Climate change and adaptation strategies: a case study of the Mulanje Mountain Forest Reserve and its surroundings

Malawi

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Contents

1.0 Introduction

As in many developing countries, the severe impacts of climate change have been noticeable in Malawi over the past two decades. The most serious climate-related catastrophes have been dry spells, seasonal droughts, intense rainfall, floods and flush floods (Action Aid, 2006). In particular, droughts and floods have increased in frequency, intensity and magnitude and have adversely impacted on food and water security, water quality, energy and the sustainable livelihoods of rural communities.

This case study focuses on communities living within the 5–7 kilometre band surrounding the Mulanje Mountain Forest Reserve (MMFR), located between latitudes 15°50' – 16°03' South and longitudes 35°30' – 35°47' East in Malawi. The site was selected because climate change and mitigation issues have a direct bearing on the communities' livelihoods and their interaction with the reserve.

These communities are reliant on the environment and in particular, the forest. The study looks at how these communities have contributed to climate change problems, and in turn, how these problems affect them. They study also looks at how they are attempting to mitigate or adapt to climate change.

1.1 Livelihoods

The Mulanje and neighbouring Phalombe districts have a high population density; on average, 185 people per square kilometre (see Figure 1). These districts have high rates of poverty and illiteracy.

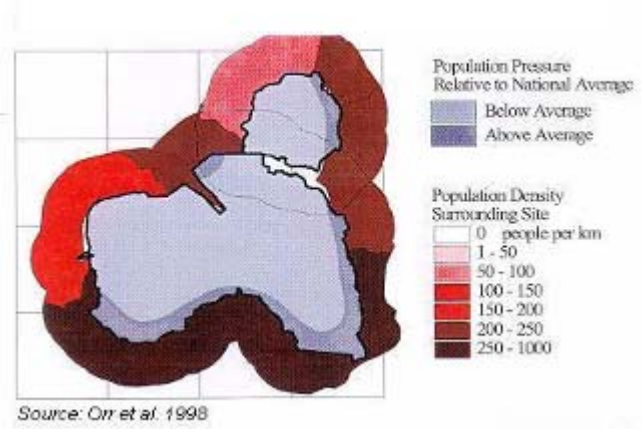

Figure 1: Estimated population densities around Mount Mulanje Forest Reserve

Many locals practice subsistence farming on less than 0.1 hectares of land, supplementing their income and dietary needs with small-scale irrigation agriculture. Those people living near the reserve boundaries also harvest and sell forest products. These include honey, fruit, wild vegetables, medicinal plants, mushrooms and some wildlife. They also gather firewood, timber, and grass for thatch and broom making. A small number of people run ecotourism ventures and collect wood for carving.

The major forest resource all communities depend on is the water supply, which they use in the home and for crop irrigation. Nine large rivers and hundreds of streams supply water to communities below and beyond the reserve.

1.2 Climate

Mulanje's rainfall and climate are affected by the mountain forest, and also partly by the Chiperoni Mountains in adjacent Mozambique. The climate is warm to hot and humid throughout most of the year, with annual temperatures averaging 21–23^0 C and maximum temperatures around 32–35^0 C during November and December.

During the dry season (June to mid-August), as a result of winds coming from the Chiperoni mountains, the Phalombe plains and those plains south of Mulanje experience cooler weather. During this period, temperatures on Mount Mulanje occasionally drop to freezing point. Tea estates located within several kilometres of the southern foot of Mount Mulanje experience dry season rainfall and occasional mists and fogs. At the Mimosa Tea Research Station (5 km from the mountain and 650m above sea level), the average annual rainfall is 1,626 mm, with 16% falling during the dry season (i.e. May to October).

1.3 Resources

Although nine perennial rivers serve the Mulanje and Phalombe districts, local communities have observed that some of these rivers no longer flow consistently throughout the year. In the Phalombe district, the Phalombe and Sombani rivers drain into the Lake Chilwa Wetland. Several tributaries of the Sombani river, flowing from the northern slopes of the massif, carry water for the greater part of the year. Other major rivers include the Thuchila, Likhubula, Muloza, Ruo, Lichenya, Lujeri and Nanchidwa rivers.

The growing population has put pressure on the carrying capacity of natural resources over the past few decades. Per-capita land holding sizes have reduced and patterns of land use have changed, in many cases leading to massive soil erosion and silting up of the river systems and reduced water flow. Demand for forest-based products has increased beyond imaginable proportions, leading to unsustainable use.

Deforestation in traditional lands, as well as encroachment in protected areas such as the MMFR, has resulted in a continued loss of plants and animal life. Forest co-management[3] is a novel concept that the people of Mulanje do not yet fully grasp or understand.

[3] The Government of Malawi's Forestry Policy of 1996 and 1997 empowers local communities to participate in managing government owned forests.

2.0 Changes in Climate

Using a number of studies conducted around the MMFR, we have attempted to assess the local communities' understanding of climate, and the cause and impact of climate change in their area over time. We also looked at the availability of institutions and organisations offering assistance in mitigating climate change issues.

Some examples of the community's perception of climate change and impact are as follows:

C.M. Nansambo, 45, understands climate change as "the average weather conditions which chiefly depend upon temperature and rainfall".

H. Manyozo, 43, understands it to be "...the difference in weather conditions in a day or over a year and influencing seasonal rainfall patterns and temperature levels. These changes often times lead to droughts and incessant rainfall, thereby affecting people's cropping patterns and agronomic calendars. The changes also affect people's health as evidenced by widespread diseases such as malaria and high blood pressure".

Mussa Chakanja, 56, with 20 years forest experience, says, "The presence of mosquitoes at high altitudes on Mount Mulanje (over 1,800m) is enough evidence that temperatures have drastically increased, favouring breeding of mosquitoes that cause malaria. From what I can remember, Mulanje district was a mosquito-free area, but this is no longer the case."

Malawi's experiences with climate-related disasters are often traced back to the 1991–92 drought in southern Africa that affected over 6.1 million people (Action Aid Report, 2006). In 1991, the Mulanje and Phalombe districts experienced continuous rain on Mount Mulanje and Michesi, which led to flash floods across nine villages when, destroying life and property. This was followed by a number of droughts and extremely poor crop harvests. The worst of these droughts occurred in 2005.

Although they seemed to lack an explicit awareness of climate change, locals still identified changed in the largely unpredictable rains and the shifting onset of the first planting rains.

R. Seveni, 50, recalls that "from January to June every year, there were heavy rains in Mulanje and the hot dry season started in August and last until October when the first rains, known as Chizimalupsya (the fire extinguisher), started. Chizimalupsya no longer precedes the main rains because the rainy season starts late, sometimes as late as December. June and July were extremely cold months with frequent fogs, but it is now difficult to tell the cold and hot seasons apart. Many rivers coming from Mount Mulanje had large pools and never used to dry. Now they frequently dry up as early as June".

2.1 Indicators of change – temperature and rainfall

There are people that believe that climate change is real and has arrived in Mulanje. The flash floods of 1991 in Phalombe still linger in people's minds.

T.A. Mkhumba, local elder: "*Why from nowhere did these rains come like that, raining for three consecutive days and nights without stopping? What other sign do you need to see to appreciate that this is as a result of changing weather?"*

Recent observations of the local weather have also triggered reactions. Temperature data from the Mimosa Tea Research Foundation[4] show a steady increase in maximum and minimum temperatures over the past twenty years (see Figure 2). From 1963–1986, the average maximum temperature hovered around 28.5^{0}C. The period between 1986 and 2006 saw an increase of over 1^0 C, with an average maximum temperature of 30.0^{0}C. The minimum temperatures have shifted to a similar degree over the same period.

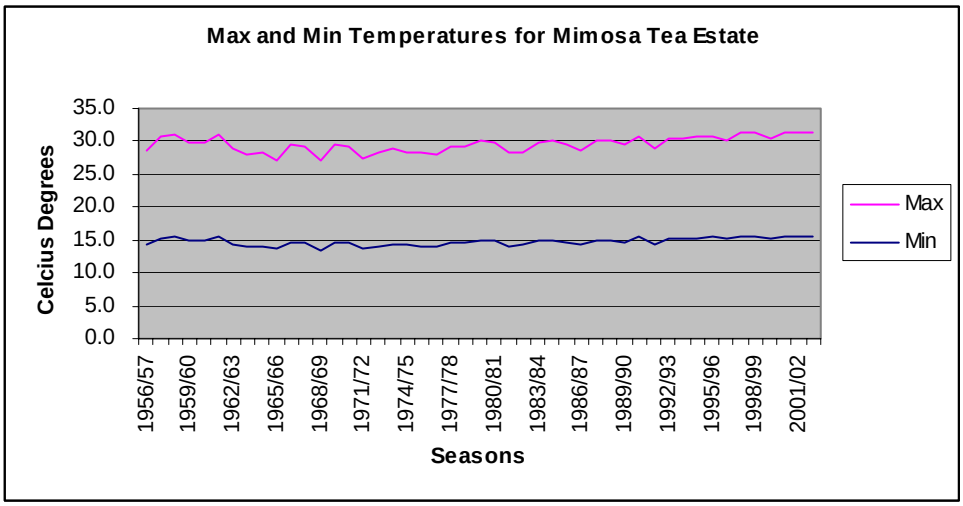

Figure 2: Maximum and minimum temperatures for the Mimosa Tea Estate
Source: Mimosa Tea Research Foundation

These temperature increases and the erratic rainfalls (see Figure 3) in Mulanje over the past two decades are used as evidence both locally and nationally of the arrival of climate change.

[4] The Mimosa Tea Research Foundation is a research station that collects climatic data and covers much of the case study area.

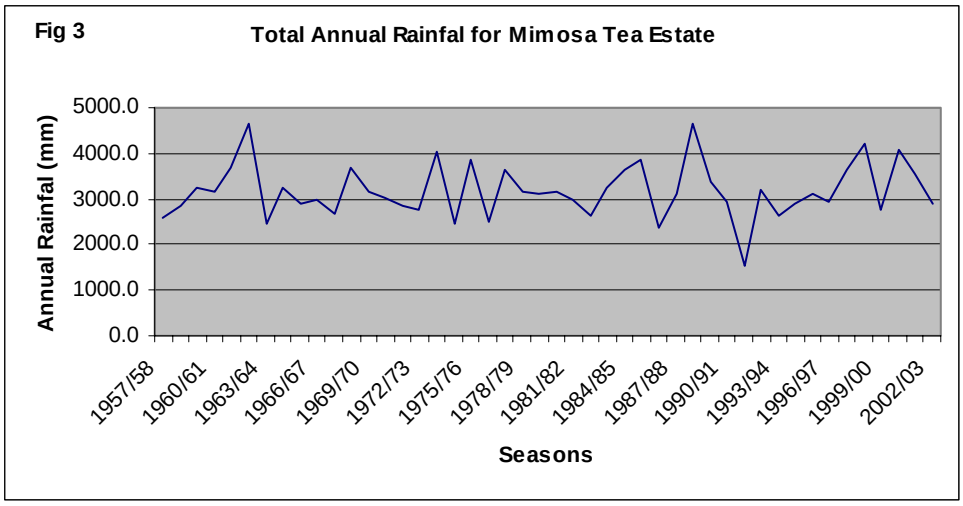

Figure 3: Total annual rainfall for the Mimosa Tea Estate
Source: Mimosa Tea Research Foundation

3.0 Changes in resources

3.1 Water

We found that the rural communities in our study area do not rely on the government to provide water for drinking and irrigation. In the past, villagers have dug wells and tapped the water table. Over time, however, the wells have dried up, and the people have turned to the rivers for water. But the rivers no longer flow reliably, as depicted in Figure 4.

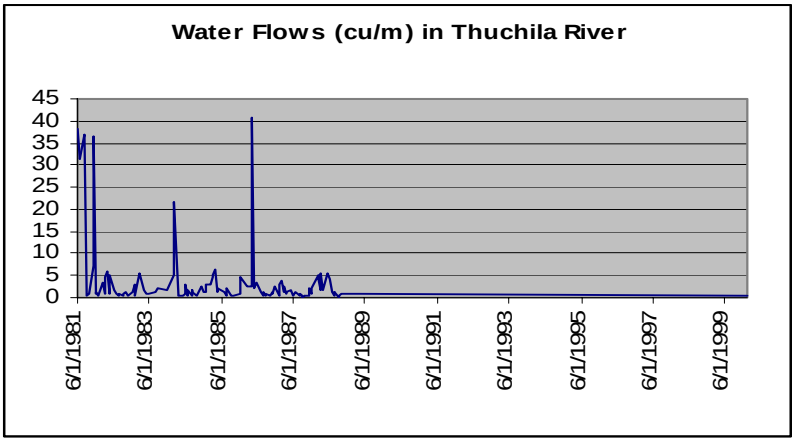

Figure 4: Water flow in the Thuchila River

The graph above depicts annual average flow of water in the Thuchila River between 1981 and 1999.

The above rainfall chart is deficient in many ways, with gaps due to irregular meter recordings, and a virtual non-recording period between 1989 and 1999. However, the first segment does depict flow irregularity, with abnormal peaks every three or so years. This is only partly due to seasonal fluctuations. These peaks are not

conclusive evidence of climate change, but it is important to note that in most cases, these peaks have followed on from a drought year. For instance, Malawi experienced a severe drought in 1980–81 and another four years later in 1985, which was followed by heavy rainfall in 1986.

An important lesson to draw from this data is that data collection on the rivers flowing from the mountain reserve is inadequate. This is in part due to a lack of people to carry out regular data collection and a lack of metering devices on the rivers. We believe it is possible to involve the communities in data collection but it necessary to install meters.

3.2 Land

An estimated 63% of the total land area in the Mulanje district is used for agriculture. Approximately 70% of this is used for subsistence farming and 30% is used commercially, mostly for tea plantations.

Forests, discounting the Mulanje Mountain Forest Reserve, occupy less than 1% of the total land area. Residential areas occupy 12% (16,563 hectares) of the total land area and the population continues to rise.

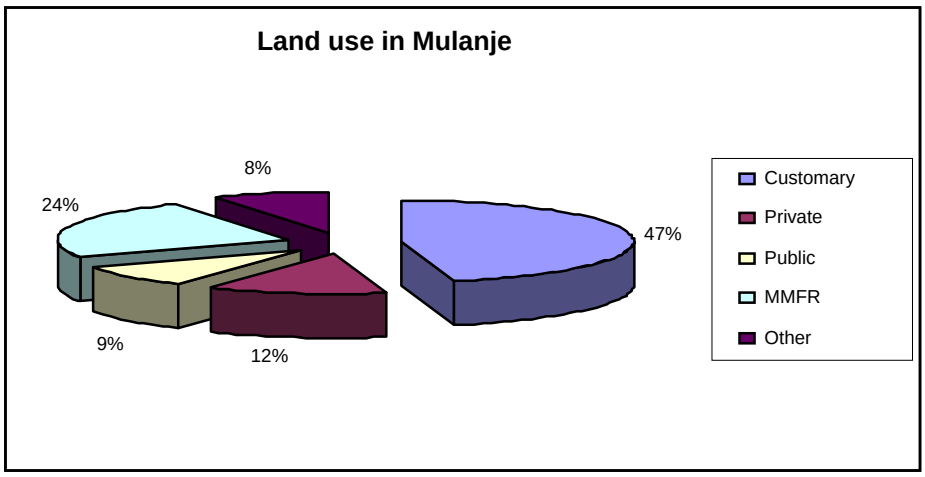

Figure 5: Land use in Mulanje
Source: Mulanje District Socio-economic Profile, 2002

Because of the rapid population increase, demand for land and resources is increasing, forcing some communities to encroach into the MMFR. Anecdotally, the MMFR boundary has receded more than seven times since its establishment in 1927.

Despite this, the MMFR is still regarded as an important landmark that supports life and regulates temperature and rainfall patterns in the district. The MMFR was established partly to protect the water catchments.

3.3 Forests and energy needs

Energy needs and the demand for bio-fuel are major threats to the district's forests. The 1999 State of the Environment report sites deforestation as the major environmental problem facing Malawi, with about 3% of forest lost every year. Although this figure is declining, this is because there is not much forest left to clear.

Wood is the most commonly used source of energy among the rural poor in Mulanje. Women collect firewood in the village, along river banks, in estate plantations and in the forest reserve for domestic use. Both women and men (especially those affected by the drought in 2005) collect some wood to sell to urban dwellers. The market for wood is strong in cities where hydro-power is neither reliable nor cheap, and improved road access to Mulanje from the near-by Blantyre city makes selling wood easier.

Firewood sellers prefer to collect wood from the forest reserve, since buyers demand the superior quality of indigenous miombo wood. Domestic needs are met with virtually anything flammable, such as bamboo, eucalyptus twigs, tea prunes, pigeon pea stems and maize stalks.

Although not a traditional livelihood or energy source in Mulanje, charcoal production is becoming widespread due to the increasing demand from cities like Blantyre and Limbe. Figure 6 shows the increase in the number of people joining the charcoal business. Charcoal production has become a major threat to the MMFR and other forests in term of deforestation.

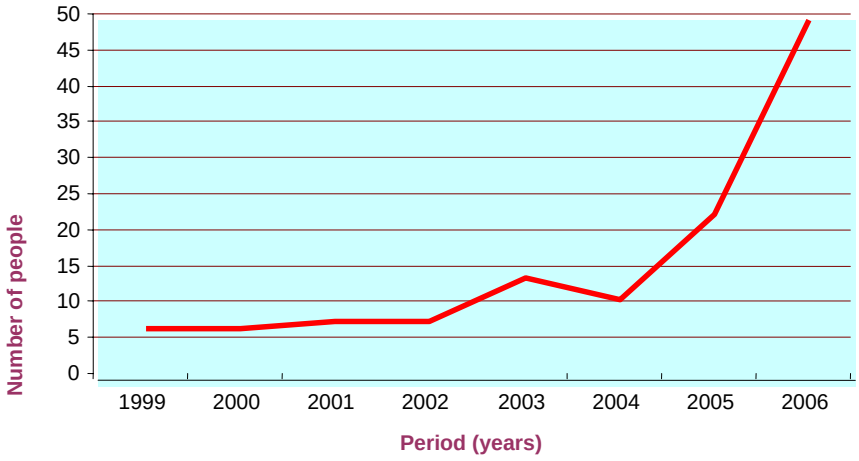

Figure 6: Number of people joining charcoal business each year
Source: Charcoal Survey, 2007

4.0 Adaptations in resource management and dependence

The communities of Mulanje are aware that instead of a seven month rainy season (October–April), they should now expect a shorter season starting in December and ending around March (approximately four months). Several examples of adaptation and resilience to this change in the climate follow.

4.1 The T/A Njema Community-based Irrigation Project

The T/A Njema Community-based Irrigation Project[5] started as an effort by one farmer to divert water from the Nanchidwa River into his fish ponds and the small vegetable gardens surrounding the ponds. His success convinced other members of the community to imitate his efforts, but soon the water supply in the canal could no longer provide the much needed water into their fields.

A village committee sought external support to build a strong and bigger structure (a weir) to assist in diverting the water, and also improve on the irrigation canal. Today, these communities are happily irrigating a larger piece of land and generating income from off-season crop sales and fish production in 45 fish farms.

(a) Weir cross-section

(b) Weir outlet from the gate

(c) Canal to be completed

(d) A field ready for second planting

(e) Irrigated field with Bean crop

Figure 7: Irrigation structures at Njema

[5] A community-initiated project that is supported with funds from the American Ambassador's Development Fund and implemented in partnership with the Mulanje Mountain Conservation Trust (MMCT).

4.2 The Chisongoli Catchment and Watershed Management Project

The Chisongoli Catchment and Watershed Management Project[6], also in T/A came about after the Mulanje Mountain Conservation Trust and COMPASS realised that people were encroaching into the reserve and destroying the forest ecosystem and jeopardising water for people down-stream.

Funded by the Unites States Agency for International Development (USAID) and the Coca-Cola company, this project helps communities around the T/A Njema area to withdraw from forest reserve and gain employment in other areas such as tea growing. The tea industry has committed to helping these individuals establish small-scale tea farms by donating tea seedlings and supporting other agronomic activities.

4.3 Changes in crop choice and farming techniques

Communities in Mulanje have responded to rainfall unpredictability by employing intercropping and relay cropping as farming techniques. Farming households are often planting a minimum of two crops in their gardens, including cereals, legumes, pulses and tuber or root crops. Fast-maturing pigeon peas, which fix nitrogen and are a source of protein, are commonly used in intercropping and are grown as a cash crop in the district.

There is, however, potential for loss of genetic resources with these adaptations. Because most farmers prefer fast-maturing varieties of crops such as maize, pigeon peas, cow peas and sweet potatoes, more traditional crop varieties are grown less and less. Nkanda, a woman traditional authority in the region, observes that nowadays not many people grow groundnuts because the rains are not favourable for the crop. The same applies to other leguminous crops such as cow peas (the local, late-maturing varieties) and sorghum, which mature very late in the season and require adequate rainfall. It is no longer possible to grow late season crops such as pulses and ground beans because a farmer cannot guarantee the crop will mature before the rains end.

4.4 The Mkhumba Boundary Communities Livelihoods Improvement Project

The objective of the Mkhumba Boundary Communities Livelihoods Improvement Project in Phalombe (a drier area of the MMFR) is to improve the lives of impoverished communities in the Phalombe district who live close to and interact with the MMFR, while at the same time encouraging the sustainable management of the reserve's natural resources and the survival of its biodiversity.

Because T/A Mkhumba is predominantly an agricultural area and most people's livelihoods dependent on farming, trading or processing of farm produce, the project

[6] A community-based project initiated to rehabilitate and protect the Chisongoli Forest and maintain its ecosystem function of watershed protection, supported by the USAID and Coca-Cola through COMPASS.

focuses on agricultural adaptation. The project assists farmers to use wetlands (dambos), small-scale irrigation and drought-sensitive crops to improve their harvests. The emphasis is on supplementing their household incomes rather than simply food production and food security.

4.5 Biomass energy conservation – a public private partnership programme

The constant demand for energy for activities such as cooking has put pressure on natural energy sources. Firewood in particular is becoming harder to find and locals must search further afield for it. In T/A Mabuka, eighteen stove producer groups from Nkuta and neighbouring villages have partnered with the Lujeri Tea Estates Company, in collaboration with IFSP/GTZ-ProBEC[7], in a project to conserve biomass energy.

The Public Private Partnership Programme (PPP) encourages people to switch from cooking on an open fireplace, which consumes a lot of firewood, to cooking on a low-cost, energy-saving stove called 'Chitetezo Mbaula', which translates as 'protective stove'.

The protective stove uses less firewood than an open fireplace because it produces more heat energy and less smoke from the same amount of wood. Not only does this save the user money, but also offers a healthier, smoke-free alternative to an open fire. In addition, the stove runs on any form of fuel available around the home, such as cassava stems, tea stems, pigeon peas stems and maize stalks.

Table 1: The benefits of a 'Chitetezo Mbaula' clay stove versus an open fireplace

Open fireplace	**Clay stove/ Chitetezo Mbaula**
Produces too much smoke	Fire burns with little smoke
The flame is uncontrolled; user has difficulty accessing the pot	Flames confined within the stove and hitting pot directly; user can access pot easily
Produces a lot of soot	Produces little soot
Setting up the fire requires 9 pieces of firewood	Setting up the fire requires 4 pieces of firewood
The entire cooking process requires 12 pieces of firewood	The entire cooking process requires 8 pieces of firewood (a total saving of 4 sticks)

[7] IFSP/GTZ-ProBEC is an integrated food security project funded by the German Technical Co-operation and has incorporated biomass energy conservation initiatives.

Figure 11: The economics of using a clay stove versus an open fireplace

In Mulanje, firewood is normally sold in sticks at market places such as the Thuchila trading centre (see photo).

1 stick of firewood costs 13-14 Malawi Kwacha (MK) (US$0.10)

Assuming an average price of MK13 per stick, the economy works out as follows:

Saving per meal (only 8 sticks instead of 12) = a saving of 4 sticks (MK 52)
Saving per day (with two meals per day) = a saving of 8 sticks (MK 104)
Saving per month (30 days) = 30 x MK104 = MK3120

A 'Chitetezo Mbaula' clay stove costs only (as of June, 2007) MK150–200

Adapted from ProBEC, 2004 report

5.0 Roles of local institutions

Initiatives to conserve the MMFR started in 1927 when the reserve was established. In 2002, the Global Environmental Facility, via the World Bank, funded a biodiversity conservation project to protect the natural heritage of the MMFR and prevent the extinction of its biodiversity. The Mulanje Mountain Conservation Trust (MMCT) was established to manage the reserve, in partnership with Malawi's forestry department, in a professional and transparent manner, and in a way where everyone benefits equally. Table 2 shows the changes in management strategies of the MMFR after the establishment of the Mulanje Mountain Conservation Trust.

Table 2: Changes in management strategies of the MMFR

Before establishment of the MMCT	**Under management of the MMCT**
Centralized and government controlled	Decentralised and open to NGOs, communities and private sector involvement
Focus on forest and water catchment protection	Focus moves towards ecosystem and biodiversity conservation
Restricted resource use by local communities through licensing and quota system	Resource sharing and ownership with focus on value adding
Policy of exclusion	Policy of inclusion through co-management arrangements

In addition to the MMCT, local stakeholders also play a role in protecting the forest reserve. The national Forestry Policy (1996) calls for individuals, community groups and private partners to participate in managing forest reserves and they do so by establishing and managing woodlots and forests in customary and private land.

In particular, the fifteen villages situated within 5–7 km of the MMFR boundary have established natural resources management committees to manage the reserve as well as address their own social needs. These committees spearhead environmental and natural resources development programmes, establish by-laws and engage the wider community in managing the reserve.

Despite these successes, interaction with the government on forest issues still remains a challenge. Locals reported to us that some arms of the government do not take forest management regulations seriously and do not enforce laws regarding the reserve. People committing illegal, forest-related offences are not punished appropriately and as such, there is little deterrent to other would-be offenders. Some communities have expressed reluctance to engage in forest protection and management if their investments are not properly protected.

On the whole though, MMFR initiatives appear to have been successful, with community members engaging in projects and initiatives, many with tangible results.

6.0 Conclusions

The importance of local climate change mitigation initiatives lies not only in their direct effects, but also in the lessons we can draw from them. In the course of our case study we looked at impacts of these initiatives on livelihoods and in addressing climate change challenges. In the following section we discuss issues that came up and make recommendations for improvement.

Addressing water supply and management in agriculture
Both the T/A Njema Community-based Irrigation Project and Chisongoli Catchment and Watershed Management Project projects show that an important focus for climate change mitigation is agriculture; specifically, addressing problems of water supply and management. From these two projects we can learn that individuals can initiate useful projects, but it is only through collective effort that a project can attract external support and achieve greater goals.

We believe there is need to increase local knowledge about water harvesting and irrigation systems so that farmers can reduce their dependency on rain water for irrigation and increase their crop production. There must be an effort to identify techniques for using rivers and streams more effectively. We believe it crucial that the focus of any initiative should not just be creating a hunger-free community, but also promoting enterprise within the community. Engaging communities in farm enterprises will also reduce their reliance on forest resources for income.

Determining river flows
In the course of our research we found that although people's livelihoods are dependent on reliable and sustainable water flows in the river systems, there is currently no reliable data or ongoing monitoring to determine river flows and the

amount of water that can be expected at particular times of the year. We believe the government water department must receive assistance in installing water gauging facilities in the most important rivers and in building local capacity in villages to routinely collect the data. Water department officials can then assemble this information for analysis and distribution.

Protecting traditional and wild crop varieties
The revelation that communities are increasingly adopting fast-maturing crop varieties bred at research stations should provide a wake-up call for all concerned. Fast-maturing varieties provide a short-term solution to hunger, but potential losses from the crop gene pool should not be underestimated. We believe that traditional crops and their wild relatives must be protected.

The Chitedze Seed Bank in Lilongwe could provide a solution to this problem, but it must cast its net wide to capture all plant genetic material for preservation purposes. Farming communities should also be encouraged to maintain these crop varieties. This could be done by providing appropriate extension messages that directly address conservation needs while also promoting climate change mitigation.

We believe that the impact of climate change on agricultural production can be minimised if different regions work together to address common concerns. Government and institutions must build on their technical capacity to assist small-scale farmers in adapting to climate change, and disseminate appropriate information.

Decentralising climate change mitigation
We believe further decentralisation of the response to climate change mitigation should occur. Projects can only address the real concerns of the people when there is a full understanding of the local situation. In addition, communities and individuals are best placed to identify and address their problems and challenges, and are often the best catalysts for change. We have observed that collective action can better be harnessed at the district level.

Developing enterprises based on forest resources
We believe there are untapped opportunities to develop non-timber, forest-based resources and products, particularly those that can be harvested without environmental damage (such as bee keeping). We acknowledge that it is difficult to develop natural resource enterprises that do not yet have a viable and existing market, and so recommend that they should be promoted as providing a supplementary income. By promoting non-timber forest resources, we believe it is possible to reduce the pressure on forest reserves, promote forest regeneration and potentially mitigate climate change. In addition, when communities realise better returns from managing the forest reserves, they will be more likely to enforce the law to protect the forests rather than expecting the government to do it for them.

Stopping the illegal charcoal trade
Lastly, our case study has demonstrated that private-public partnerships (see section 4.5, encouraging the use of energy-efficient clay stoves) to mitigate climate change do work and should be promoted. However, issues such as the increase in charcoal trading dilute the impact of such projects, as well threatening Malawi's forests. We

believe it will require a concerted effort from all sectors of society to stop illegal charcoal dealing.

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