). Budgetary allocations are made by governments for securing agricultural services (e.g. investment in agricultural ministries, agricultural research and agricultural extension) while investments in forestry are made at a much lower level. Part of the reason for this relates to the severe under-accounting of forestry in national accounts (Lebedys 2004). In fact, a wide range of miombo woodland products used for subsistence or traded in informal markets do not enter the national accounts. Given the widespread reliance on fuelwood the failure to acknowledge its contribution is particularly significant. For example, Cuco et al. (2003) refer to the national household fuelwood consumption in Mozambique of about 17 million cubic meters per year, representing US\$706 million per year that does not enter the national accounts.

The lack of technical, financial, and marketing services limits the development of forest-based micro-enterprises. Shackleton (2007) argues that much of the locally initiated trade in natural resource products is invisible, neglected, and unsupported and, consequently, poorly recognized by important stakeholders such as traditional authorities, municipal authorities, landowners and managers.

Part of the problem of 'forestry marginalisation' lies with the forest services themselves who have by-and-large remained locked in an old-style forestry focused on timber, plantations, silviculture, and on-station work. Miombo woodlands are about honey, mushrooms, wildlife, and a diverse range of other natural products. Forestry agencies have been slow in coming to grips with this reality. Inventories and management plans for high value species seldom look beyond timber and fail to take woodcarving, and other local livelihood activities, into account.

As a result of under-investment, technical information regarding management of miombo is limited. Forest growth and yield data is scarce, therefore the values used to estimate cutting cycles and the annual allowable cut are partly guesswork. There is minimal investment in timber inventories by Forest Departments within miombo woodlands. In

Zambia, for example, no detailed national forest inventories have been done since the 1960's to determine or to assess the quantity and quality of the country's forest resources and estimates remaining woodland cover, growing stock and stocking rates are based on limited local level inventories.

Forest Department management has also been misguided at times, relying on systems that don't work for miombo. For example, a felling system termed 'high grading' of timber is used, where only mature *Dalbergia melaonxylon* trees are felled. Beale (1995) suggest that this could reduce future regeneration due to a lack of reproductively active trees. A similar conclusion was reached by Desmet et al. (1996) who studied *Pterocarpus angolensis*. In this case, the most important requirement for the survival of *Pterocarpus angolensis* populations was the continued presence of mature, reproductive trees in the population – the very size classes being felled under 'high grading'.

The technical information available also does not take into account the new reality that much of the management will be undertaken by local people. For example, there are few innovative schemes in miombo woodland for linking forest inventory data to local people's knowledge and values (e.g. see Cunningham 2001). Access to GIS data and satellite imagery is limited and hardly ever fed into participatory land management planning. Very little is done and developed in terms of participatory fire management (Banda et al. 2006).

Under-investment also results in poor enforcement of forestry regulations or lack of sufficient investment in devolving responsibilities to local people. In many cases, lack of attention to forestry regulations or poor management (e.g. no fire control) leads to resource destruction (Box 1).

5.4 Sustainable Use Barrier #4: Domestication of high value species reduces importance of natural forests

It is now well known that when forest products are commercialized, many will be domesticated and subject to more intensified production (Arnold et al. 2006; Arnold and Dewees 1997; Ruiz-Perez et al., 2004). Taking woodfuel as the example, Arnold et al. (2006) note that the potential for increasing supplies from farmer-grown trees is likely to continue to grow, and that changes in land tenure and labour availability will favour the expansion of low-input tree crops. Growth in markets for woodfuel can be expected to enhance tree crop production. This trend is positive for people and (planted) tree cover, but may lead to less interest in maintaining forest if it can be replaced by faster growing alternatives. Alternatively, if higher production can be achieved in smaller areas, natural forest cover may be maintained if extraction is reduced. There could be some losers, as some of the small-scale producers from natural forest may be driven out of business. The poor with few assets (land and capital) are much less likely to capitalize on the opportunities created by commercialization and new market opportunities.

5.5 Sustainable Use Barrier #5: Cash constraints

The absolute income of most rural households is very low; for example, even the wealthiest quartile in the Zimbabwe sites of Mutangi and Romwe has a mean income of

less than US\$1 per person per day (Campbell et al. 2001). While woodlands are quite important for subsistence products they are less important for cash income, especially so for the wealthier households. In Shindi (Zimbabwe) 14% of the total cash income comes from woodlands, with no clear pattern amongst wealth quintiles, except in the case of the top quintile which shows the least reliance on cash from woodlands (about 7% of total cash income) (Cavenshish, 1999). In one of the few experimental studies of rates of time preference in the region, conducted in Zimbabwe, rates were very high indicating the strong tendency to discount the future (Kundhlande 2000). If households want to secure cash, will they choose to over-use and, if necessary, deforest? Or will their desire to secure subsistence products keep use conservative? And will wealthier households not be more likely to liquidate the woodland assets than the poorer households? These are some key questions that need to be explored, and placed in context of the institutions that govern resource use.

Moving beyond the level of households, several countries across the miombo region have changed their economic direction, from centralized socialist approaches to more market driven approaches. With governments relinquishing control over many industries, privatization of forest-based industries has occurred, but rarely with a view to long-term, sustainable management (Box 1). Instead, ‘resource mining’ is more common, shifting short-term profits to urban, commercial sectors or other natural resources. In others, the political will to enforce the law is absent, even for high value species.

Box 1: The decline of timber stocks in Mozambique – when multiple barriers come into play

Miombo woodlands have a relatively low proportion of high quality commercial timber species, yet some have extremely high value. *Dalbergia melanoxylon* (African blackwood or mpingo) is one of the world’s most expensive timbers, with sawn billets selling for up to US \$18,000 per cubic metre when they are used to produce the worlds finest woodwind instruments such as clarinets, oboes, bagpipes (Jenkins *et al.*, 2002; Ball, 2004). *Dalbergia melanoxylon* is the third highest foreign exchange earning species for Tanzanian forestry, bringing in an estimated \$1.5 million/yr from exports (Beale, 1995).

Considering that *Dalbergia melanoxylon*, often co-occurs with other valuable timber species, such as *Pterocarpus angolensis*, closer examination of forestry regulations in practice in the case of *Dalbergia melanoxylon*, Tanzania’s national tree, is therefore instructive. Given its status as a national icon and a valuable source of foreign exchange, is this species managed sustainably?

In Tanzania, close to half of *Dalbergia melanoxylon* was felled illegally (Moore and Hall, 1987). Minimum diameter size classes are commonly disregarded, with 54% of logs in a sawmill inspected by Ball (2004) being smaller than the minimum diameter. Official statistics for *Dalbergia melanoxylon* also rarely reflect real harvest levels. Backéus et al (2006) have recently suggested that selective logging of *Dalbergia melanoxylon* is likely to result in its local extinction...and this is for a species where “resource rents” are high.

Sustainable management is not possible if neither forest management area boundaries nor well founded rules for resource management are respected. Despite these high values, fire management is poor and fire sensitive timber species such as *Guibourtia* and *Baikaeia* are in decline.

6 Conclusions

HIV/AIDS is one of the major problems facing people in the miombo region, the social and economic costs of which have been well documented, though less so for use of miombo woodlands (FAO, 2005, and Kayambazinthu *et al.* 2005). The main findings of these studies suggest that miombo woodlands are safety nets for households. Thus sustainable management becomes important from many angles – to secure safety nets; to derive cash income.

This paper has laid out a series of barriers to sustainable forest management, some of which are difficult to remove (e.g. low productivity), while others require changes in policies and practices. In a forthcoming paper, Abbot *et al.* (in prep.) will identify the way forward to get sustainable forest management in the miombo region. These range from removal of restrictive legislation, to enhancing rights and responsibilities of local people, to having a multi-faceted strategy which builds business capabilities and resources for e-commerce (Molla and Hicks, 2007).

For some products, the barriers will be easier to remove. For example, for honey production it is relatively easy to achieve sustainable forest management. In fact, beekeeping and use of products such as edible insects and mushrooms have significant potential to support environmental conservation by making habitat destruction more costly (Hausser and Mpuya 2004; Mickels-Kokwe, 2006; Munthali and Mughogho, 1992). But the ease with which sustainable production can be achieved is offset by the multiple uses and actors involved in miombo woodland use. For example, beekeepers are only one player amongst many – they will be aware of the need to conserve forests but have little control over others, e.g. pit-sawyers, charcoal makers (Mickels-Kokwe, 2006).

7 Figures and Tables

Figure 1

The miombo eco-region, as defined by WWF. This region is largely covered, or was previously covered, by wet and dry miombo woodlands, but also includes a variety of other associated dry tropical woodlands (source: Kowero, 2003; WWF-SARPO 2001).

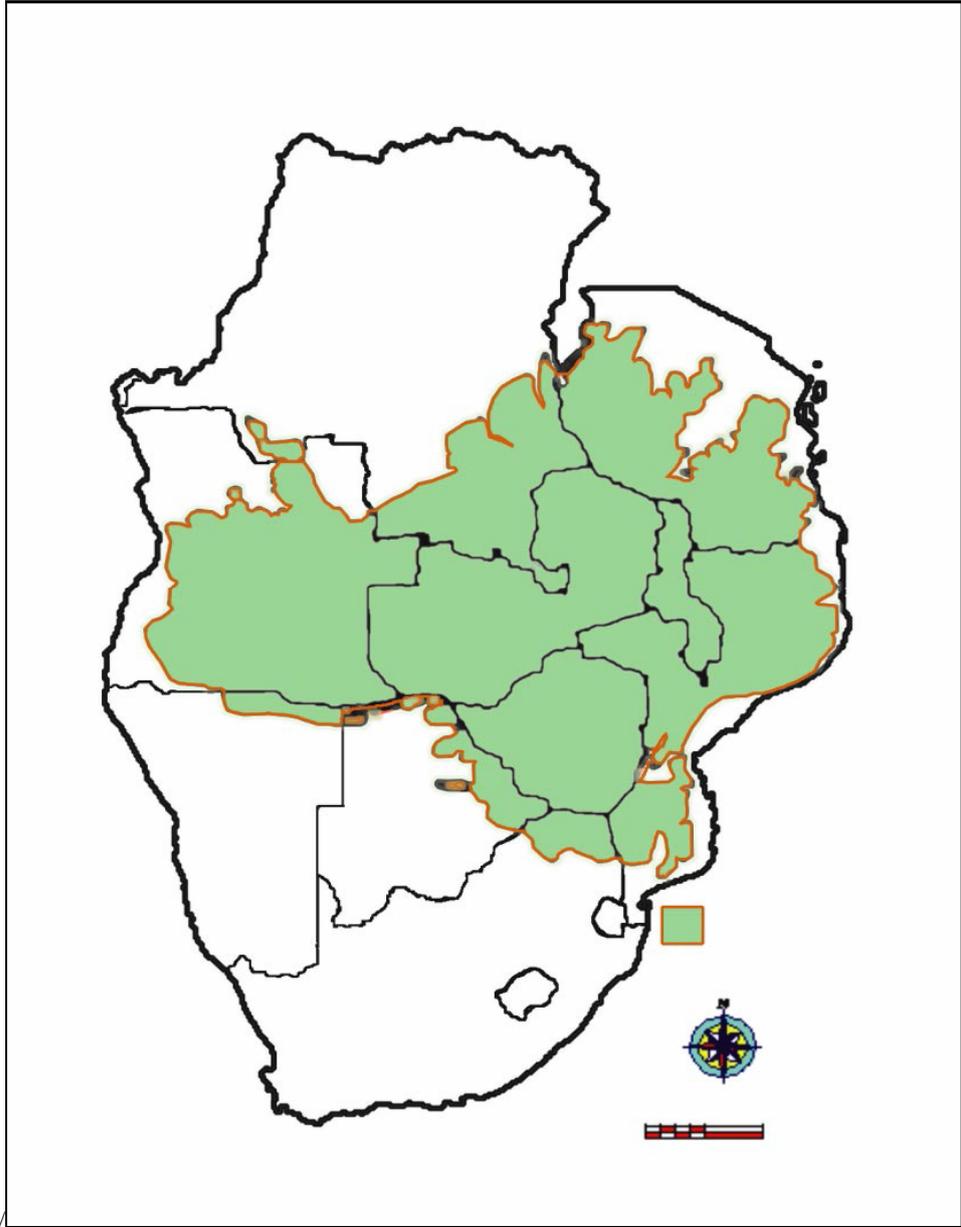


Table 1

Deforestation rates in countries where miombo woodland predominates (FAO, 2007). The similarity of the data between the two periods points to the lack of reliability of such estimates.

Country	Total forest (2005)	Annual Change Rate			
		1990-2000		2000-2005	
		1000 ha	1000 ha	%	1000ha
Angola	59104	-125	-0.2	-125	-0.2
Malawi	3 402	-33	-0.9	-33	-0.9
Mozambique	19 262	-50	-0.3	-50	-0.3
Tanzania	35 257	-412	-1	-412	-1.1
Zambia	42 452	-445	-0.9	-445	-1
Zimbabwe	17 540	-313	-1.5	-313	-1.7

Table 2

Indicators of poverty from countries where miombo woodland predominates

Country	GNI per capita, Atlas method (current US\$)		Growth rates (%)					Life expectancy at birth, total (years)	Secondary school enrolments (%)	
	2001	2005	2001	2002	2003	2004	2005	2005	2001	2005
	Angola	470	1410	3	14	3	11	21	41	17
Malawi	140	160	-5	3	6	7	3	41	33	28
Mozambique	210	310	13	8	8	7	8	42	7	14
Tanzania	270	340	6	7	7	7	7	46		
Zambia	300	500	5	3	5	5	5	38	23	28
Zimbabwe	540	350	-3	-4	-10	-4	-6	37	43	

World Bank indicators data set (<http://ddp-ext.worldbank.org>)

8 References

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