Miombo woodlands – opportunities and barriers to sustainable forest management

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ABSTRACT

Miombo woodland is the most extensive tropical seasonal woodland and dry forest formation in Africa, with seventy-five million rural people and 25 million urban dwellers relying on miombo for their livelihoods. Poverty reduction in the miombo countries remains problematic, and deforestation is high. We describe how opportunities for miombo product use are strongly determined by biogeography and evolutionary history. There are a number of opportunities to manage and benefit from miombo woodlands: (1) forests are still a valuable resource; (2) resource rights are shifting to local people; (3) new approaches to integrating conservation and development are emerging; and (4) forest markets are emerging and expanding. However, there are a number of barriers to sustainable use and benefit from miombo. We recognise eight key barriers: (1) low inherent productivity; (2) managing for multiple products; (3) disenabling forest policy; (4) marginalisation of the forestry sector; (5) cash constraints pushing decisions towards high preferences for rapid exploitation; (6) low margins and high management and transaction costs; (7) weak local organisations; and (8) weak national organisations. The miombo countries are part of the 'bottom billion' (Collier 2007), the 50-60 failing states with a population of a billion whose problems defy traditional approaches to alleviating poverty. Poverty is not going to go away through any simple solution. Miombo woodland management and use will not be part of the solution in getting people out of the 'bottom billion', i.e. miombo will not contribute significantly to poverty elimination. However, in the face of prolonged poverty, miombo woodlands are crucial for poverty mitigation. Miombo woodlands can bolster livelihoods, act as safety nets in times of emergency and serve as gap fillers in times of seasonal shortages. They also shore up livelihoods in the face of HIV/AIDS and may indeed prove more reliable resources than dryland agricultural resources in the face of climate change. The crucial role of miombo for poverty mitigation is in spite of the fact that miombo is of low productivity and is not well-endowed with high value timber resources. This makes them less interesting to commercial concerns, but what matters is their high local value to tens of millions of poor households.

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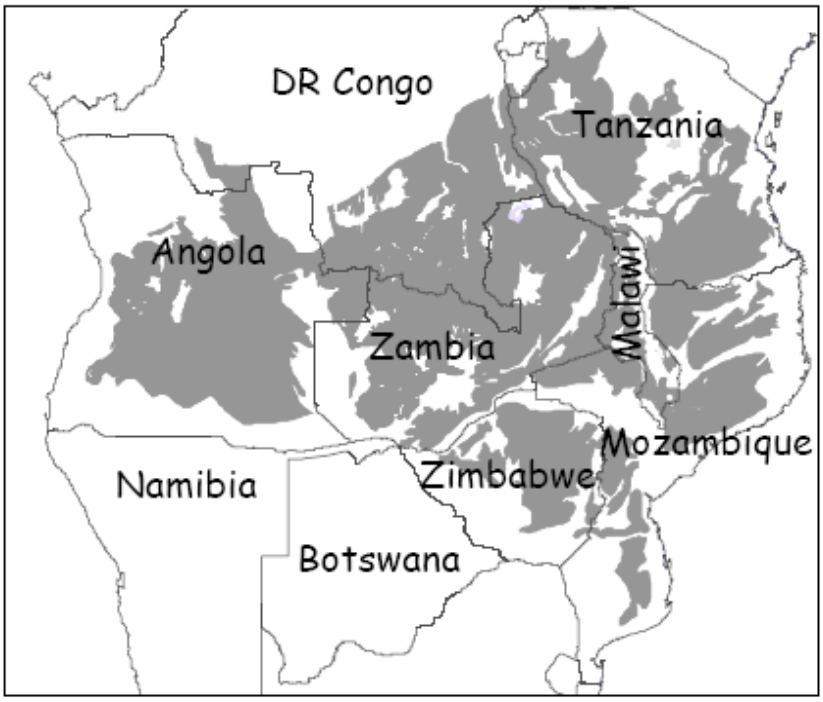
1 Introduction

Miombo woodland is the most extensive tropical seasonal woodland and dry forest formation in Africa (perhaps even globally), covering an estimated 2.7 million km^2 in regions receiving more than 700 mm mean annual rainfall on nutrient-poor soils (Campbell et al. 1996; 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). Seventy-five million people inhabit areas covered, or formerly covered, by miombo woodland, with an additional 25 million urban dwellers relying on miombo wood or charcoal as a source of energy[5]. Very similar dry forest formations stretch across northern Africa, south of the Sahelian zone (Mayaux et al. 2004). The miombo has some specific biogeographical features that set the context for people's use of woodland resources – these we outline in Section 2.

Figure 1: The distribution of miombo woodland (based on White 1983)



[5] Based on: rural and urban population numbers in 2007 from UN Population Fund for each of the listed miombo countries; estimates for each country of the population in dry forest areas (in contrast to, e.g. humid forest areas); and urban use of wood energy (Campbell et al. 2003; Kambewa et al. 2007; Stockholm Environment Institute 2002). Population numbers for DRC miombo area were derived from figures provided by the African Forests Observatory project (FORAF).

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There are very few 'good news stories' in the region, 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) and in many case study areas (e.g. Luoga et al. 2005; Mwase et al. 2007). 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. However, generalisations are not easy: there is much variation in levels and causes of deforestation across the region (Abbot and Homewood 1999; Chidumayo 2005a; Dewees 1995; Fisher and Shively 2007; Luoga et al. 2000; Mwampamba 2007; Sprague and Oyama 1999). Poverty reduction in the miombo countries remains problematic. Life expectancies are low as a result of the HIV/AIDS epidemic and secondary school enrolments remain generally low (Table 2). Per capita gross national incomes (GNI) are low except in the case of oil-rich Angola. While most countries (with the exception of Zimbabwe) have increased their GNI, and some countries have demonstrated impressive economic growth rates (e.g. Angola, Mozambique and Tanzania), poverty headcounts remain high (Table 2). The lengthy civil wars in Angola and Mozambique devastated the economies and thus growth is from a low level. In Angola the growth is now driven by the expanding oil economy, but poverty is widespread (Anderson 2006; Le Billon 2005). Digging deeper into the Tanzanian poverty data indicates that rural poverty is not going away (Ellis and Mdoe 2003).

Table 1: Deforestation rates in countries where miombo woodland predominates (FAO 2007).[1]

Country	**Total forest (2005)**	**Annual Change Rate**			
		1990-2000		2000-2005	
	1000 ha	*1000 ha/yr*	*%*	*1000 ha/yr*	*%*
Angola	59,104	-125	-0.2	-125	-0.2
Malawi	3402	-33	-0.9	-33	-0.9
Mozambique	19,262	-50	-0.3	-50	-0.3
Tanzania	35,257	-412	-1.0	-412	-1.1
Zambia	42,452	-445	-0.9	-445	-1.0
Zimbabwe	17,540	-313	-1.5	-313	-1.7

[1]The similarity of the data between the two periods points to the lack of reliability of such estimates**.**

Nevertheless, some developments in the miombo region give room for optimism, notably community-based approaches of miombo management in Tanzania (Wily and Dewees 2001; Blomley and Ramadhani 2006) and cases of forest enterprise development from Southern Africa (CIFOR 2004; Mander and le Breton 2006; Odera 2004). Section 3 examines the opportunities to manage and benefit from miombo woodlands: (1) forests are still a valuable resource; (2) resource rights are shifting to local people; (3) new approaches to integrating conservation and development are emerging; and (4) markets are emerging and expanding.

The opportunities from miombo woodlands can be harnessed to improve livelihoods and enhance sustainable management but a range of barriers exist, which we classify as biophysical, policy, economic, and organisational (documented in Sections 4, 5, 6 and 7, respectively). We recognise eight key barriers: (1) low inherent productivity; (2) managing for multiple products; (3) disenabling forest policy; (4) marginalisation of the forestry sector; (5) cash constraints pushing decisions towards high preferences for rapid exploitation; (6) low margins and high management and transaction costs; (7) weak local organisations; and (8) weak national organisations.

Table 2: Indicators of poverty for selected years from countries where miombo woodland predominates[1]

Country	Gross National Income per capita (current US$)		Poverty headcount ratio at $1 a day (PPP) % of population	Growth rates (%)					Life expectancy at birth, total (years)	Secondary school enrolments (%)	
	'01	*'05*		*'01*	*'02*	*'03*	*'04*	*'05*	*'05*	*'01*	*'05*
Angola	470	1410		3	14	3	11	21	41	17	
Malawi	140	160	21 *(2005)*[2]	-5	3	6	7	3	41	33	28
Mozambique	210	310	36 *(2003)*	13	8	8	7	8	42	7	14
Tanzania	270	340	58 *(2000)*	6	7	7	7	7	46		
Zambia	300	500	64 *(2005)*	5	3	5	5	5	38	23	28
Zimbabwe	540	350	56 *(1997)*	-3	-4	-10	-4	-6	37	43	

[1]World Bank indicators data set (http://ddp-ext.worldbank.org)
[2] This low poverty level seems highly unlikely (e.g. see Ellis et al. 2003)

Rural poverty must be seen in the context of the available resources including woodland resources (e.g. Cavendish 2000). In this paper we use the conceptual frameworks of Sunderlin et al. (2003, 2005) for poverty alleviaition and forest-based poverty alleviaition. These authors specify two types of poverty alleviation, applied at the household level. These are:

- Poverty mitigation or avoidance, that is, the use of forest resources to meet household subsistence needs, to fulfil a safety net function in times of emergency, or to serve as a ''gap filler'' in seasonal periods of low income, in order to lessen the degree of poverty experienced or to avoid falling into poverty; and
- Poverty elimination, that is, the use of forest resources to help lift the household out of poverty by functioning as a source of savings, investment, accumulation, asset building, and lasting increases in income and well-being.

Sunderlin et al. (2005) go on to identify four ways in which forest-based poverty alleviaition can be realized. First, it can be realized by converting forests to non-forest land uses such as permanent agriculture. Second, it can be realized by assuring access to forest resources and achieving this either by protecting the existing benefits that forests provide to rural people, or by redistributing access to, and benefits from, forest resources. Third, it can be realized by making transfer payments to forest dwellers who protect

forest environmental services. Fourth, it can be realized by increasing the value of forest production through: technologies that increase physical forest output; higher prices for forest products (including better market access); increased processing and forest-based value-adding activities; and the development of new products. We return to these conceptual frameworks in the conclusions (Section 8), and explore how they relate to miombo woodlands and the people dependent on them.

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 (Abbot, in press).

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. The distinctiveness of miombo as a source of products was highlighted by Wilson (1990) who demonstrated the marked differences that occurred between miombo and adjacent vegetation types in terms of food plants, grazing resources, and ultimately human well-being.

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 canopy tree species, a high diversity of shrubs, trees, vines and perennial herbs in the legume sub-family Papilionaceae dominate the herbaceous layer.[6] In addition, grass genera which produce useful thatch[7] 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 with their characteristic vegetation also result from human influence (e.g. dung accumulations at old homestead sites or 19th century iron-smelting sites).

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 100 million people. In some countries such as Malawi, wood resources are no longer abundant. Many woody species

[6] This includes a high diversity of *Crotalaria* (300 species) and *Indigofera* species (Rodgers et al. 1996) 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.
[7] Such as *Eragrostis, Loudetia, Hyparrhenia,* and *Hyperthelia*

rely on vegetative reproduction, so to some extent the miombo is highly resistant to cutting because of its ability to regenerate (Chidumayo 2004).

Secondly, there is a relatively low proportion of high quality commercial timber species, most of these are in the Leguminosae[8]. The national forest inventory of Mozambique indicated that out of the total standing wood volume, only 7% is commercially valuable as timber (Marzolli 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.[9]

Fourthly, the easy availability of fibrous bark leads to its use in construction, weaving (with bark from *Brachystegia boehmii* particularly favoured) as well as for bark beehives (*Brachystegia spiciformis* and other species). During the civil war in Mozambique, populations in very remote areas used *Brachystegia* 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 trees in the miombo produce small, hard, explosively dispersed seeds. None of the seeds of these dominant genera are edible.[10] As a result, a higher diversity of gathered plant foods comes 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 species[11]; (ii) two major fruit producing species occurring in large stands are in the Euphorbiaceae, namely from *Uapaca kirkiana* and *Schinziophyton rautanenii;* (iii) species formerly at low densities now increased due to human dispersal[12];
(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 hunger 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.

[8] Genera include: *Afzelia, Baikiaea, Dalbergia, Guibourtia, Milletia, Pterocarpus, and Pericopsis.* There is also *Faurea saligna* in Proteaceae.
[9] 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.
[10] Exceptions are the arils of *Guibourtia coleosperma* and seeds of the understorey shrub *Bauhinia petersiana* which both provide important food sources to !Khwe San people in the Angolan and Central miombo woodlands.
[11] *Berchemia, Carissa, Ficus, Garcinia, Diospyros, Pappea, Syzygium, Parinari*
[12] *Sclerocarya, Strychnos, Adansonia, Berchemia*

Sixth, the Caesalpinoid tree species, as well as *Uapaca kirkiana*, have fungal associations with their roots[13] (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% of which are edible (Morris 1994). Significant differences between different vegetation types within the miombo region are also important.[14]

Seventh, the dominance of *Brachystegia*, *Julbernardia* and *Isoberlinia* 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 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.

3 Opportunities to manage and benefit from miombo woodlands

3.1 Forests are still a valuable resource

Fortunately, information on the role of miombo in woodlands is quite well documented, as Cavendish (2000) undertook a very detailed and innovative case study on woodland income in Zimbabwe, and this was followed by several others throughout the region (Campbell et al. 2002; Fisher 2004; Hegde, in prep.; Jumbe, in prep.; Mutamba, in prep.; Oystein, in prep.). As the measure of overall household welfare, Cavendish (2000) and the subsequent studies have used total income, namely the sum of cash income, net gifts/transfers, subsistence income and environmental income. Environmental income records the contributions natural resources, including woodlands, are making to rural household welfare. While consumption is often preferred to income as a welfare measure in household studies (Deaton 1980), in the above-mentioned studies the distinction between total income and consumption is not large. This is because quantitatively significant economic activities, namely the consumption of own-produced goods and of own-collected environmental goods, represent both income and consumption. Cavendish (2000) found that these two items comprise c. 60% of total incomes, so household income and consumption are of similar magnitude.

The above studies all record high levels of forest dependence in miombo woodland. In the Zimbabwe studies woodlands contributed about 15% of total income (Cavendish 2002; Campbell et al. 2002), but this figure was greater than 50% in some Zambian sites

[13] Ectomycorrhizae

[14] For example, macrofungi genera which are a major source of edible species in miombo and *Uapaca* woodlands are conspicuously lacking in *Baikiaea* dry forest (Piearce and Chitempa 1984).

(Mutamba, in prep.).[15] The Zambian dependency levels are some of the highest so far recorded globally (see Vedeld et al. 2004 for a global overview). The miombo studies also show that it is the poorest of the poor that depend relatively more on woodlands. Campbell et al. (2002) in southern Zimbabwe found that 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 woodland income to the household accounts leads to a 12% reduction in measured income inequality.

Using seasonal household data for rural Malawi, Fisher and Shively (2005) found that households experiencing an income boost had lower forest extraction, compared to those not receiving such a boost. Shackleton (2006), Kayambazinthu et al. (2005), FAO (2005) and Barany et al. (2004) point to the importance of dry forest resources to households afflicted by HIV/AIDS, whereas Tairo (2007) and Ngaga et al. (2006) point to miombo woodland as the provider of 'famine foods'. These studies suggest that forests have a role to play as natural insurance (e.g. see Pattanayak and Sills 2001; Takasaki et al. 2004; McSweeney 2002, for insurance values of forests).

If we turn to individual products, the importance of forests is clear. Arnold et al. (2006) point to the continuing importance of woodfuel in Africa, citing the prediction of the International Energy Agency (IEA) (2002) 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, apiculture 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). Large volumes of miombo wood are used in home and pen construction (Grundy et al. 1993). The growing timber sector of Mozambique reached export value of US$65 million in 2005, representing 4% of the total national exports. Numerous examples of trade in forest products are found in the literature, demonstrating the significant contribution made by individual or groups of forest products to national and regional economies.

3.2 Resource rights are shifting to local people

In the last few decades, 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 resource management to local stakeholders (White and Martin 2002). A wide range of studies on devolution processes in miombo countries 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). Wily (2000, 2003) concludes that policy or legal commitment to decentralization in the land and forestry sector is very widespread (see also Anderson et al. 2006). In the miombo countries the intent to decentralise, at least in the policy, is

[15] The figures for Cavendish (2000) were recalculated so as to exclude non-woodland environmental income (e.g. clay, gold).

widespread, though the experience is not necessarily positive (Table 3 – we return to decentralisation under later sections).

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 as legitimate resource users rather than as poachers, criminals and squatters; new channels for rural dwellers to communicate their priorities to government decision-makers, and, in some places, improved community-government relations; contributions to villagers' organisational 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. Working in Tanzania, Lund (2007a) found that decentralising taxation to the lowest local government tier was a viable approach to enhancing revenue collection from the use of relatively low value natural resources, and ensured that a share of the collected revenue was used to finance public services.

Tanzania has one of the most advanced community forestry jurisdictions in Africa (Blomley 2006). Participatory forest management (PFM) has become a central strategy of the country's forest policy, laws and programmes. Initially, PFM was driven by projects working with local governments and non-government organisations and focusing on particular forest resources. The government then decided to mainstream service delivery through national and local government institutions, supported by direct block grants to local governments. By the end of 2000, 500 villages in Tanzania had declared new forest reserves, and 318,000 ha of forests were under community-based forestry management and 70,000 ha were under joint management (Wily and Dewees 2001; Masayanyika and Mgoo 2001). More recent estimates show the trend continues rapidly, with community and joint managed areas now covering more than 3 million ha established with over 1800 villages (Blomley and Ramadhani 2006). Most efforts have taken place in non-gazetted, non-reserved forests, that is, outside of central or local government Forest Reserves. The authors note that management and protection of woodlands has improved remarkably.

3.3 New integrated conservation-development approaches are emerging

The miombo region and neighbouring areas are at 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 region) is the prime example where 'win-win' outcomes for local 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 much 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 in press).

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. 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 might be losing something, because they are being asked to adopt a non-preferred land-use practice. 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. However, they also come with problems as a tool for enhancing poverty alleviaition (Pagiola et al. 2005; Wunder in press.). The poorest of the poor may not be able to get involved in PES because they may lack control over the land and therefore not be in a position to enter into a contract for service delivery. Poor households may lack the necessary capital, skills or labour, as well as access to credit or technical assistance, to implement the changes required by the PES scheme. In addition, transaction costs of PES schemes with numerous smallholders may be high relative to PES schemes that deal with a few large landowners. Thus PES may not necessarily be pro-poor, and Wunder (in prep.) argues that it should primarily be based on deals that make sense in terms of the primary goal – environmental service delivery – and not focus on subsidiary goals.

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 tourism and carbon sequestration. With the current focus on climate change, carbon markets are becoming increasingly likely (Chomitz 2007). The woodlands have lower wood carbon storage levels per hectare than tropical forests, but could possibly be included in avoided deforestation schemes.

Good PES schemes have five basic features, as illustrated by CAMPFIRE – Communal Areas Management Programme for Indigenous Resources – in Zimbabwe. 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 hunting and aesthetic landscape values) (Frost and Bond in press). 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 in press).

For CAMPFIRE, it is worth noting that the monetary contributions from external donors, like USAID, 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 integrated conservation and development (ICDP) 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 in Mozambique (Hegde, in prep.). The British company, Envirotrade, are paying for carbon sequestration in agroforestry. Local communities receive conditional payments if they adopt various tree-planting measures. In the medium run this is likely to raise incomes and diversify livelihoods, but in the short run households are reluctant to adopt these measures, due to liquidity shortages and risk aversion. 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 ICDP.

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. While PES can be implemented in a community context, the sustainability will be limited if the pre-conditions and governance structures are not enabling for PES. Furthermore, closer examination of many of these PES schemes shows that they often come with a large non-PES component. There is also a need to trial more pure PES arrangements, as these will be attractive to commercial partners in future carbon markets.

3.4 Markets are expanding and emerging

Already covered in the previous section are the emerging markets for environmental services, but in addition there are new niche markets for forest products, rapidly expanding urban markets, new buyers of old products and new communication technologies that enhance markets for the poor. These emerging market trends offer promising opportunities for poor people.

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 organisation based in southern African (Box 1), 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 (Mander and 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.[16] 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.

Box 1: Tapping new markets: PhytoTrade Africa's approach to natural product commercialisation

PhytoTrade Africa (www.phytotradeafrica.com) is the Southern African Natural Products Trade Association. Since its inception in 2001, PhytoTrade Africa has been committed to improving rural livelihoods through developing a sustainable natural products sector. PhytoTrade works with over 50 members in southern Africa (Botswana, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe), who in turn work with tens of thousands of rural producers of natural products.

PhytoTrade Africa has developed environmentally sustainable and ethical supply chains for natural cosmetic and food ingredients that are wild harvested from indigenous plant species. The association is currently researching over 300 species of useful plants, but focal species include manketti/mongongo (*Schinziophyton rautanenii*), baobab (*Adansonia digitata*), sausage tree (*Kigelia africana*), Kalahari melon (*Citrullus lanatus*), marula (*Sclerocarya birrea*), mobola plum (*Parinari* spp) and sour plum (*Ximenia* spp). Categories of products produced include herbal teas, essential oils, gums and resins, lipid oils and fruit pulps.

With training and capacity building from PhytoTrade Africa, association members are able to assure industry of reliable supply chain management and adherence to strict quality control measures. PhytoTrade's members supply products for the nutraceutical, phyto-medicinal, botanical, flavour and fragrance, herbal remedy, dietary supplement, functional food, cosmeceutical and personal care industries. The association develops commercial opportunities on behalf of its members based on partnerships with companies in key natural products markets. This involves not only developing long-term trusting partnerships with international companies, but also ensuring that strong legal and technical agreements are in place. Commercial partnerships are based on a sound approach to both market and product development that demonstrate meaningful financial and technical commitment by both parties. PhytoTrade Africa works in four key areas: institutional development; product development; market development; and supply chain development.

Expanding domestic markets

Urbanization is on-going and growing urban populations have greatly increased the demand for charcoal, medicinal plants, wild meat, construction wood, among other products (e.g. Lowore 2006). 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

[16] 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).

levels. The Stockholm Environment Institute (SEI) (2002) 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 estimated value of the charcoal industry in the four largest urban areas of Malawi is about US $41.3 million (Kambewa et al. 2007). This figure is slightly less than the value of Malawi's tea industry, and accounts for about 0.5% of the country's GDP. 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 (Pereira 2001). The per capita woodfuel domestic consumption ranged from 0.92 to 1.00 m^3 (Brouwer and Falcao 2004). 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 charcoal industry for the largest urban areas in Malawi provides significant employment. It is estimated that 92,800 people owe their livelihoods to charcoal: 46,500 producers, 12,500 bicycle transporters, 300 other transporters and 33,500 traders (Kambewa et al. 2007). 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). Krog et al. (2005) found 198 medicinal plant traders in three markets in Maputo, up from 10 in 1980. The traders were selling over one 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 in miombo countries. 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. 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 fuelled 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). In southern Tanzania, there is also an upsurge of illegal logging, with hardwoods also being exported to China (Milledge et al. 2007).

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; 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 favourable prices (IFAD 2006).

But what does this mean for forest product trade in the miombo region. To date there have been no studies, but anecdotal evidence suggests that poor producers are using mobile phones to expand market opportunities. One such example comes from Zambia, where rural honey producers are able to get market information from urban areas and thereby plan production more efficiently.

4 Biophysical barriers to sustainable management of miombo

There are some biophysical barriers to sustainable management of miombo woodland, most important of which are the inherently low productivity of miombo and the problem of managing multiple products. There are other biophysical barriers but we will not discuss them in detail. One of these is the legacy of past (and to lesser extent current) warfare in the region, which has left some resource stocks severely depleted. 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, with income from natural resources financing many conflicts (Andersen 2006). 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 logging and poaching flourished. Similarly, in Mozambique, large numbers of wild animals were decimated by ivory and bush meat poachers between 1983 and 1995 (Mangue and Oreste 1999). 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 (Zweede et al. 2006).

4.1 Barrier #1: Low inherent productivity

The limited data on growth rates for miombo suggest that rates are low. This is because they are located on some of the poorest soils in Africa. Because the woodlands have low productivity, returns to active management will generally be low, thus providing few incentives to actively manage.

Yield data have been comprehensively compiled by Frost (see his Table 2.7). Dry miombo coppice plots in Zambia had yields of about 2 m^3 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 (2007) estimated forest yield in Mozambique from 2.0 to 4.8 m^3 per ha per year 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. In Tanzania, Misana et al (2005) estimated 2.3 m^3 per ha per year from regrowth of miombo woodland, suggesting that it takes 8 to 15 years for the degraded woodlands to recover for charcoal production, providing that a minimum tree size of greater than 10 cm dbh (diameter at breast height) for charcoal making is observed. While growth is slow, strong coppicing occurs so coppice management is possible (Luoga et al. 2004). The above applies to entire stands – turning to individual species, Caro et al. (2005), suggests that the prospects for sustainable management look bleak (their focus was on *Pterocarpus angolensis*).

4.2 Barrier #2: Managing for multiple products

While growth rates are low, miombo woodlands have diverse resources which make them valuable, particularly at the local level. For example, there is a predominance of *ectomycorrhizae* in miombo woodland (see Section 2), many of which produce mushrooms, making miombo woodlands one of the prime 'mushroom kingdoms' 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). There is a predominance of edible insects, making the woodlands an important source of insect protein (Cunningham 1996). One further well-known feature 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. From a household perspective, miombo has diverse resources, with Cavendish (2002) recording over one hundred different types of resource utilisations in a single study area, with many types having multiple species (e.g. 47 wild fruits, over 40 medicinal species, 40 wild vegetables).

The problem is that it is not easy to manage multiple resources (Chidumayo et al. 1996). There are likely to be multiple trade-offs in managing different resources, and there are numerous information gaps on the species concerned. The main technical management issues in miombo woodland largely relate to harvesting, regeneration, coppice management, fire management and grazing management. Because of the diversity of uses of miombo woodland, the intensification of any one particular management strategy is likely to affect the production of other woodland products. For example, in Eastern

Province (Zambia) beekeepers hung hives in the forest but a timber concession license (to a prominent businessman) resulted in a significant number of big, flowering trees being cut, leading to reportedly lower honey production levels (Mickels-Kokwe 2006). There are also numerous examples of conflicts between charcoal producers and those wanting other resources from the woodlands.

5 Policy barriers to sustainable management of miombo

There are a number of policy barriers to miombo use and management. These may be both within and external to the forestry sector. Here we examine two barriers: (a) forest policy that is disenabling, either because they are highly restrictive or they do not tackle the issues that would provide incentives to small-scale producers and community initiatives; and (b) lack of support for the forestry sector within government planning and allocation. In many cases the issue is not the lack of reasonable policy, but rather how that policy is interpreted and implemented (e.g. Salomão and Matose, in press). We return to many of these issues under Barrier #8 related to weak national institutions.

5.1 Barrier #3: Disenabling forest policy

Regulatory instruments

A range of regulatory instruments – designed to prevent over-exploitation of forest resources and to raise revenues for resource management (see 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. In addition, revenue generation has been limited and some would argue that the state has limited rights to collect revenues (Box 2).

Openshaw (1977) and Dewees (1995) discuss the measures introduced in Malawi to curb the charcoal market in order to reduce deforestation. Charcoal became more costly to produce and to get to the market, as authorities had to be bypassed, usually with bribes (Box 2). With production pushed out of the legal domain the forestry department had less control over the 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. More recently, Kambewa et al. (2007) also conclude that current efforts in Malawi to discourage charcoal making are expensive and ineffective.

A plethora of regulations does little more than act as a means by which petty officials extract informal payments (Dewees 1995; Box 2). 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, and getting timber through checkpoints.

Box 2. Issues related to revenue generation from the forestry sector

Informal payments to officials
In Malawi, it was estimated that 'private taxation' of charcoal traders diverted US$700.000 per year from Government (Kambewa et al. 2007) (a sizeable number, considering the budget that is allocated to forestry – Table 4).

Low levels of official revenue collection
In Mozambique it is estimated that in the Maputo area, a mere 1% of the potential fees and licenses were actually collected (SEI 2002). In Zambia the estimate is about 10% and in Tanzania about 25%.

Incentives for local governments not to devolve revenue collection
Forest revenues are an important source of 'untied' income for local governments (Blomley 2006). This causes a potential conflict of interest as district councils hold the key to transferring forest management (and revenue collection responsibilities).

Rights to revenue collection
One may question the right of the public sector to extract rents from what are essentially unmanaged woodlands, held in trust by Government, but in name only. Government's only rights to forest product revenue were based on a colonial designation of an area as a forest reserve, not on any legitimate right derived from protection or use.

Devolving rights to local people
Another policy issue is the limited rights devolved to local actors or the lack of clarity with respect to local rights. Table 3 highlights some of the issues in relation to decentralisation and devolution in miombo countries (Table 3). Wily (1999) argues that full power needs to be devolved to local communities not just use rights. Pilot schemes that don't give meaningful power to local actors are said to be unlikely to be successful (Wily 1999; Matose 2006). Schafer and Bell (2002), based on Mozambique experience, suggest that the state reluctance to devolve control over natural resources stems from the desire of forestry personnel to protect the forests above all else, the economic interests of state agents in valuable natural resources, and the unwillingness of politicians to allow local control in areas sympathetic to the opposition.

In a number of countries, the policy framework is not conducive to local control (e.g. Blaikie 2006; Campbell et al. 2001). The forest law in Angola is non-existent with the sector still using the Forest Ordinances from colonial times. Progress to participatory forest management has been slow in Zambia because of the lack of policy and legal frameworks (Gibbon et al. 2005). But in some cases there is good policy, e.g. Tanzania, and decentralized management has been mainstreamed throughout the forestry sector. But even here there are critics. For example, Petersen and Sandhövel (2001) point to lack of clear rights and adverse incentives, while Meshack et al. (2006) have recorded the high transaction costs of local control, and suggest that these are highest for the poorest of the poor. They conclude that policies and legislation need to be simplified in order to reduce transaction costs. 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. Goldman (2003) working in community-based conservation in Tanzania also suggests that planning remains a top-down affair, despite the rhetoric.

Table 3: Trends in decentralisation and devolution in some of the miombo countries[1]

	Malawi	**Mozambique**	**Tanzania**	**Zambia**	**Zimbabwe**
Decentral-isation policy	Decentral-isation policy in place since 1998	Decentralisation implemented (Matose and Salomao 2007; Nielsen et al 2006)	Decentralisation implemented and considerable progress in most sectors.	Decentral-isation launched in 2004 but no enabling laws	Decentral-isation in place
Forestry and decentral-isation	Decentral-isation not adequately addressed in the forest policy	Forestry policy (1998) and act (2002) call for delegation of responsibility to the lowest level. Land and wildlife/forestry laws contradictory with respect to tenure	Forestry policy (1998) and forest act (2002) indicate clear commitment to decentralisation. Forest and land policy closely aligned	Forestry policy (1998) and forest act (1999) only allow for community involvement in local forests (not national). Policy disenabling (Gibbon et al. 2005)	Policies for local control in place for wildlife but not forestry
Commit-ment to implement-ation	Few practical results (Blaikie 2006). Devolution in forestry less successful than other sectors. Forestry slow to approve local forest management plans.	Commitment at policy level, but many implementation problems. Devolution fragmented and limited by sector-related barriers and lack of procedural guidelines. More successes for wildlife than forestry	Implementation extremely impressive with large numbers of villages and big forest areas already covered (Blomley and Ramadhani 2006)	Implementatio n mechanisms vague	Decentral-isation to district councils only. Committees often collapse when projects end. More successes for wildlife than forestry
Benefit sharing	Government retains powers to define the type and location of resources that communities may manage	Very restricted benefits from concessions; and often benefits do not reach communities	Village Forest Reserves are fully devolved; communities receiving full revenue rights (Wily and Dewees 2001)	Limited benefits to local communities. Elite capture by traditional leaders	Benefits end with the district council. Elite capture by traditional leaders
Main-streaming	Projects the norm	Projects the norm	Forestry devolution mainstreamed	Projects the norm	Projects the norm; though wildlife was mainstreamed

[1] Based on information collated by Fiona Paumgarten

One manifestation of the lack of commitment to devolution is the focus for devolution efforts on degraded resources rather than on the high quality woodlands. Another manifestation is the limited benefits that local producers are allocated. In Mozambique, the forest regulation establishes that only 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, only US$422.000 (in 2006) was handed to 956 communities (Sitoe et al. *in prep*.).

5.2 Barrier #4: Marginalisation of the forestry sector

As has been noted above, forest resources play crucial roles to local livelihoods, 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 (for an example, see Box 3). However, forestry is generally marginalized in the national policy arena and budgeting process with few resources to support sustainable management, develop appropriate technical information and enforce regulations (Barany et al. 2004; Mlay et al. 2003). Forestry spending has to be mobilized in the face of many competing priorities -- health, education, transport, as well as agriculture. Agriculture appears to do relatively well by comparison to forestry. For example, in Malawi agriculture gets a 30 times higher budget than forestry, even more if irrigation is added (Table 4). All countries have agricultural extension service, but forest extension services are either missing or extremely limited. On the continental African agenda, forestry does not yet feature to any extent in the development framework of NEPAD (Fakir 2003).

Table 4: Budget allocation to different sectors: the case of Malawi 2007/08

	Total recurrent and capital budget (US$ million)	**% (of total budget)**
Forestry	4.7	0.4
Agriculture	149.8	13.5
Education	125.5	11.3
Health	130.7	11.8
Irrigation and Water Development	36.7	3.3
Lands and Natural Resources	23.2	2.1
Tourism, Wildlife and Culture	5.3	0.5
Local Government and rural Development	12.0	1.1
Total budget	1108.6	

Lack of resources means that the forestry departments are unable to effectively implement forest policies, have limited capacity for regulation, and provide limited services to smallholders and communities (though part of the problem also relates to their lack of service orientation – see Barrier #8).

The lack of technical, financial, and marketing services limits the development of forest-based micro-enterprises, though lack of attention to micro-enterprises is widespread and not limited to forestry. 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.

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.[17] In Zambia, for example, no detailed national forest inventories have been done since the 1960's to determine or to asses the quantity and quality of the country's forest resources and estimates of remaining woodland cover, growing stock and stocking rates are based on limited local level inventories. Under-investment (and corruption) also results in poor enforcement of forestry regulations (Box 3). In many cases, lack of attention to forestry regulations or poor management (e.g. no fire control) leads to resource destruction (Chidumayo 2002).

Box 3: 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 world's finest woodwind instruments such as clarinets, oboes and 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 per yr from exports (Beale 1995) (this only represents the legal trade – the illegal trade is many fold more).

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* is therefore instructive. Given its status as a national icon, the Tanzanian National Tree, 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.

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

There is another dimension to marginalization, namely that forestry personnel are generally unable to get forestry issues considered by other branches of government, be they in the energy sector, agricultural sector or local government. Solutions to the

[17] Though one could argue that in the face of multiple priorities and limited budgets more attention should be paid to woodland resources than commercial timber species, given the needs and priorities of smallholders and communities.

'charcoal problem' may well lie with national energy policies (Dewees 1995; Kambewa et al. 2007). The agricultural sector still enjoys subsidies and is a driver of deforestation (Kowero et al. 2003). While forestry may declare production illegal (as in the case of charcoal in Malawi) another Ministry (Local Government) allows sales and collects revenue from the trade (Kambewa et al. 2007).

6 Economic barriers to sustainable management of miombo

In this section, we examine the economic barriers to achieving sustainable management. Below we discuss: high rates of time preference and thus lack of investment in longer term initiatives; and, low margins due to poorly developed markets and lack of value addition.

An additional barrier, but not discussed below, is the lack of markets for ecosystem services, in particular carbon. A carbon market could possibly be important in providing incentives for resource conservation. Another barrier that requires mentioning is the trend towards domestication – while this trend may be appropriate and desirable from a market and livelihood perspective, it has the effect of reducing interest in the natural miombo woodland. 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, labour availability and increased scarcity of wild resources will favour the expansion of low-input tree crops. This is very much what has happened in higher rainfall areas, but whether it is as likely in the drier miombo woodland areas is open to question.

6.1 Barrier #5: Cash constraints pushing decisions towards high preferences for rapid exploitation

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. 2002). While woodlands are quite important for subsistence products they are less important for cash income, especially so for the wealthier households. In Shindi (Zimbabwe) 9% 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 4% of total cash income) (Cavendish 2000). 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). Luoga et al. (2000) calculate that charcoal production is profitable only if resource stock decline is discounted. If households want to secure cash, will they choose to over-use and, if necessary, deforest? Or will their desire to secure subsistence products ensure conservative use? And will wealthier households not be more likely to liquidate the woodland assets than the poorer

households given they are less reliant on woodlands? 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 3). Instead, 'resource mining' is more common, shifting short-term profits to urban, commercial sectors or other natural resources.

6.2 Barrier #6: Low margins – high management and 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).

But margins in miombo regions 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 (Box 2). However, this argument is weak as there is no evidence that collected revenues would be returned to management. The stronger argument for improved revenue collection is derived from the view that this would increase the market price, and reduce demand as a result.

7 Organisational barriers to sustainable management of miombo

In this section we examine organisational weakness at two levels: local organisations and national organisations.

7.1 Barrier #7: Weak local organisations

Local organisations are often weak, be they local community organisations (Campbell et al. 2001) or local government levels (Blomley 2006). This has a number of negative consequences: lack of clear and accepted local rules and regulations; elite capture; and limited market power.

Lack of clear and accepted local rules and regulations
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. The complexity of the commons is well established (e.g. Cavendish 2002). 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 poses special difficulties for the design of common property resource management.

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. Nemarundwe 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). The lack of moral and political legitimacy of some organisations undermines the effectiveness of local institutions (Kayambazinthu et al. 2003, drawing on case studies from four miombo countries). Poor leadership often 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. Eriksen (2007) argues that local power struggles are preventing local communities from adopting burning regimes that would be more environmentally sustainable and more in line with present day farming systems.

It may be challenging to bring about major improvements in management ahead of emergence of stronger local organisations in rural areas, and effective transfer of rights and responsibilities over the resource to these local institutions (Arnold et al. 2006). Community organisations, 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 result is local community members becoming employees, therefore weakening their position as partners.

Elite and external actors capture values

Elite capture or capture of value by external actors constitutes a disincentive for local collective action towards woodland management. When there are more-or-less significant values and economic rents, there may be widespread contestations over resources and/or capture of the benefits by elites (Campbell et al. 2001; 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. It is important to guard against the domination by elites in newly created institutions, as commonly happened in India's joint forest management program (Kumar 2002). Brockington (2007) points to the problem of corrupt village government in Tanzania and how their practices of resource grabbing, often in tandem with higher levels of government, could undermine devolved forest management. Logan and Moseley (2002) studying Zimbabwe's CAMPFIRE conclude that the program will not achieve local empowerment without addressing the administrative and legal structures that underlie the nation's political ecology. Elite capture does not always occur. For example, Lund (2007b) found that forest decentralization in Tanzania's Iringa district had overwhelmingly positive livelihood effects, including in terms of well-functioning local governance and benefit-distribution systems.

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. This occurred in the case of the Zambian beekeepers who lost their resources to a timber concession licensee (Mickels-Kokwe 2006). The beekeepers had no means of influencing the allocation of licenses or the behaviour of the concessionaire, who was a prominent businessman, demonstrating the importance of social and political networks in shaping the distribution of benefits. Comparing similar products in national versus international markets (e.g. honey sold in Zambia versus honey exported), big (external) players tend to dominate even more when international trade is involved. 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 trade 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 international market (Wynberg et al. 2003) (Box 4).

There are also examples of the state and its actors dominating resource control. 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 (Mapedza and Madondo 2000; Mapedza 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. Mackenzie (2006) suggests that corrupt officials capture much of the rent in the Mozambican timber trade to the detriment of the forests and local people.

Box 4: Can export markets benefit the poor?

Marula (*Sclerocarya birrea*) features prominently in the semi-arid, deciduous savannas of southern Africa, including being found in drier miombo woodland (Shackleton et al., in prep.; Wynberg et al. 2003; Wynberg 2005). It constitutes an essential part of the livelihoods, culture and spirituality of rural communities throughout its distribution range. Many parts of the tree are used, including the fruits (locally consumed as fruit, or in beer/wine and jams, and internationally traded liqueur), kernels (food), oil (cooking, personal care products), bark, roots and leaves (medicine), and wood (carving, utensils, fuelwood). Commercialisation of marula products takes many forms, from household level trade in beer/wine to international markets for *Amarula* liqueur and the use of kernel oil in personal care products, such as by The Body Shop in a new cosmetics range.

The international returns to Amarula liquor are unknown, but are believed to be significant with exports to 28 countries around the world. The commercialisation of marula brings a suite of opportunities for rural development, but also a number of challenges and threats – for subsistence users, for the resource base, and for traditional customs. The increased commercialisation generally entails a shift from small-scale to large-scale activities. This shift can produce undesirable results, especially at the community level and for more marginalised households. Small-scale enterprises will typically maintain activities in the household, involve local labour, be based on simple technologies, have low capital requirements and be accessible to the most socially disadvantaged groups. Growing the industry could involve a different and more entrepreneurial group of people and marginalise long-established producers, introduce new technologies with potentially negative impacts on women and the poor, and remove benefits and control from the community level. Where can the balance be struck?

Because of the seasonal nature of marula fruiting, scaling up is unlikely to increase monetary benefits at the household level (as there is a limit to labour availability), but will increase the spread of benefits amongst the community, with the involvement of more households. However, increased commercialisation could also result in the possible monopolisation of the resource and trade by particular households or elites within the community, particularly if technological innovation makes processing faster, more efficient and more profitable. Scaling up could also increase the domestication of marula, which if not done carefully, could induce shifts in benefits to richer farmers or to large companies.

Wynberg et al. (2003) recognise four main models of marula commercialisation: the 'Local Entrepreneur' (local beer and kernel traders), the 'Altruist' (Mhala Development Centre – MDC – producing oil and juice; the 'Honest Broker' (an NGO CRIAA SA-DC – producing oil), and the 'Corporate Buyer' (Distell – producing the liqueur). The liqueur returns some R1 million to communities, while CRIAA and MDC return a quarter to a third of this. Much smaller is the local trade. The corporate model relies on trickle down benefits, with skewed power relations between producers and the company. There is no control of the value chain by local producers. Producers are price takers. Traders do quite well, earning 1.3 to 2.1 times more than farm workers. On the other hand, the company has the ability to invest in marketing, image-building and product development; and thus expand the market and spread the benefits to more communities.

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 (see also Fairhead and Leach 1998). 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) rather than those 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. 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 regulations 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 (Sitoe et al. *in prep*).

The lack of strong local producer associations

Local enterprises in miombo woodlands produce products, such as honey and edible mushrooms, for which there are significant national and export markets. 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 and requires hundreds – or even thousands – of rural harvesters to collect these products. Numerous small producers also make brand recognition, quality control and market growth very challenging. To take the honey example, in the North West Province of Zambia, an estimated 15,000 beekeepers own an average of 73 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). The question is how dispersed production by numerous producers can be bulked up to meet market standards?

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 organisations 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 (NWBP) 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.[18] In southern Africa, the eight country network PhytoTrade Africa operates as an umbrella body for smaller member businesses.

[18] The honey competes with the large volume suppliers such as China by being high quality and organic.

7.2 Barrier #8: Weak national forestry organisations

This barrier is a result of a number of factors. One is that forestry organisations are weak because they are under-resourced (see Barrier #4). The other is because they lack appropriate service orientation, which is what we will focus on in this section.

Forest institutions in Africa were established when there were other priorities and objectives, and were never designed to be responsive to the needs of local communities. The idea of forest institutions as organisations with serious service delivery functions is not common, as compared with other organisations such as schools and health centers, where service orientation is the rationale for their existence. Forest organisations in Africa largely see themselves as relevant simply because of their regulatory functions, rather than because they are supposed to manage forests *per se.*

And when they do turn their attention to management, their lack of service orientation is again evident. By-and-large they remain locked into 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, if they are ever done, seldom look beyond timber and fail to take local livelihood activities into account. 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 melanoxylon* 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. Forest department perspectives on tree availability often do not mesh with local people's perspectives (Walker and Peters 2007). 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. Rural development forestry needs to provide local solutions to local problems and to recognise the influence of diversity within the rural community (Abbot 1997).

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. Decisions about forest management were taken in centralized government offices, far from the people affected by the policies,

or more typically, decisions were not taken at all. For example, in Tanzania huge areas of miombo were gazetted as forest reserves, but there were no institutions established or developed to manage these areas, because management was largely not needed half a century ago when they were established. At that time, woodlands were abundant and could be harvested (high graded) at will. The long term institutional ramifications were serious, because no tradition of management *per se* ever developed around these areas -- only regulation and a narrow focus on revenue generation. It is not surprising that commitment to devolution has been week even in the face of appropriate policy (Table 3). For example in Malawi, it is not generally the policy that is the problem, but rather the interpretation and implementation of the policy (Kambewa et al. 2007). Frameworks for forest management such the Forest Act, the National Forest Policy, and Standards and Guidelines for Participatory Forestry Management are in place, all of which are intended to promote good forest practice throughout Malawi, but implementation is slow and devolution is resisted. There has been reluctance to take responsibility for new ideas and ways of engaging with multiple stakeholders (Gibbon et al. 2005).

8 Conclusions

The miombo countries are part of the 'bottom billion' (Collier 2007), the 50-60 failing states with a population of a billion whose problems defy traditional approaches to alleviating poverty. These states are caught in at least one of four common traps: (a) armed conflict (DRC, and until recently Angola and Mozambique); (b) mismanaged dependency on natural resources (particularly Angola and DRC); (c) weak governance (most of the countries, more so in some, e.g. Zimbabwe, DRC, Angola; and in all of them in the their recent history); and (d) landlocked countries surrounded by poor countries (Malawi, Zimbabwe and Zambia). Poverty is not going to go away through any simple solution. In fact two trends are likely to make poverty worse: HIV/AIDS and climate change. The former is already afflicting poverty on millions of households, while the latter is likely to drive negative trends in agricultural systems and water availability.

And, of course, miombo woodland management and use will not be part of the solution in getting people out of the 'bottom billion'. However, the above context points to the important role of miombo woodland. And here we return to the recognition by Sunderlin et al. (2003) of two types of poverty alleviaition: poverty mitigation and poverty elimination. Major structural changes of the type argued by Collier (2007), but miombo woodlands are crucial for poverty mitigation. And in the face of what is likely to be a prolonged period of poverty, poverty mitigation is essential.[19] Miombo woodlands can bolster livelihoods, act as safety nets in times of emergency and serve as gap fillers in times of seasonal shortages. They also shore up livelihoods in the face of HIV/AIDS and may indeed prove more reliable resources than dryland agricultural resources in the face

[19] There will, however, be a small number of cases where miombo woodland can help in poverty elimination. Shackleton et al. 2007 shows very clearly how informal markets are important for livelihoods in the mitigation sense, but in the case of all the four products she examined there were individuals who used the forest product markets as pathways out of poverty (for example, the woman trader of mats who used the substantial benefits she derived to send her son to University).

of climate change.[20] On the positive side some new opportunities may be opened up through the emergence of carbon markets. Miombo fires make a significant contribution to greenhouse gas emissions (Sinha et al. 2004; Silva et al. 2003), and there is the potential that fire management could be rewarded by carbon payments, as is occurring in other savanna systems (Whitehead et al. 2005). And potentially avoided deforestation in miombo could become part of the carbon market.

The crucial role of miombo for poverty mitigation is in spite of the fact that miombo is of low productivity and is not well-endowed with high value timber resources. This makes them less interesting to commercial concerns, but what matters is their high local value to tens of millions of poor households.

Sunderlin et al. (2005) recognise four routes to forest-based poverty alleviaition (Table 5). The first route is not a forestry option as it involves conversion of miombo. To fully serve as a means to poverty mitigation, woodland needs to be secured, not lost. The second route, especially devolution of rights and responsibilities to communities and lower tiers of government is a distinct possibility, but requires addressing a multitude of barriers. But, as demonstrated in Tanzania, it is something that can be achieved. The third route is also a possibility, but is awaiting the emergence of widespread markets for environmental services. To get these payment mechanisms working will also need a swathe of barriers to be overcome.

The forth route is also a possibility, and involves two concurrent approaches. One involves enhancing forest-based markets. A number of barriers would need to be addressed, including the removal of restrictive legislation, and the strengthening of forest enterprise associations. The other is ensuring sustainability of the forest product markets. Key barriers to overcome will be related to the regulatory and devolution frameworks, and the weak national institutions. 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).

[20] Though miombo functioning is also likely to be negatively effected by climate change (Trouet et al. 2006; Chidumayo 2005b).

Table 5. Four routes to forest-based poverty alleviaition

Routes to poverty alleviaition (Sunderlin et al. 2005)		**Impact on miombo**	**Barriers to overcome**							
			low inherent productivity	managing multiple products	disenabling forest policy	marginalisation of forestry	cash constraints	low margins	weak local organisations	weak national organisations
1. Converting forests to non-forest land uses		Negative – land clearing	(not a forestry option)							
2. Assuring access to forest resources and achieving this by:	protecting the existing benefits that forests provide to rural people,	The past experience with state protection has not been very positive	X	X	X	X	X	X		X
	redistributing access to, and benefits from, forest resources.	With appropriate institutions and incentives impacts on miombo can be positive		X	X	X	X	X	X	X
3. Transfer payments to forest dwellers who protect environmental services.		Presumably positive (few cases currently exist)			X		X	X	X	X
4. Increasing value of forest production through: technologies; higher prices; increased value-addition; new products.		Outcomes variable, as commercial-isation by itself can reduce miombo quality	X	X	X	X	X	X	X	X

The solutions to the broader problems and to the entirety of miombo resources will not be simple. Revitalising forestry services and building strong local organisations will be crucial but will take time. These governance issues will have to be part of the Collier (2007) agenda of improving national and local governance.

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