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When will community management conserve biodiversity? Evidence from Malawi

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Abstract. Both development practitioners and conservation organizations are focused on community ownership and management of natural resources as a way to create incentives for the conservation of biodiversity. This has led to the implementation of a number of large community-based conservation projects in sub-Saharan Africa, in countries including Namibia, Zimbabwe, Malawi, Zambia, and Rwanda. While the concept is logical, and valuation studies may suggest that conservation is more valuable than other uses of the resources in some areas, there has been little detailed analysis of the financial costs and benefits to the communities, to determine whether they would actually have an incentive to conserve if they had more extensive legal rights to the resources. This paper assesses the conditions under which this approach may be viable, based on a valuation study of the resources of Mount Mulanje in southern Malawi.

1 Introduction

Community ownership and management of natural resources are often regarded by the development and conservation communities as preconditions for conservation of biodiversity in Africa. This approach has been written into law for forest management in Mali, built into the design of wildlife management projects in Namibia and Zimbabwe, been the subject of much discussion among conservation biologists, and informed the design of donor-funded projects throughout the continent (see, for example, Blaikie, 2006; Hecht et al., 2008; Roe and Jack, 2001; Schwartzman et al., 2000; Terborg, 2000). Several kinds of logic underlie this emphasis. In part, it is a response to extensive work on common property resources, which suggests that with community collaboration, everyone will be better off than if individuals compete to claim shares of the resource base (Hardin, 1968; Ostrom, 1990). It is also a response to many years of state-dominated resource management systems, under which resources belong to the state, and the forest department is a police force whose primary role is to protect the state's property against depredations by the population (Thomson, 1995). In contrast, community ownership is often associated with economic approaches to resource management; with changes in resource tenure, the revenues from sustainable use are expected to exceed those from other uses, including converting forests to agricultural land, consuming wildlife, and so on.

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This paper considers whether this approach is likely to work in a specific case, that of Mulanje Mountain in southern Malawi. It is the outcome of an economic valuation study of the resources on that mountain, which unexpectedly shed useful light on the effectiveness of community-based resource management. The study was conducted by two groups; the USAID-funded natural resources management project COMPASS, and a local conservation NGO, the Mulanje Mountain Conservation Trust (MMCT). While it focuses only on one example, it suggests that economic criteria will be one of the key issues that determine whether community-based management can be an effective strategy for conservation in the developing world.

2 About the mountain

Mount Mulanje is an area of unique biodiversity and endemic species in southern Malawi, an hour east of the commercial capital of Blantyre. The plateau and almost-vertical slopes of the mountain are a protected forest. A road circling its base runs through the districts of Mulanje and Phalombe, where about four hundred thousand people in some one hundred thousand households live within a seven-kilometer buffer zone around the protected area.[1] The lower slopes of the

[1]These figures were calculated based on Malawi National Statistical Office population projections. The full study on which this article is based, including the final report, the spreadsheets showing all calculations and providing all sources, and the full text of most of the source documents used to obtain input data, is available at http://www.joyhecht.net/mulanje/mulanje.html.

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mountain are characterized by miombo woodlands, a mixed forest including many species valued for fuelwood and building materials. The upper slopes are an afro-montane forest ecosystem, with a somewhat different mix of tree species. Throughout the woodlands are stands of the endangered Mulanje cedar (*Widdringtonia whytei*), a species endemic to this mountain and a few similar mountains across the border in Mozambique. This cedar, Malawi's national tree, is prized for use in making furniture, chests, and curios sold to tourists. At an elevation of two thousand meters is a wide grassy plateau, from which a few rugged peaks rise another thousand meters.

The slopes and plateau of Mount Mulanje are rapidly being encroached upon. The thousands of women living near the mountain climb its slopes two to three times a week to collect fuelwood, which they carry down on their heads in twenty-kilo loads. Men climb the mountain in search of building materials to construct homes for their families. In the past hunters prowled the forest and plateau in search of large game, but now only rodents and the occasional small antelope remain on the mountain. The mountain's timber is cut for sale in Blantyre, or, with even greater destruction, for manufacture of charcoal sold in Blantyre. The cedar is cut illegally for sale to furniture and curio-makers. Residents of nearby villages clear the forest and cultivate the slopes, desperate for more agricultural land. Hunters set fires to flush out the remaining wildlife; cedar cutters set fires for cooking or light that accidentally spread across the forests. At times even the Forest Department staff responsible for sustainable management of the forest set fires, to protest government layoffs that threaten to put them out of work.

At the same time, the mountain provides a broad range of natural resources and environmental services to the people who live near it, including food, fuel, medicines, and pure water from its many rivers and streams. If the encroachment is not stopped, all of the services will be lost except access to cultivable land, to the detriment of those who live in Mulanje and Phalombe Districts.

In response to these challenges, COMPASS and MMCT undertook to estimate the economic value of the resources and services provided by the mountain. The hope was to demonstrate that the value of the mountain's resources, if managed sustainably by the communities dependent on them, would be greater than their value under the ongoing patterns of encroachment by local residents and outsiders.

This analysis was expected to provide an economic grounding for the work of both COMPASS and MMCT. COMPASS was engaged in developing economic activities such as beekeeping and fish farming, which depend in one way or another on protecting the mountain's resources and therefore were expected to create financial incentives for conservation. MMCT was working with villages around the mountain on conventions through which participating villages would be allocated a forest area that was theirs to manage and use sustainably, which included giving them the authority to prevent other people from using their resources. Both COMPASS and MMCT were interested in analytical results that could make an economic case for the strategies they were pursuing, and hoped to obtain them from this study.

In addition to the activities of COMPASS and MMCT, the Malawi Forest Department is responsible for a number of aspects of resource management on the mountain. They are supposed to sell permits for removal of fuelwood, at a price of 7 kwachas per headload;[2] in practice, however, almost all fuelwood collection is unpermitted. The Department has extensive plantations of eucalyptus and other species on the mountain, which they manage for commercial forestry. They manage a permit system for cedar harvesting, which only allows collection of wood that is already dead. In addition, the Department is supposed to maintain firebreaks to prevent extensive damage should fires start.

In practice, they were doing little of this in 2005 when the study was conducted. They were very short-handed, and could not properly manage the commercial forests or maintain the firebreaks. Very few permits were issued, and forest agents were known to take bribes instead of issuing fines when people were caught collecting materials without a permit. Cedar harvesting occurred without permits; one group of loggers met on the mountain even said their employer had a permit from the Phalombe Forest Department to clearcut live cedar from the area where they were working.

COMPASS and MMCT hoped that, in addition to justifying their own activities, the economic study would demonstrate to the Forest Department that they would be better off if they carried out their duties correctly than if they continued accepting bribes and not doing their work. To make this case, the study estimated the revenues the Department would receive if they collected all required permit fees; the hope was that this would be enough to enable the Department to cover the cost of protecting the forest.

3 Scenarios

The study was carried out in several steps. We began by identifying the different uses of resources from the mountain. Next, we estimated how much was used in the base year, 2005, and its economic value. We then projected future physical availability and monetary value of the resources provided by the natural forests (though not the commercial plantations) under four different scenarios:

Business as Usual: This scenario assumes that management of the forest is unchanged. Demand for resources will increase with population growth, to a point at which the resources will be completely depleted because demand exceeds sustainable yield.

Scenario 2, Improved Forest Management: This scenario assumes that a combination of projects will increase

[2] At the time of this study there were about 125 Malawi kwacha (MK) to one US dollar.

incomes from resource-based activities and reduce fuelwood demand, while improved forest management will more than double sustainable fuelwood supply.

Scenario 3, More Effective Forest Department: In addition to the assumptions of scenario 2, this scenario assumes that the Forest Department is able to play a more effective role in managing the natural forests, by turning plantation management over to a private concessionaire, retaining the revenues from logging permits and other fees instead of turning them over to the national treasury, and correctly collecting the 7-kwacha headload fees. This would increase their revenues to over forty million kwachas per year. With these funds, we assume that the Forest Department will be able to reduce forest fires, illegal cedar cutting, charcoal burning, agricultural encroachment, and other harm to the resources.

Scenario 4, Additional Plantations: The last scenario adds one more assumption, that the 7700 hectares of now-vacant land within the protected area are planted with eucalyptus, which will replace the miombo woodlands as a source of fuelwood. It does not address the question of whether the eucalyptus would be sold or would be free; by not factoring in a price elasticity of demand it implicitly assumes the latter. This makes it rather unrealistic. It does show, however, that if demand were shifted away from the miombo woodlands, they would survive much longer, buying time to address the problem of finding alternatives to fuelwood as a source of household energy.

4 Spatial context and population data

Based on satellite imagery for south eastern Malawi (Bouvier, 2006), we located vegetation classes on the mountain and defined a seven-kilometer buffer zone around the protected area. Using data from the National Statistical Office, we estimated the population and number of households in the buffer zone. We assumed that seven kilometers was the maximum distance people would walk to collect resources from the protected forest, although as discussed below we did not assume that everyone living within the buffer obtained their resources from the mountain. These spatial and population data underlie almost all of the results of the study. Combined with information about the location of wells, they also enabled us to estimate the number of individuals and households dependent on gravity-fed water from the mountain, another value underlying the calculation of resource use. Tables 1 and 2 show the results of these calculations.

Table 1. 2005 population figures for Mulanje and Phalombe.

	Population	Individuals	Households
Mulanje	District	522 893	126 930
	No. on gravity-fed water	259 498	62 992
	No. in 7 km buffer	239 892	58 233
Phalombe	District	290 042	74 129
	No. on gravity-fed water	134 054	34 262
	No. in 7 km buffer	150 705	38 517
Total	District	812 935	201 059
	No. on gravity-fed water	393 552	97 253
	No. within 7 km of border	390 597	96 750

Source: Calculated based on National Statistical Office data and Bouvier 2006.

Table 2. Land cover in the Mulanje Forest Preserve and the 7-km buffer zone.

	1973	1989	2002
Afromontane Forest	9292	6140	7928
Miombo Woodland	14 584	11 552	12 976
High grass	12 124	16 586	17 920
Rock	2562	4944	2777
Bare soil/no vegetation	10 351	2834	2318
Plantation	851	1337	3292
Disturbed/shrub/re-growth	3032	9403	5585
Total classified area	52 796	52 796	52 796
Cloud cover – unclassified	3516		
Classified plus unclassified	56 312		

Source: Bouvier, 2006

5 Resource use and value

The estimates of resource use in 2005 came from a wide range of sources. There was not sufficient time to do primary data collection, so we had to rely on other studies of Malawi and in some cases in adjoining countries. We identified some twenty four types of resource use that we wished to include in the study, of which we were able to locate data for eighteen. The full detail on how quantities and values were estimated for this study is available from the source documents and is summarized in Table 3.[3] Some description for the largest values is of particular interest.

5.1 Fuelwood for household use

Fuelwood for household use turned out to be by far the most important resource on the mountain in economic terms, and therefore warrants a rather detailed discussion. We located four different studies that estimated how much fuelwood is

[3] http://www.joyhecht.net/mulanje/mulanje.html

Table 3. Value of Mulanje resources, 2005, in kwacha (MK 125 = $ US 1.00).

Activity	Value added in Mulanje/Phalombe	Forest Department Revenue	Value added outside Mulanje/Phalombe
Household fuelwood use	323 190 649	29 345	
Cedar sales (legal and illegal)	74 299 847	3 923 852	
Gravity-fed drinking water	71 843 416		
Thatch for domestic use	32 371 059		
Agricultural output on converted land	30 944 000		
Tea irrigation	20 157 587		
Poles for home construction	17 789 401		
Fuelwood use for bricks	4 526 003		
Honey	2 008 920		18 180 000
Crafts sales	1 587 600		n.a.
Tourism	1 396 600	1 411 000	n.a.
Smallholder irrigation	1 332 000		
Charcoal	784 750		
Aquaculture	734 310		
Rope	145 916		
Plantation sawlogs		371 840	
Plantation poles		1 278 584	
Plantation fuelwood		1 727 757	
Mushrooms gathered		NO DATA	
Grazing		NO DATA	
Honey gathering – wild		NO DATA	
Gathered fruits		NO DATA	
Medicinal plants		NO DATA	
Hunting		NO DATA	
Total value from forest-based activities	583 112 058	8 742 378	18 180 000

used per household in Malawi, and two that estimated prices for fuelwood (Abbot and Homewood, 1999; Brouwer et al., 1997; Simons cited in Lowore, 2003; Killy Sichinga (COMPASS II staff) personal communication). We essentially averaged these, to arrive at an annual household use figure of 2371 kilos and a market value of 2.35 kwachas per kilo, or an annual value per household of 5567 kwacha. Of course this is not household expenditure on wood; very few households in this area buy fuelwood. Rather, it is the market equivalent of resources that they obtain in kind, by expending their own labor to collect it.

Using measurements of the weight of miombo species (Abbot and Lowore 1999), we estimated the volume of wood used per household at 2.486 cubic meters per year. Converting weight to volume is essential to compare household use with forest growth, because the latter is typically measured in volume.

The total household consumption in the buffer zone, based on these estimates, would be 241 500 cubic meters per year. However, we do not think that everyone in the buffer zone obtains all their fuelwood from the protected area. Based on the impressions of MMCT staff working closely with communities in Mulanje and Phalombe, we assumed that 60% of household fuelwood comes from the protected area and the remaining 40% from other sources. This gave us a 2005 volume of wood from the protected area of about 145 000 cubic meters, valued at about 323 million kwacha.

To understand the projections for fuelwood demand, we must also understand the dynamics of wood supply. Forests grow at an annual rate referred to by foresters as mean annual increment (MAI). This is the amount of wood that may be harvested sustainably each year, without decreasing the supply that will be available in the future. In addition to the MAI, branches fall off of trees and trees die naturally. This is referred to in the business to as dead wood shedding or "slash"; that wood may also be consumed without harming future forest yields. If current consumption is higher than the sum of MAI and slash, however, then future MAI and slash will be lower than it is today; thus future supply is not independent of current consumption.

The business as usual projection of fuelwood use assumes that demand will grow at the same rate as population; population growth projections come from the National Statistical Office, and are based on the 1998 census. We assume that all demand will be met by miombo woodlands (lower down on the slopes) for as long as they last. When they have been completely depleted, demand is expected to shift to afromontane forest (higher up the slopes). However, because afromontane forest is less accessible and less desirable as fuelwood, we assume that at that point the share of population supplied by the forest will drop from 60% to 30%. This assumption serves as a proxy for the impact of increased scarcity on use, as well.

In the business as usual scenario, we assume a mean annual increment of 2.0 cubic meters per hectare, and a slash rate of 1.46 cubic meters per hectare (the former an accepted rule of thumb for degraded miombo woodlands, the latter from Abbot and Homewood, 1999). Some forest will be lost each year to fire and agricultural encroachment; the methods for estimating this are discussed below. Based on these assumptions, we calculated that in 2005 the demand for wood was 144 900 cubic meters, and the sustainable yield was 72 322 cubic meters, so demand is twice the supply. If forests are used at this rate, the miombo woodlands will be gone by 2010, and the afromontane forests by 2016.

The second scenario assumes a reduction in demand for fuelwood due to use of improved cook stoves and building with compressed rather than baked bricks. It also assumes that the mean annual increment of miombo woodlands rises from 2.0 to 4.5 between 2005 and 2010. This is higher than any observed growth rates for miombo, and was based on the guesses of government foresters as to what might be achieved with optimal knowledge about how to manage these ecosystems. Moreover, we assumed that this could be achieved across the entire miombo woodland in the protected area, although this was beyond the implementing capacity of the projects and organizations now working to improve forest management in the region. These assumptions are obviously wildly optimistic. Nevertheless, under this scenario the miombo woodlands are depleted by 2011 and the afromontane forest by 2018. Even the best possible forest management will not achieve much.

In the third scenario we assume that the areas lost to fire and agricultural encroachment drop by factors of four and three, respectively, due to improved policing by the Forest Department. We also assume that a stronger Forest Department will begin effective collection of the legally-required 7-kwacha fee per headload for collection of fuelwood from the protected area. Based on estimates of the current cost of fuelwood collection derived from the time required and the price of labor, the imposition of the fuelwood fee is equivalent to about a 12% increase in fuelwood cost. Information in the literature (Arnold et al., 2003) suggests a price elasticity of demand for fuelwood in southern Africa of 1, in which case fuelwood use would drop by about 12% if the fee were actually collected. Under these assumptions, the miombo woodlands are gone by 2014, and the afromontane forests are declining in 2023, the endpoint of our projections.[4]

[4]Government of Malawi population projections on which the study was based extend to 2023. All of our projections are closely tied to population growth, and we did not want to undertake our own population projections beyond that year, so their figures placed an endpoint on our work.

The fourth scenario includes new eucalyptus plantations on now-vacant land within the protected area. Once they have grown to maturity, we expect that demand will first be met by sustainable harvesting of those forests, and only once that supply has been consumed will it be met from miombo woodlands or afromontane forests. Under these assumptions the miombo woodlands are almost entirely depleted by 2023, and the afromontane forests are still healthy.

Table 4 below provides some detail on the evolution of demand for and supply of fuelwood under each of the four scenarios. Table 5 gives the years in which each source of wood will be depleted under each scenario.

5.2 Drinking water

About half of the residents of Mulanje and Phalombe obtain their drinking water from gravity-fed sources running off the mountain. Mulanje water is famous for being so clean that everyone – even expatriate economists – drinks it straight out of the streams. If the forests were destroyed, the drinking water supply would be contaminated and the water pipes clogged with sediment. This actually occurred on another mountain near Mulanje, where political change led to sudden deforestation and cultivation of the slopes, followed by a significant degradation of the gravity-fed water supply. The value of the forest in protecting Mulanje water is therefore well understood. We estimated the quantity of water used by rural communities (which is not metered) based on the quantity consumed by urban households served by standpoints (which is metered, but family members must fetch water and carry it to the home). This was corroborated by anecdotal evidence on the quantity of water that rural dwellers bring from streams or water points each day. We valued rural water at the price paid by urban households served by standpoints. Based on those figures, the value of water supply from the mountain in 2005 was about 72 million kwacha, as compared with 323 million for fuelwood; not trivial, but far below the value of the fuelwood. We assumed, for the projections, that deforestation would reduce available water supply by 25%, a modest assumption.

5.3 Cedar

Several things contribute to loss of cedar hectarage and volume; legal cutting of dead cedar, illegal cutting of live and dead cedar, fire, and aphids (a parasite that kills live cedar). The total annual loss, based on two studies (Sakai May 1989 and Makungwa 2004), was estimated at 5611 cubic meters, of which some 400 m^3 per year were legal permitted removal of dead wood (Makungwa 2004). Based on discussions with Julian Bayliss, MMCT ecologist, we estimated that of the remaining 5211 m^3 lost, 4800 m^3 are live cedar, and of that, 2400 m^3 are illegally cut and the rest lost equally to fires and parasites. Of the 411 m^3 of lost dead cedar that is not harvested legally, we assumed that half is harvested illegally and

Table 4. Demand for and Supply of Fuelwood 2005 through 2023.

	2005	2010	2015	2020	2023
Business as Usual					
Demand, m^3/year	144 900	181 550	222 690	271 721	307 204
Miombo:					
Volume of available dead wood	18 941	15 752	0	0	0
Natural growth of this forested area	25 952	21 583	0	0	0
Afromontane:					
Volume of available dead wood	11 573	9837	8101	0	0
Natural growth of this forested area	15 856	13 478	11 099	0	0
Total Annual supply, BAU	72 322	60 650	19 200	0	0
Scenario 2					
Demand, m^3/year	144 900	170 580	209 398	260 351	297 665
Miombo:					
Volume of available dead wood	18 941	15 752	0	0	0
Natural growth of this forested area	25 952	48 561	0	0	0
Afromontane:					
Volume of available dead wood	11 573	9837	8101	0	0
Natural growth of this forested area	15 856	30 325	24 973	0	0
Total Annual Supply, Scenario 2	72 322	104 475	33 074	0	0
Scenario 3					
Demand, m^3/year	127 512	150 239	176 097	207 040	229 476
Miombo:					
Volume of available dead wood	18 941	17 957	0	0	0
Natural growth of this forested area	25 952	55 358	0	0	0
Afromontane:					
Volume of available dead wood	11 573	11 139	10 705	10 271	10 010
Natural growth of this forested area	15 856	34 338	33 000	31 662	30 860
Total Annual Supply, Scenario 3	72 322	118 792	43 705	41 933	40 870
Scenario 4					
Demand, m^3/year	127 512	150 239	176 097	207 040	229 476
Miombo:					
Volume of available dead wood	18 941	17 957	16 672	15 199	14 166
Natural growth of this forested area	25 952	55 358	51 397	46 855	43 671
Afromontane:					
Volume of available dead wood	11 573	11 139	10 705	10 271	10 010
Natural growth of this forested area	15 856	34 338	33 000	31 662	30 860
Total Annual Supply, Scenario 4	72 322	118 792	111 774	103 987	98 707

the rest lost to fires. Based on his research on cedar, Julian estimated a mean annual increment of one cubic meter per hectare; this low figure is why cutting live cedar is always illegal. The value of annual cedar sales, both legal and illegal, is about 75 million MK; like water, a significant figure but far below the value of fuelwood. We assumed that as the forest is cleared, all cedar will also be cleared, since it is unrealistic to expect valuable cedar to be left in an otherwise clearcut forest.

5.4 Thatch

Most rural homes in Malawi have thatch roofs. From data on use per household and price (Simons, 1997, cited in Lowore, 2003) we estimated the value of household thatch use in 2005 at about 32 million MK. This is expected to increase over time with population growth.

5.5 Agricultural encroachment

Agricultural encroachment reduces forest-based income and creates agricultural revenue; both of these were considered in

Table 5. Lifespan of woodlands.

	Miombo	Afromontane
Business as Usual	2010	2016
Scenario 2	2011	2018
Scenario 3	2014	declining in 2023
Scenario 4	almost gone in 2023	healthy in 2023

the study. Based on the satellite imagery developed by DAI (Bouvier, 2006), we estimated that 1,934 hectares of land in the protected area were being cultivated in 2005. The value of this land was calculated based on average maize yields and prices. In 2005 the revenue on this land was estimated at about 31 million MK. It was expected to grow slowly over time as a function of population growth.

5.6 Poles

Traditional Malawian home construction uses poles collected from the forest. Based on data on the labor required to gather poles for a single house (Simons, 1997, cited in Lowore, 2003), we estimated the value per house based on prevailing labor wage rates. This was combined with data on housing types in Mulanje and Phalombe to estimate number of homes built per year and the total value of poles. In 2005 this came to just under 18 million MK; it is expected to increase over time with population.

5.7 Tea irrigation

The area directly south of Mount Mulanje is occupied by extensive tea plantations, the property of two international companies, Lujeri and Eastern Produce. Most of the tea is irrigated. The manager of Lujeri provided us his full records on irrigation water for 2004, which we used to estimate water use by Eastern Produce as well. The tea estates do not pay for irrigation water, and no good method was available to estimate its value in production. All clonal tea (their major crop) must be irrigated, and it is not meaningful to estimate a water value based on the marginal tea output attributable to an additional unit of water. We used half of the price of water at community standpoints (the lowest marketed water price) to estimate the value of tea irrigation water; this is obviously somewhat arbitrary. The total value in 2005 came to about 20 million MK.

The tea estates have taken steps to protect their own water supply against harm due to upstream forest degradation. They own much of the forested land in the watersheds above their irrigation intakes, so they can prevent its degradation themselves. As a result, their need for water does not create an incentive for them to conserve forests on land within the protected area.

5.8 Fuelwood for brick burning

Many Malawian homes are constructed of baked brick, whose manufacture consumes significant quantities of fuelwood. Based on data from several studies (World Bank/UNDP et al., 1989; Zingano, 2005; and Konstant, 2000), we estimated the value of the wood used in 2005 to be just under 5 million MK. In the business as usual scenario, we expect the use of wood to rise with population growth. In the second scenario, we expect it to drop somewhat as some burnt bricks are replaced with compressed bricks. We do not anticipate any further change in fuel use for brick manufacture in the third and fourth scenarios.

5.9 Beekeeping

Beekeeping was a major activity of the COMPASS project, expected to create significant financial incentives to protect the forests in Malawi. Estimates of the current level of beekeeping activity were provided by Moffat Kayembe of MMCT, while data on its cost structure come from Kadale Consultants (2005). Based on these data we estimated the value of honey production in 2005 at about 20 million MK, most coming from sales outside of the regions of Mulanje and Phalombe. This was not expected to increase over time, because the COMPASS experts considered the productivity too low in the Mulanje area to be profitable. Once the protected area forests are gone, we expect all beekeeping to end, since the pasture for the bees will have been destroyed.

5.10 Tourism

In many African countries, ecotourism is expected to provide a significant economic incentive for conservation, and Mulanje is no exception. However, our findings suggest this is unlikely. We used data on visitor-nights on the mountain, and the charges for porters and use of the huts on the plateau, to estimate the total value of tourism in 2005 at less than 3 million MK. Members of the Mulanje Mountain Club said they would not hike the mountain any less if the forests were gone, so the value of tourism is not expected to be affected by degradation of the forest. Therefore ecotourism revenues will not create a financial incentive to protect the forest.

5.11 Other activities

The estimated economic values of other activities dependent on the mountain were close to or lower than those already discussed. The sale of craft items was estimated to bring in about 1.6 million MK, smallholder irrigation about 1.3 million MK, charcoal manufacture under 800 thousand MK, and aquaculture, another activity supported by COMPASS also under 800 thousand. Table 3 (above) summarizes all of the values estimated for 2005 resource use from the mountain.

6 Discussion

The logic underlying the COMPASS and MMCT strategies for managing the resources of Mount Mulanje was that community-based forest management and the introduction of economic activities dependent on forest conservation would create financial incentives to protect the forest and harvest its resources in both biologically and economically sustainable ways. The valuation work was expected to demonstrate that the communities living and working in the area would be financially better off if this were done, encouraging the Forest Department to play its role more effectively as well.

Instead, the results suggest that neither the COMPASS nor the MMCT strategies can work. The basic problem arises because of the large quantity of fuelwood gathered from the protected area each year. The MMCT approach to community forest management involves allocating to each village in the buffer zone an area of forest land which is its property, to manage and to use sustainably. MMCT staff believes, with some reason based on experiences elsewhere, that giving villages control over their forests without interference from the government will encourage them to protect their own resources so as to ensure that they will have an ongoing resource supply to meet their needs. Village management includes appointing individuals to patrol their area of forest, to ensure that local use rules are respected.

However, even at current population levels there is not enough forested land around Mulanje for each village in the buffer zone to be allocated an area large enough to meet its needs. As we saw in Table 4, in 2005 the demand for wood was twice what could be sustainably harvested from the protected area. That means that either each village will be allocated only half enough forest to meet its needs, or only half of the villages can be allocated forest land. In the first case, the villagers will not be able to manage their own land sustainably in the absence of another source of free fuelwood. In the second, the "have" villages will be faced with the unpleasant task of excluding from their land the residents of neighboring "have-not" villages that were not allocated forest land. Village patrols to ensure sustainable use could work when the supply is, in fact, large enough to go around. When faced with depredations by neighbors with no other source of fuel, however, it is hard to imagine how this can be successful.

Confronted with this situation, the MMCT response was that it is better to protect some forest than to do nothing. They may be right. As long as only a small amount of the forest is under community management, the rest will still be available for others to use – albeit perhaps with more pressure on it than there would have been otherwise. So there will not be overt conflict between have and have-not villages, and some forest land will indeed be managed sustainably. However, if we are seeking a strategy that can lead to conservation of the whole protected area, this one cannot work. The only solution that is compatible with ensuring the well-being of the adjacent communities would have to involve finding alternate sources of energy so as to reduce their demand for wood from the forest. Community management cannot work if the total demand exceeds sustainable yield.

The financial data suggest that similar problems would be generated by the COMPASS activities. In the case of beekeeping, the output of honey and the revenues from its sale depend on conserving the forest vegetation on which the bees depend for pollen. Two factors are expected to lead to this conservation. First, the individuals maintaining hives will themselves stop their depredation of the forests, because their own bees depend on the vegetation they would have used for fuelwood, and the honey sales will provide them enough income to convert to another energy source instead of gathering wood. However this will not prevent the depredations committed by their neighbors who do not raise bees. While there is apparently a vibrant market for honey, it is not so great that half of the population – those who create the excess demand for fuelwood – could become honey producers and buy their fuel out of their earnings.

Second, therefore, those who do raise bees are expected to pressure their neighbors not to degrade the forests. If forest degradation actually brought no returns – as is the case for some forest fires – this form of social pressure might be effective. However where the degradation is the result of harvesting necessary products for which there is no cost-effective alternative, it is hard to see how one relatively well-off villager – the one who is dynamic enough to invest in honey production – will be able to convince his less well-off neighbors to stop gathering needed fuelwood in order to protect the income of the richer man or woman.

The same challenges arise in the case of aquaculture. That activity depends on the pure water that runs off the mountain, a resource that can be threatened by degradation far upstream from the fish ponds. The few individuals who are building fish ponds are not likely to be able to control the behavior of everyone who depends on forest resources upstream from their water supply. It is more likely that, like the tea estates, they will find a way to protect the water flowing into their own ponds rather than trying to manage the entire watershed above them. As the value of their fish will not exceed the value of the wood gathered by a whole community, they cannot afford to compensate their neighbors for foregone fuelwood out of aquaculture profits.

The Mulanje case does not mean that community-based forest management, or development of economic activities that create an incentive for conservation, can never work. Rather, it gives us a way to assess in advance whether such strategies can be effective. If the total community demand is less than the sustainable yield, then community management may be an efficient and effective way to bring about sustainable resource management. Where total demand exceeds sustainable yield, however, introducing community management without finding alternative sources of energy or other resources cannot solve the problems in the long run.

This work also does not mean that we should give up on sustainable forest management; after all, limited use of miombo woodlands and full access to other forest resources is still much more valuable than the BAU scenario, in which there will be neither fuelwood nor other resources in fairly short order. However it does mean that demand-side efforts to reduce the pressure on the forest will be essential if we are to arrive at sustainable use. If we cannot reduce pressure on the forests from fuelwood demand, then in due course the forests will be gone, and scarcity will force households to find other sources of energy. If we could find a way to force that switch now instead of waiting for it to happen as an outcome of scarcity, then the community would clearly be better off; however this may be very difficult in practice.

References

Abbot, J. I. O. and Homewood, K.: A History of Change: Causes of Miombo Woodland Decline in a Protected Area in Malawi, J. Appl. Ecol., 36, 3, 422–433, 1999 (available online: http://www.joyhecht.net/mulanje/refs/refs.html).

Abbot, P. G. and Lowore, J. D.: Characteristics and management potential of some indigenous firewood species in Malawi, Forest Ecol. Manag., 119, 111–121, 1999.

Arnold, M., Köhlin, G., Persson, R., and Shepherd, G.: Fuelwood Revisited: What Has Changed in the Last Decade?, CIFOR Occasional Paper No. 39 (Bogor, Indonesia: Center for International Forestry Research), 2003 (available online: http://www.joyhecht.net/mulanje/refs/refs.html).

Blaikie, P.: Is Small Really Beautiful? Community-based Natural Resource Management in Malawi and Botswana, World Dev., 34, 11, 1942–1957, 2006.

Bouvier, I.: Mount Mulanje Land Cover Time Series Analysis, Short-term Technical Assistance Draft Report for COMPASS II, 2006 (available online: http://www.joyhecht.net/mulanje/refs/refs.html).

Brouwer, I. D., Hoorweg, J. C., and van Liere, M. J.: When Households Run Out of Fuel: Responses of Rural Houses to Decreasing Fuelwood Availability, Ntcheu District, Malawi, World Dev., 25, 2, 255–266, 1997.

Hardin, G.: The Tragedy of the Commons, Science, 162, p. 1243, 1968.

Hecht, J.: Valuing the Resources of Mulanje and Mountain: Current and projected use under alternate management scenarios." Study carried out fo rhte COMPASS II Project, DAI. (Blantyre, Malawi: April 2006), 2006 (available online: http://www.joyhecht.net/mulanje/mulanje.html).

Hecht, J., Gibson, D., and App, B.: Protecting Hard-Won Ground: USAID Experience and Prospects for Biodiversity Conservation in Africa, Prepared for USAID by Chemonics, International, through the Biodiversity Assessment and Technical Support (BATS) Program, 2008 (available online: http://www.joyhecht.net/professional/papers/Protecting_Hard-Won_Ground.FINAL.pdf).

Kadale Consultants: Honey Sub-sector Initial Report, Prepared for COMPASS II, 2005 (available online: http://www.joyhecht.net/mulanje/refs/refs.html).

Konstant, T.: Non-Timber Forest Products: Curent and potential value on Mulanje Mountain, Final Report prepared for the DFID/MMCT Mulanje Massif Project, 2000 (available online: http://www.joyhecht.net/mulanje/refs/refs.html).

Lowore, J.: Miombo Woodlands and Rural Livelihoods in Malawi, Prepared for the Center for International Forestry, Harare, Zimbabwe, 2003 (available online: http://www.joyhecht.net/mulanje/refs/refs.html).

Makungwa, S. D. (University of Malawi, Bunda College): Inventory Results of Mulanje Cedar Resources on Mulanje Mountain, Prepared for Mulanje Mountain Conservation Trust, 2004 (available online: http://www.joyhecht.net/mulanje/refs/refs.html).

Ostrom, E.: Governing the Commons, Cambridge, England, Cambridge University Press, 1990.

Roe, D. and Jack, M.: Stories from Eden: Case studies of Community-Based Wildlife Management, London, International Institute for Environment and Development, 2001.

Sakai, I.: A Report on the Mulanje Cedar Resources and the Present Crisis, Forestry Research Record No. 65, Forestry Research Institute of Malawi, Zomba, 1989 (available online: http://www.joyhecht.net/mulanje/refs/refs.html).

Schwartzman, S., Moreira, A., and Nepstad, D.: Rethinking Tropical Forest Conservation: Perils in Parks, Conserv. Biol., 14, 5, 1351–1357, 2000.

Simons, G.: Community-Based Natural Resources Management in Mwanza East: A Study on Utilization and Marketing of Non-Timber Forest Products (NTFPs), Vol. II, , 1997, Referenced in Lowore, 2003.

Terborgh, J.: The Fate of Tropical Forests: A Matter of Stewardship, Conserv. Biol., 14, 5, 1358–1361, 2000.

Thomson, J. T.: Mali: The Enabling Framework for User-Based Governance of Forest Resources, Prepared for the Fifth Common Property Conference "Reinventing the Commons" Bodoe, Norway, 24–28 May 1995.

World Bank/UNDP/Bilateral Aid Energy Sector Management Assistance Program: Uganda: Energy Efficiency Improvement in the Brick and Tile Industry, 1989 (available online: http://www.joyhecht.net/mulanje/refs/refs.html).

Zingano, B.: The Problem of Fuel Wood Energy Demand in Malawi with Reference to the Construction Industry, 2005 (available online: http://www.joyhecht.net/mulanje/refs/refs.html).