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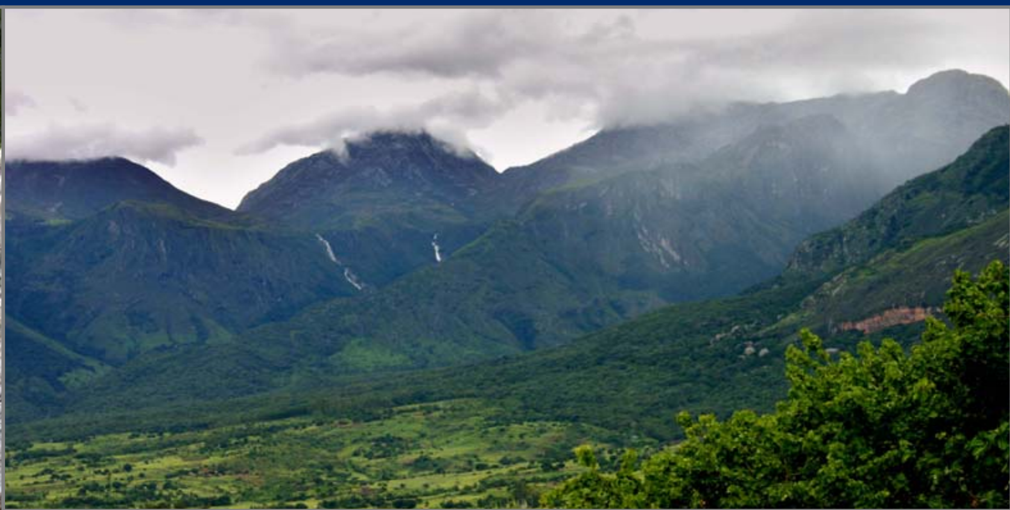
VALUING THE RESOURCES OF MULANJE MOUNTAIN

STUDY DESIGN

OCCASIONAL PAPER NO. 9

COMMUNITY PARTNERSHIPS FOR SUSTAINABLE RESOURCE MANAGEMENT (COMPASS II)



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VALUING THE RESOURCES OF MULANJE MOUNTAIN: STUDY DESIGN

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LIST OF ACRONYMS

COMPASS	Community Partnerships for Sustainable Resource Management
DAI	Development Alternatives, Inc.
EMP	Environmental Management Programme
GDP	Gross Domestic Product
GIS	Geographic Information System
GTZ	German Technical Assistance
IHS	Integrated Household Survey
MMCT	Mount Mulanje Conservation Trust
NSO	National Statistical Office
PLUS	Public Land Use Study
SRWB	Southern Regional Water Board
TAM	Tea Association of Malawi
TEV	Total Economic Value

PREFACE

Development Alternatives Inc. (DAI) was contracted by the United States Agency for International Development (USAID)/Malawi to implement the second phase of the Community Partnerships for Sustainable Resource Management (COMPASS II) under Contract # 690-C-00-04-00090-00. USAID and DAI signed the contract on April 30, 2004 with effective dates of May 1, 2004 to March 31, 2009.

The contract engages DAI and its implementing partners[1] to assist USAID/Malawi in achieving progress toward the Strategic Objective of sustainable increases in rural income, and specifically the Intermediate Result of household revenue from community-based natural resources management activities increased.

The purpose of COMPASS II is to enhance household revenue from participation in community-based natural resource management (CBNRM) initiatives that generate income as well as provide incentives for sustainable resource use in Malawi. This is part of a strategy to mainstream community-based management of natural resources within a transformational development framework that progresses toward eventual graduation from developmental foreign aid, one of the USAID global operational goals for broad-based prosperity in stable, democratic countries such as Malawi. Building on solid foundations from previous investments by USAID and others of increased capacity among Malawian government and nongovernmental organizations to adopt strategies that ensure long-term economic and environmental sustainability, COMPASS II seek to accomplish three objectives:

1. To increase the decentralization of natural resource management,
2. To enhance rural communities' capacity to sustainably manage their natural resources, and
3. To increase sales of natural resource-based products by rural households.

Achievement of progress toward these objectives requires a multi-faceted approach toward devolving authority and responsibility to manage natural resources to field levels, facilitating the acquisition of skills and tools to dispatch that authority responsibly, and profiting from sustainable utilization of those natural resources as an incentive to manage the natural capital assets sustainably.

One way that the COMPASS II implementation team is working toward achieving these objectives is to build awareness among a wide range of CBNRM stakeholders about the opportunities that improved management of natural resources by communities could provide toward economic growth in Malawi. The CBNRM Occasional Paper series makes better information more widely available, highlighting some of the evolution in thinking among CBNRM practitioners in Malawi and throughout southern Africa. The series is intended to provide up-to-date information about various aspects of CBNRM, and promote wider discussions about the different approaches to field practice. It is hoped that by providing current information to audiences that may not otherwise have access to technical reports, and by stimulating discussions, practitioners in the region and beyond may be able to contribute to further improvements.

This document is the 9th in the Occasional Paper series. It provides an overview of the first phase of an extensive study being undertaken to determine the economic value of one of Malawi's critical ecosystems: Mulanje Mountain. The study, once completed, will provide valuable information to resource managers and others about the likely economic impacts of different management scenarios. To our knowledge, this is the first attempt in Malawi to conduct such an economic valuation exercise on an entire ecosystem. The author—Dr. Joy Hecht—has extensive experience in the field of economic valuation of natural resources, including non-traditional resources such as the existence value of biodiversity.

Please feel free to send comments on this title in the Occasional Paper series, or request additional copies, through the COMPASS II offices in Blantyre, or by email to compass2@dai.com.

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[1] Wildlife & Environmental Society of Malawi, Kadale Consultants, Ltd., and Spectrum Media

1. INTRODUCTION

The resources provided by Malawi's Mount Mulanje are under threat. This area of unique biodiversity and endemic species is being encroached upon by cultivators, harvesters of timber, charcoal-makers, fire-setting hunters, and, according to some, even staff of the Forest Department responsible for its sustainable management. 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, most importantly, pure clean water from its many rivers and streams. If the encroachment is not stopped, all of the other services will be stopped, to the detriment of those who live in Mulanje and Phalombe Districts. The cost of replacing those services is likely to be much greater than the costs of preventing encroachment, and the benefits reaped in the short run by those responsible for encroachment are likely to be far lower than the benefits of sustainable use of the mountain.

This paper presents the design of a study to actually estimate the value of the mountain's services, to permit rigorous comparison of the costs and benefits of alternate management scenarios in the region. It is the result of a three-week mission to Malawi conducted in June and July 2005. The mission was spent gathering basic information about the uses of and threats to the mountain, developing a framework for their valuation, identifying (insofar as possible) data sources that could be used to complete that framework, and mapping out a time frame and staffing needs. The study is to be implemented in a subsequent mission to Malawi, probably to be conducted in late 2005 or early 2006.

2. FRAMEWORK FOR ASSESSMENT

Many studies have reviewed the range of activities that actually or potentially could depend in full or in part on the resources of the mountain. For the most part the motivation for these studies has been to identify activities that could be introduced (or expanded) in the region that might both increase incomes of the poorest groups and induce them to reduce the pressure they place on the mountain's resources. This is motivated by a dual objective; the desire to conserve the Mulanje cedar and other elements of the mountain's biodiversity, and the desire to improve well-being in the surrounding area. The former objective may be the dominating one for some stakeholders, but it is clear to everyone involved that biodiversity conservation cannot occur at the expense of local groups, and will be much more effective if at the same time – or as a result – local groups are better off.

This report takes a somewhat different perspective. The proposed study aims to undertake two related tasks. First, it will estimate the monetary value of the services now derived from the mountain, and to assess how that contribution would change under several alternate management scenarios. The mountain provides both marketed and non-marketed benefits, and the study will consider both of them, estimating values for non-marketed services in accordance with methodologies developed in the environmental economics literature.

Second, it will consider whether "user pays principle" – a fairly recent alternative to the familiar polluter pays principle – can usefully be applied to raise funds with which to conserve the mountain's resources.[2]

- In looking at the economic value of the mountain, we must consider the scale of our analysis. Four distinct scales could be relevant to consideration of Mount Mulanje:
- The forest reserve. This is the area whose value we are trying to estimate; it is where the degradation is occurring and endemic species still survive. Hardly anyone lives in the reserve and even fewer live there legally, but many people engage in economic activities here.
- The immediate mountain region; this is the area from which people will walk to the mountain to gather resources, and is the area that the Mount Mulanje Conservation Trust (MMCT) uses to define its scope. People who live in this region comprise most of the direct users of resources from the mountain. They also cause much of the degradation of the mountain, through unsustainable harvesting practices; therefore in addition to being users, they are potential protectors of the resources. This region includes the tea estates, plantation forests owned and managed by the Forest Department, and plantation forests owned and managed by the tea estates. The exact boundaries of this region will have to be determined in early stages of the study.
- The larger region that uses water from the mountain, through gravity-fed systems or directly from rivers and dambos (riverbanks). People in this region are, for the most part, users of mountain resources (particularly water) but not directly degrading the forests through their actions. The area supplied with water from the mountain will be determined at the start of the study. This area will be delimited based on the location of gravity-fed drinking water systems; it will not extend to more distant users of the rivers, nor will it include users of Lake Chilwa. Although those more distant users may be affected by water issues on the mountain, they are also affected by other water systems beyond the scope of this study. The extent of gravity-fed water supply therefore offers a clear-cut way to define the area of our interest.
- The country as a whole. This includes users of resources such as charcoal, ecotourism services, and minerals if they were to be exploited.

In considering the impacts of different management scenarios and whether users can pay to protect the resources, we must take into consideration not only how much the value of the mountain is, but who receives that value. For two reasons, benefits to residents of the mountain region will be more important than benefits to others. First, it is mountain region residents who are in a position to protect the resources; since protection is one of the goal of mountain management (as opposed to maximizing its total economic value), then benefits that will further that goal are crucial. Second, improving the livelihoods of poor rural communities is one of our goals, both directly and because with improved livelihoods they may be less likely to degrade the mountain. Again, this suggests that we must give priority to benefits that accrue to residents of the mountain region over benefits that accrue elsewhere in

[2] See, for example, Winrock (2004) and Landell-Mills and Porras (2002).

Mulanje and Phalombe or elsewhere in the country. In carrying out the study, we will therefore distinguish values of the mountain according to which of these population groups and geographic areas is affected.

3. TASK 1: VALUING THE MOUNTAIN BASED ON ALTERNATE RESOURCE USE SCENARIOS

The study will consider several different, incompatible approaches to managing the resources on the mountain. The baseline for the work will be identification and valuation of current uses of the mountain. Using a variety of data sources and methods, we will determine which resources are being used from the mountain, the quantity being used, and the monetary value of those resources. We will also consider who receives these benefits, since our primary concern is with low-income local residents, rather than urban dwellers or foreign investors.

3.1 Introduction to Valuation

3.1.1 Conceptual issues

Assigning an economic value to the goods and services of the mountain will be a key and sensitive element of this task, and therefore warrants a brief introduction.[3] Conceptually, what we do when we put an economic value on a particular environmental asset such as the Mulanje forest is to identify each of the individual services it provides, place a value on it, and then add up the values to calculate the total value of the forest. Using some services of the forest may preclude using others, however. For example, if the Mulanje forest is cut down for timber, it will no longer provide habitat for wild plants and animals or protect the gravity-fed water supply of the region below it. Our total value must be for the forest as used for a specified set of goods and services that are compatible with each other; hence the consideration of several different scenarios when we value the Mulanje forest.

We must ask, though, what we mean by the economic value of an environmental resource like a mountain. This could be answered in several different ways:

- Market value of the goods and services provided by the mountain – the price times the quantity sold (or used, in the case of non-marketed resources). This means we must estimate what the price would be for items that are not actually paid for; the field of valuation offers several methods for doing this, discussed below.
- For some analytical purposes, such as comparing the financial returns to alternate strategies, we are interested not in market price, but in price less input costs. This is not typically the amount estimated in valuation studies, but it may be important for our purposes.
- How much people would be willing to pay for the goods and services if they had to. This differs from what the price would be, because some people would actually be willing to pay more than the market price, while others – ones who do not buy the item – would not be willing to pay that much.
- Contribution of the mountain to the country's gross domestic product (GDP) or to the equivalent regional product. This is a much more complex value to estimate, especially if we want to know what total GDP would be with and without the resource, rather than simply knowing what the resource contributes without knowing the total GDP. It involves tracking all uses of the resource, for final consumption and as an input into production of other goods or services. It also involves identifying the impact of resource use on household incomes (through employment, say, on tea plantations), how those incomes are spent, the impact of those expenditures on incomes elsewhere in the region, and so on. (Economists call these multiplier effects.) This kind of analysis will be beyond the scope of this study.
- Employment directly created through different scenarios for resource use.

This study will focus on the market value of the mountain's products and, to a lesser extent, on the input costs of each product and the employment it creates.

In considering the market value of products, it is important to distinguish between stocks and flows – that is, the value of the mountain itself as an asset or stock, and the value of the flow of services provided each year by the mountain. The distinction between stocks and flows is easily understood for timber, though we could make the distinction for each of the goods and services provided by the mountain. The

[3] This discussion of valuation methods is based on the introduction to Hecht, ed., 1999.

forest could be seen as a productive asset from which some number of trees can be sustainably harvested each year for timber without reducing the productivity of the asset in future years. The sale price of sustainably harvested trees would be the value of the flow of services from the timber asset. Alternately, the timber in the whole forest could be given a value; this might be the price of the forest as a whole if the right to cut it down were sold. The stock and flow values are related; in a theoretically efficient market, the value of the stock equals the net present value of the income stream which would result from its sustainable management. The Mulanje forests can be valued in either stock or flow terms, depending on what is most useful for the analysis. What is essential, however, is that when comparing different management systems or summing the values of different services, they are in the same terms, so that we don't find ourselves comparing stocks of one service with flows of another.

3.1.2 What are we valuing?

Economists have organized the services of the environment into a standard presentation in developing a framework for valuation. The point of departure is that we want to estimate the total economic value (TEV) of an environmental asset. TEV is broken down into use values and non-use values:

TEV = use value + non-use value

"Use values" are clearly identifiable human uses of the environment. This includes direct use of raw materials, both of marketed products such as timber and of non-marketed products such as gathered fuelwood, water extraction, soil, and so on. It also includes so-called "indirect uses" of the environment, such as ecotourism, scenic vistas, protection against erosion or floods, protection of the quantity and quality of the water supply, and so on. By and large the indirect uses are not marketed, though access to protected areas is a notable exception. Thus:

use value = direct use value + indirect use value

"Non-use values" of the environment capture our willingness to pay simply to know that the resource will continue to exist, even though we have no expectation of using it or even seeing it in the future. For example, some people are willing to pay to help ensure the existence of elephants in parts of Africa. This is termed existence value. A related form of non-use value is termed option value; this would be the willingness to pay for the option to come see the elephants someday. Some economists also identify what they call quasi-option value. This is the expectation that the value of the option will increase over time, as the elephants (or other environmental goods or services) become scarcer. Yet another non-use value is bequest value; in this example, it would be the willingness to pay to ensure that future generations would be able to see the elephants. Thus:

non-use value = existence value + option value + quasi-option value + bequest value,

and to sum up:

TEV = direct use value + indirect use value + existence value + option value + quasi-option value + bequest value.

The table below lists the goods and services that are – or might be – obtained from the Mulanje forests:

Table 1: Total Economic Values of a Mulanje Forests

Direct uses	Indirect uses	Option Values	Existence Values
Timber Poles Thatch Bamboo Wild plants Hunted animals Medicines	Ecotourism Watershed protection; ensuring quantity and quality of water supply Prevention of erosion, siltation, and landslides Carbon fixation	Future direct & indirect uses.	Willingness of outsiders to support protection of the forests. This is not likely to be significant for Mulanje.

This study will focus on direct and indirect uses; option and existence values are not likely to be as significant for Mulanje.

3.1.3 Valuation methods

Economists have developed many methods for valuing the non-marketed services of the environment. No one method is suited to all services, meets all theoretical criteria, or can always be applied with readily available data. Rather, it is necessary to choose among methods for each service, based on what is appropriate and feasible. One set of valuation techniques depends on using market data for related products to estimate a price for environmental goods and services. These techniques include dose-response analysis, consideration of defensive expenditures and substitute goods, travel demand analysis and hedonic pricing.

Dose response: The dose-response method, borrowed from medical analyses of the health impact of increasing levels of medicine, measures the impact on economic output or expenditure of increasing environmental degradation. It is typically used to estimate the impact on agricultural output of increased pollution, soil erosion, or other incremental change. The decrease in the value of crop may be understood as a proxy for the costs of pollution or of farmers' willingness to pay to prevent it.

Defensive expenditures: Defensive expenditures are those made to protect against the impacts of environmental degradation. For example, the cost of boiling and filtering drinking water if it becomes polluted may be considered a defensive expenditure. These may be understood as a lower bound (or minimum estimate) on the cost of environmental harm and willingness to pay for preventing it.

Substitute goods: In some cases there is a private market for goods which are also available "free" from the natural environment. For example, in many areas people can either use their time to gather fuelwood, food, and medicinal plants, or they can use their money to purchase close (or identical) substitutes in local markets. The price in the local market is often used as a proxy for the value of the gathered resource. We are likely to use this approach to value many of the products of the Mulanje forests.

Travel demand: The travel demand method has been developed as a way to estimate willingness to pay for recreational amenities provided by the environment. It involves using data on distances traveled and expenditures for travel, and from there to estimate a demand curve for a specific national park or other natural site. From the demand curve, the analyst can estimate the actual willingness to pay for the recreation experience at the site. This may be useful for looking at the value of ecotourism in Mulanje; however it estimates tourists' willingness to pay for the experience, not the current returns to the region from ongoing tourism.

Hedonic pricing: Hedonic pricing techniques use regression analysis to determine the contributions of different characteristics of a good to its price. This technique has been refined in the analysis of housing markets. The price of properties is estimated as a function of their features; number of bedrooms, square footage, lot size, neighborhood characteristics, and so on. This method can be used to determine the contribution of a clean or quiet environment to the value of a home. It can also be used to identify the wage premium paid to workers in dangerous or polluted environments.

Another set of valuation techniques involves asking direct questions about preferences and willingness to pay for environmental goods and services. These techniques are generally referred to as contingent valuation methods. Interviewees are asked how much they are willing to pay for a given good or service or how much compensation they are willing to receive to tolerate it. In the contingent ranking method respondents are asked to rank several alternatives rather than directly expressing a willingness to pay or to accept.

The advantage of contingent valuation methods is that they provide information about exactly the question of interest rather than depending on proxy markets. The disadvantage, of course, lies in the unreliability of respondents' information about their own willingness to pay, either because they simply have no idea and find the survey confusing, or because they are lying in order to influence the study results in one way or another. In the Mulanje context, contingent valuation is likely to be too complex and too time-consuming; we are likely to rely insofar as possible on the prices of substitute goods in local markets to estimate the value of the goods and services provided by the mountain.

3.1.4 Estimating input costs

Although conventional valuation estimates market price rather than price net of input costs, for our purposes it will be useful to identify both. In a market economy this would be quite straightforward, because inputs to production are purchased. The net value of the item is therefore its market value less the cost of producing it.

In the Mulanje context this is more complex. The input costs may be of several types:

- Direct marketed costs of gathering goods, such as the costs of purchased tools to cut thatch or wood, or the cost of beehives. These costs may be borne either by the residents, as in the case of tools, or in some cases by donors, as in the case of honey projects where beehives are given to the participants rather than purchased. These costs may also be distinguished between investments and operating costs of the activity in question. It should be possible to identify these costs in calculation of the net value of mountain resources, as well as identifying whether they have been paid by donors or by those engaging in the activities.
- Direct time costs. Local residents put unpaid time into collecting fuelwood and thatch, engaging in agricultural activities, and so on. If they were employees, their time would have a marketed price, which would be factored into a financial analysis of the productive activity in question. In Mulanje this time is often unpaid. For some analytical purposes it would be of interest to assign a value to this time, possibly as a basis for estimating the value of the products being gathered. This is particularly appropriate where residents have the option of paid employment and are turning it down in order to allocate their time to gathering "free" goods. For our purposes, assigning a value to unpaid labor will not be useful. However, to the extent possible we will gather information about how much time is spent collecting each product, so the information will be available in the future if it is needed.
- Many schemes for improving rural livelihoods or conserving the forests involves significant resource commitments by donors, in the form of training, information sharing, market development, project design, and so on. From the perspective of the local resident these costs are unknown and irrelevant, but from a social perspective they are part of the costs of starting up new economic activities. Because this is not a cost-benefit analysis of the donor project, but is a valuation of the mountain, we will not deduct these costs when calculating net value of mountain resources.
- Some activities on the mountain involve commercial expenditures of capital and operating costs from the rest of the country. Manufacture of charcoal involves such expenditures. On a much larger scale, extraction of bauxite would requite massive investments, probably from an overseas mining corporation. It would also involve significant subsidies from the Malawi government in the form of tax rebates. Values estimated for the product of charcoal and bauxite mining will take into account the private costs; it may not take into account the government subsidies.

3.2 Current situation: the base case[4]

The current direct and indirect uses of the mountain include:

- Timber – cedar, eucalyptus, and pine
- Poles, thatch and other building materials
- Wood used to make tools and curios
- Fuelwood
- Wood and other plants used to make charcoal
- Wild fruits and vegetables
- Wild animals that are hunted
- Medicinal plants
- Water for drinking, sanitation, irrigation, power generation, and tea processing
- Tea, which depends on water from the mountain
- Honey – bees depend on forests to obtain pollen
- Tourism
- Conversion of forest land to agriculture

[4] More precise steps to be taken in carrying out the analytical work for the base case and the scenarios are set out in section 5 of this report.

For each of these, we will obtain the best information we can about the quantity being used and by whom. We will use market prices to value most products taken directly from the mountain for sale or consumption. Some of these activities are illegal, destructive to the forest, or both. To properly value the base case, we will have to obtain information about these as well. This will give us insights into how much practitioners of these activities can earn. This information will be essential when we consider other strategies for management of the mountain, because it will show us what the more sustainable activities have to compete with in order to wipe out the destructive ones. Obtaining data about illegal activities, in particular, may be difficult.

For water, we may use other valuation methods, since applying market prices may not be appropriate. Valuing water is tricky, because it plays several roles in the regional economy. Like fuelwood, foods, and other mountain products, it is directly consumed by end users. In addition, however, it is an input to other productive activities, including agriculture, tea cultivation, commercial businesses, and institutions such as the Mulanje hospital and local government offices. The water used as an input could be valued much as we value other products, based on its price. Alternately, we could look at the value of the items produced using the water – food for local consumption and sale, tea for export, health care, public services. However, the value of those final products is not due only to water; it is attributable to the full range of inputs used to produce them. There is no clear way to distinguish the contribution of water to the value of final output from the contributions of labor, land, and other inputs. There also is no clear way to put a monetary value on health care and public services, since these are not sold in markets either. Moreover, we want the value of water to be comparable to the values of other items, which it would not be if we expanded it to include the products it is used to produce.

For all of these reasons, we will treat water used as an input to production in the same way as we treat other mountain products, estimating the price that might be paid if it were sold in the market and using that as an estimate of its economic value. While this does not capture the role of water in the economic structure of the region, it is compatible with the method we will use to value other resources from the mountain, and can therefore be added to them to estimate TEV for the mountain.

Over time, the current uses will not all be compatible with each other. Hunters set fires, which destroy many of the other resources obtained from the forest. Degradation of the forest cover is likely to reduce both the quantity and quality of the water supply, which will impose costs on households and may make irrigated tea production impossible. In the present, these activities go on side by side, competing for resources from the forest. The alternate scenarios will embody choices among these activities, so we can assess how the value of the forest differs depending on which activities prevail in the future.

3.3 Scenario 1

The first scenario will project current use patterns into the future, assuming no major changes from the current management strategies. This can be done in several ways. First, we will project population into the future (or, more likely, obtain such projections from the National Statistical Office or another reliable source). These figures will be used to project increases in demand for forest resources, on the assumption that per capita demand will not change. Based on increased demand for each resource, including both those that can be sustainably harvested and those whose harvesting is destructive, we will project the impact of future harvesting on the resource base, in terms of degradation of land cover and soils. This will be represented spatially as projections of land cover on the top of the mountain, factoring in, to the extent possible, knowledge of where different kinds of degradation or encroachment have occurred in the past or are likely to occur in the future.

At the same time, we will extrapolate from the trends observed in land cover time series developed by the PLUS project and the MMCT environmental monitoring program (EMP), to project land future land cover assuming continuation of the patterns observed between 1984 and 2002 (and possibly updates to 2005). We will compare the results obtained this way with those from the population and demand projections, to see whether they are consistent with each other. If they are, that may be seen as confirmation that our estimates are in the right range. If they are not, we are likely to consider the projections based on population to be more reliable than those based on land cover.

We will then project the monetary value of the resources expected to be available in the future by multiplying price times quantity. Future prices will be based on extrapolations of the consumer price indices available from the National Statistics Office (NSO), and perhaps on cost of living estimates made by the Tea Association of Malawi in the process of setting wages for tea estate workers. Because the Tea Association of Malawi work is based specifically on Mulanje rather than on the whole country, these may be more reliable than the NSO consumer price indices.

3.4 Scenario 2

Note: *The second scenario could be included in this study if resources are available and if exploitation of Mulanje bauxite seems probable. However, given the need to limit the study to a manageable scope, it is likely that we will omit this scenario. It is included here for reference, but is not further developed in the sections below on data needs and study implementation.*

The second scenario will extend the first one with the introduction of the bauxite mining that has been under discussion for over a decade. It will take into account the impacts of mining on employment, local incomes, and the availability of resources from the mountain. Basic information about the impacts of bauxite extraction will come from the 1993 feasibility study conducted by MET-CHEM, a Canadian firm (MET-CHEM 1994). This will be supplemented with discussions with government officials to assess the likelihood of bauxite extraction becoming a reality. If any environmental groups are focusing on this issue, we will also take into account their assessment of the potential environmental and social impacts.

The MET-CHEM study suggests a number of ways in which bauxite extraction may affect the Mulanje region. The bauxite is located on the Lichenya plateau, which will over time be cut across with roads and much of the surface apparently disturbed. The study projects that the mine will be operational for at least twenty five years, and includes plans to restore the area after it closes. Over the period of its operation, use of the area for any other activities may be eliminated or at least severely constrained. Facilities to be constructed on top of the mountain include shops to wash and repair vehicles, to store petrol, and for electrical repairs; these could be sources of pollution to surface and ground water and to soil. The disturbance on the Lichenya Plateau will likely drive away remaining wild mammals and birds, and of course much plant life on the plateau is likely to be removed. The feasibility study indicates that sewage will be handled through septic systems on top of the mountain.

The feasibility study does not propose construction of a road up to the plateau, since this would be too disruptive to the environment. Instead, it suggests a four-kilometer aerial ropeway, which will be used to move people, equipment, and materials up and down the mountain. The impact of this on the slopes and at its base where items are loaded, unloaded, and moved in and out will have to be taken into consideration. If there are routes from the upper end of the ropeway to other parts of the mountain top, and if the ropeway may be used by people not affiliated with the mine, then this could change use patterns on the rest of the mountain. It could facilitate construction of tourist facilities elsewhere on the mountain and make it easier for tourists to visit the area, at least if the experience of going past the mine is not so unpleasant as to deter tourists altogether. It might also make it easier for local residents to come in to exploit other natural resources on the mountain, hastening the degradation of those areas.

A bauxite refinery and an alumina smelter are proposed for construction in the village of Ndala, across the road from Likhabula. Clearly a key question will be how many jobs this creates, the extent to which those jobs go to area residents vs. outsiders, and how much they pay. Other issues will concern the impacts of the plants on the land around them, water quality, air quality, and noise. Construction at the plant and the mine site is expected to take four to five years, after which there will presumably be a readjustment in employment needs which will also have to be taken into account. The feasibility study indicates that residences for the workers will be constructed in Mulanje and sewage handled through the local system, which will presumably mean no treatment.

The water need for mining, refining, and smelting will be a matter for consideration as well. The feasibility study estimates annual needs, and suggests that they will construct a reservoir on the Likhabula River to ensure a constant supply over the year. Total demand is just under two million cubic meters per year, which appears to be feasible given the mean flows that they report. To assess whether their water use is likely to put a strain on other users, we will have to obtain whatever water flow data are available, as well as data on other extractions from the Likhabula. Some water flow data have been collected by the Water Department over the past decades, but it is not clear whether they will be adequate for this assessment.

Based on our projection of environmental impacts of bauxite mining, we will make a second valuation of the resources available from the mountain in the future. Clearly the value of biological resources will drop, but this might be outweighed by the value of the bauxite and its impact on local employment and incomes, so the comparison between scenarios one and two will be informative.

3.5 Scenario 3

The third scenario will be the most interesting and the most difficult. It will project the value of the mountain if the forest resources are preserved better through implementation of many of the schemes now being developed by MMCT, COMPASS II, and other groups. The difficulty of this scenario is realistically to project the effectiveness of the different schemes and their impact on forest protection and resource availability. These schemes are basically of two types: those that require forest protection in order for participants to make money, and those that do not require forest protection but are expected to generate enough income for participants that they will no longer need to rely on forest resources for their livelihood. The first category includes the following (and perhaps others that have not yet been identified):

- Honey harvesting, to the extent that the bees depend on the forest reserve for pollen.
- Better management of thatch cultivation, to prevent early harvesting and fires
- Sustainable harvesting of wood products and building materials
- Eco-labeling for curios or other products from sustainably harvested wood, especially cedar
- Processing and marketing of gathered fruits and vegetables (mushrooms)
- Bioprospecting
- Ecotourism
- Livestock grazing in the forest reserve
- Sustainable hunting; whether this is realistic will have to be determined
- Bottled water; this has been mentioned, though no serious consideration of it has yet been identified

The second group, activities that could increase revenues but do not depend on sustainable management of the forest, now includes:

- Planting fruits, vegetables, small-holder tea, building materials, and other agricultural products that may bring a higher income than subsistence agriculture
- Various livestock (unless they graze in the forest, in which case they fall into the previous category)
- Beekeeping, if the bees are not using the forest reserve for pollen
- Land redistribution – providing alternate land to people who are encroaching on the forest or in other ways degrading it

For any of these new activities to head off the threats to the mountain, the people now engaging in illegal or destructive activities have to change their practices so they no longer harm the forests. This may mean that they must be directly engaged in the new activities, so they are ensured an alternate means of earning a living. Moreover, that alternate living must compete financially with the destructive activities from which they now support themselves. For subsistence activities, this may not be difficult. For illegal timber harvesting and some other commercial uses of the resources, however, the destructive activities may be quite lucrative, and finding others that can compete on a financial basis may be hard. Alternately, residents who do engage in activities dependent on sustainably managed resources might bring community pressure to bear on those who are now causing harm. Under some circumstances this may be sufficient to bring about changes in their behavior. This is a less reliable mechanism, however, especially to the extent that those causing harm are landless immigrants from elsewhere in Malawi or from Mozambique.

For each new activity, we need to understand how much income it could generate, how it creates an incentive to protect the forest (if it does), and what institutional mechanisms must be in place to ensure that such protection is effective. To get this understanding, we will have become thoroughly familiar with the literature on these activities. We will also want to talk with people introducing them, to get their assessments of how much the activities could contribute to income generation and forest protection. These assessments will, of necessity, be somewhat subjective. However, it is probably the most realistic strategy for developing an understanding of the services the mountain could provide if it were managed more sustainably.

The valuation of the resource stream from the mountain under scenario 3 will have to take into consideration possible conflicts among the activities. In particular, in some areas there may turn out not to be enough water, and decisions will have to be made as to which activities should have priority. So far there is little information with which to determine whether or where water shortages may become a problem, aside from a single anecdote. In that case, during a drought about five years ago, the Lujeri Tea Estate was asked to stop irrigating its Sayama block because there was not enough water left in the river to supply domestic users downstream.[5] To the extent that proposed activities in the region depend on additional water use – notably for irrigation or for aquaculture – the possibility of water shortages will have to be taken into account in projecting incomes or how the mountain may be protected.

Another activity underway in both Mulanje and Phalombe districts is the rehabilitation of gravity-fed water systems. These projects, now supported by Oxfam, GTZ, and CIDA, provide better water supply than was available before, and created dependence by the beneficiaries on effective management of the upstream forests. However most of the beneficiaries do not live in the mountain region, so they are not in a position to participate actively in resource protection. Many of them do make modest contributions in cash or in kind (or both) when the water systems are rehabbed; however these go to construction and maintenance of the systems themselves, not to buffer zone protection.

3.6 How the Scenarios will be Used

The comparison of the scenarios will give us insights into the implications of different management strategies for the mountain. The comparison of scenario 3 with the other two will be of particular interest, since it shows what the value will be of effective management of the mountain. If it comes out significantly higher than scenarios 1 and 2, then we will be able to make a strong case to the Forest Department, government officials, and donors that additional investment in improving natural resources is justified. We will also be able to make a case that the forest should be managed not by a Forest Department focused on selling timber, but by a broad range of stakeholders interested in sustainable management of the full set of resources provided by the mountain.

Before undertaking the study, however, it is important to consider what we will do if scenario 3 comes out considerably lower than either of the other two. In that case, we cannot make an economic argument for conserving the forest on top of the mountain. If projects like COMPASS II and MMCT are interested in forest conservation because they believe it is economically advisable, such a result will show that their assumptions are, in fact, incorrect, and would argue that they should put aside their conservation efforts in favor of other approaches to economic development. If their commitment to conservation results from ideological conviction rather than economic expedience, such a result would place them in a different quandary. They would have to present a different justification for their work, and could well have more trouble justifying it to Malawian officials and local residents. The possibility that this will be the result of the study should be considered before we undertake the work.

[5] Personal communication with Jim Melrose, Managing Director of Lujeri Tea Estates, 12 July 2005.

4. TASK 2: APPLYING THE USER PAYS APPROACH

4.1 Concepts Behind the User Pays Approach

Environmental economists and policy makers have traditionally considered it fair to apply the polluter pays principle in deciding who is responsible for maintaining environmental quality. Underlying this principle is an assumption that no one has the right to degrade the environment, so those whose activities cause harm should bear the economic burden of prevention or mitigation rather than shifting the burden to those suffering the consequences. The polluter pays principle has received support in many international organizations, and many countries have expressed a commitment to implement it in their environmental policy strategies.

While this makes good sense in theory, in practice it is unrealistic when very poor communities dependent on the use of natural resources for survival are degrading them so they cannot be used by others downstream from them. In the classic example, landless people are forced to cultivate steep mountain slopes, the worst land in their areas, because they have no other way to eke out their subsistence. This leads to runoff, soil erosion, landslides, stream siltation, erratic stream flows, downstream flooding, degradation of downstream water supplies, and a host of other problems. However the upland cultivators have no alternatives and cannot be expected to bear the economic burdens they are placing on others. To prevent the degradation, therefore, it may be reasonable to ask those who want to use the downstream resources to bear the costs, which they may be willing to do because it is less expensive than finding alternatives.

This situation can arise even when upstream users are not impoverished, as in the well-known example of the New York City water supply. In that case, the City was faced with a legal obligation to improve the quality of its drinking water, and was facing a huge investment in a new water treatment plant. Water quality could also be ensured by protecting it at the source, so it did not become contaminated. However, source water protection would impose costs on the upstream residents, who would be restricted from developing their land as they wish, and on upstream local governments, whose property tax revenues would be reduced if development were constrained. The City therefore negotiated an agreement with local governments surrounding the reservoirs to protect the water at the source, and made appropriate payments to the upstream residents in return. The key to the viability of this agreement was that for the user – the City – it was less expensive to pay for protection than to treat, and for the protector the compensation for protection exceeded what they would receive from other uses of the resources in their community. The second purpose of this study, therefore, is to determine whether a similar arrangement might be feasible on Mulanje Mountain.

4.2 Applying User Pays to Mulanje

On Mulanje several groups are involved with using or potentially protecting the resource:

- Residents of the region immediately surrounding the mountain are both the users of many of its resources and the people causing harm – or, from a different perspective, the people who could protect the resources.
- In the same region, the tea estates, other commercial enterprises, and a number of public enterprises including the hospital and government offices are users of the water from the mountain, though they are not in a position to protect its forests.
- Residents further from the mountain are users of its water, through gravity-fed systems that meet domestic needs. They are not potential protectors of the mountain.
- People elsewhere in the country are or could be users of the region's resources, through purchases of charcoal, curios, honey, and potentially bauxite.

The local users who are in a position to protect the resources are, for the most part, financially unable to do so. Some local water users are paying modest sums to cover the maintenance of their water systems and providing in kind contributions to their construction, but increasing this to cover conservation efforts is unrealistic. The same goes for domestic water users further away, who benefit from but are not direct users of the mountain. Commercial users of water piped directly to their establishments already pay for water on the basis of quantities used, and may not be in a position to pay more. Government users are similarly billed for the water they use, although their track record on paying their bills is, according to the Mulanje office of the Southern Regional Water Board (SRWB), not stellar. The set of users most likely to be able to contribute for conservation include the tea estates and consumers elsewhere in the country of goods produced using mountain resources as inputs.

The study will have to assess carefully the financial status of those groups to determine whether it is realistic for them to contribute for conservation. Preliminary information about the tea estates suggests that this idea is worth pursuing, though it is by no means certain that it will be viable. Financial returns to the tea industry depend largely on four variables totally out of their control; world prices of tea, exchange rates, domestic inflation, and rainfall. When there is a drought in Malawi or when world prices drop, their profits drop markedly. If there is domestic inflation but the kwatcha is overvalued, then the margin between input costs and sales prices is squeezed. On the other hand, if rainfall is good and the dollar-kwatcha exchange rate rises faster than domestic inflation, they can do very well. Predicting any of these three variables is obviously difficult.

At present the tea estates pay for water extraction on a per-permit (or per-intake; each intake requires a permit) basis rather than based on how much they use. The price is MK 3,000 every five years for each intake. Lujeri Estates, one of the two major producers in the region, has 50 intakes; the number for Eastern Produce, the other major estate, may be similar. For Lujeri that means payments of MK 30,000 per year, less than US$ 250 at the bank rate of US$1= MK 124 when this paper was written. They recognize that this sum is negligible compared to the value of what they are receiving. On the other hand, they also do not consider upstream forest degradation to be a significant threat to their water supply, because of the particular locations of their irrigated estates. They are concerned about recurrent drought, but that is a different kind of problem, and does not create an incentive to protect the forest. We have not yet had a similar discussion with Eastern Produce, so we do not know yet whether their situation is similar or different. Moreover, there is some evidence that in fact forest encroachment may be threatening Lujeri's water supply, based on information that the estate's director may not have at present.[6]

It may be possible to impose water use charges on the tea estates, with the resulting resources going to source water protection. The SRWB does not bear the costs of the tea estates' water system systems, so they cannot argue that they should receive any water payments assessed. It would be essential to make a case that the revenues should not go into the treasury; we do not know yet who receives the water permit fees, although they are likely to go directly to the treasury at present.

If such a scheme were set up, several issues would be crucial in its implementation:

- How should the money be used? Some of it would probably go into the schemes described in scenario 3, which are expected to reduce degradation of the mountain and increase local incomes.
- How would the estates be guaranteed that they are receiving what they are paying for, i.e. that their water supply will continue to be plentiful and clean? Some of the revenues would have to go to implementing a physical monitoring system that tracks water flows and quality on the mountain.
- How should the water be priced? This question could be approached from several perspectives. One is by determining what an "appropriate" price is for the water, based on what other commercial water users pay and how much we estimate the tea estates can afford. The other would be to determine how much money we need to protect the water resources and monitor them, and set prices designed to bring in that much. This issue would have to be discussed by all of the stakeholders to be resolved.
- How would the revenues be managed? This might be done by creating a management committee including representatives from all stakeholder groups; the tea estates, the Forest Department, the SRWB, the local residents, MMCT, and perhaps others. This committee could have responsibility for deciding how the funds are used and ensuring that individuals who now threaten the forest are earning enough from the new schemes to be able to change to new activities. It would also have responsibility for ensuring the neutrality of those implementing the monitoring system, so there are no incentives to say the water is being protected if in fact it is not.

[6] Personal communication from Carl Breussow, executive director of MMCT, July 12 2005.

The details of such a system would have to be refined; the aim of this study is simply to determine whether it may be financially feasible.

5. STEPS IN THE ANALYSIS

5.1 Base Case – the Current Situation

5.1.1 Spatial data work

- Obtain population data from the 1998 census and projections at the most detailed level of spatial disaggregation possible.
- Two options exist for land cover data. One is to work from available analyses of land cover on the mountain (1984 and 1994 from PLUS, 2002 from MMCT-EMP), possibly updating them with 2005 data. Alternately, if the planned DAI/Bethesda work on land cover from the 1970s to the present is available in time, we can use that instead; this may prove to be easier because we can ask the DAI team to include specific analyses and data manipulations of interest to this study. Either way, the land cover data should show us changes in density of forest cover and where the forest has been removed entirely and replaced with cultivation.
- Identify watershed boundaries and determine which way water flows on the mountain, based on stream network and contour lines. This will require input from someone with knowledge of hydrology and GIS to ensure that we do it correctly. It may be possible to do it through the DAI/Bethesda work on land cover.
- Get data on water distribution networks, so we can see where intakes are and who is on each intake; include this in the system of spatial overlays. These data will come from SRWB or from the donors working on gravity-fed water systems, and may have to be digitized.
- Overlay the stream network, watershed boundaries, water points, and distribution network, to see which gravity-fed points and which populations depend on which streams.
- Obtain additional data on tea estate intakes and water use, to identify where they are and how much water they take from each stream.
- Overlay the water system data with spatial data on location of the irrigated tea estates and how estate irrigation relates to other demand for the same water.

5.1.2 Non-spatial data work

- Estimate how much is being used of resources gathered out of the forest, based on whatever data can be found in reports and from speaking to people in the field. This will be particularly difficult for illegal activities.
- Obtain price (and, if available, quantity) data from NSO surveys, other reports, and primary data collection.
- Organize information about each activity into a standard template that shows (insofar as possible) how much of the product is consumed, where it is consumed (which part of the region around the mountain), how far people walk to get it, its price, impacts on the mountain of its extraction and where they occur, direct costs incurred to collect it (if any), and other information as it is determined to be useful. These templates, once fully developed and incorporated into scenario 3, will be used to compare alternate income-generating schemes for the region, in order to identify those likely to have most potential in the future. They will also be used to compare sustainable activities with those that destroy the forest resources, in order to understand what it will take for sustainable activities to compete financially with destructive ones.

5.2 Scenario 1

Scenario 1 will involve projecting future resource use and degradation, and using that to predict the expected impact on water quantity and quality in the rivers. The projection of where degradation is expected to occur will be done in two different ways, and the results compared. The initial steps will be the same in the two methods:

- Project district population, disaggregated to the village level.

- Use village population estimates to project the demand for forest resources, based on per capita data obtained in doing the base case.
- Use historic data on price trends to project prices into the future.

The methods for projecting where degradation and encroachment occur will differ:

First method: Use the village population estimates to project where additional degradation is expected to happen. This will require developing an algorithm for linking population growth and location to forest degradation, and then implementing the algorithm within a GIS framework. The algorithm should probably take into account slopes, where encroachment is possible, how easy it is to climb the mountain to collect resources, the quantity of resources available to start with, and other factors. Development of this algorithm should involve discussion with people who may be in a good position to advise as to how and where degradation is now occurring, and the factors that determine where it is likely to occur in the future. Then project land cover pattern in the future based on implementation of the algorithm.

Second method: Extrapolate directly from degradation patterns of the past to project degradation patterns in the future. An algorithm will be needed for this as well. It will probably anticipate that thinning of forest cover will progress as it has in the past, and that additional encroachment will expand out from where it is now, although the location of new encroachment might be predicted based on other criteria.

We will then compare the two different methods for extrapolating where degradation will occur and how much there will be. If they come out substantially the same, this will suggest that we are on the right track. If they differ significantly, the first method will probably be considered more reliable.

Once the algorithms are designed and implemented, it should be straightforward to project population, resource demand, and land degradation year by year into the future. We will do this for a number of years, to see at what point there will no longer be resources available, or the more destructive activities will have wiped out the less destructive ones. It is necessary to do this for many years in succession because as long as the resource supply has not been mined, we may find that resource use grows each year, giving the impression that this management approach could continue indefinitely. At some point, however, the destructive uses will impinge on the non-destructive ones, and the amount available each year will drop off.

Based on where degradation is anticipated each year, we will project the impacts on water quantity and quality in the rivers flowing off the mountain. This will depend on developing an algorithm that relates land cover to erosion, siltation, water flows, rainfall, and other characteristics of the river networks, and will require input from an experienced hydrologist. (We will assume that average rainfall conditions prevail, or run the algorithm under alternate rainfall scenarios to get a range of results.) The algorithm will then be implemented in the GIS, so that we can determine how degradation of the forest affects downstream water users in each year, and at what point (if at all) it precludes the possibility of downstream water uses.

5.3 Scenario 3[7]

Implementation of scenario 3 will rely on the spatial data and some of the algorithms developed for scenario 1. It will differ from scenario 1 in that it will not assume constant per capita use of mountain resources. Instead, it will assume that the processes observed in the base case and projected in scenario 1 will be changed through the introduction of a variety of schemes designed to increase rural incomes and create incentives to protect and sustainably manage the resources.

The key issue in design of scenario 3 will be the impact of those schemes over time on several variables:

- Per capita demand for resources harvested off the mountain.
- Destruction of mountain resources in the process of harvesting them.
- Area of land converted from forest to agriculture (or encroachers on the mountain who are convinced to move off of it).

[7] As mentioned above, we have not developed scenario 2 further, as we consider it of relatively low priority for this study.

Other impacts of the schemes will also be important - e.g. incomes, employment, returns to investment in different schemes, prices of the products sold through those schemes, input costs, location of the schemes, number of household involved, and so on - but for the purpose of modeling the impacts on forest resources, those are input variables rather than the final outcome. They will be identified and included in the templates on the different uses, but those data may not go directly into the value of the future flow of services from the mountain.

To identify all of this information - the three variables of direct focus in valuation, the other values, and the time horizon for developing the scheme up to its maximum feasible level - we will have detailed discussions with the people most involved with implementing them. We have no *a priori* basis for projecting the effectiveness of the different schemes, and we therefore have to rely on the assessments of the people working on them. This means that the projections in scenario 3 are inherently subjective, since they are based on the opinions of the experts in the schemes rather than mathematical projections from current data. However that is unavoidable. Because we will be obtaining standard information about each scheme from the experts, and the experts on one scheme are not likely to be the same people who know about another, we will, at least, not be getting one person's estimation of the prospects for one scheme compared with another. That means that the information the experts give us will not be biased by which scheme they have decided is the best. Each expert will presumably know about the value of his or her own scheme, and will think it is a good one, but will not know how other experts evaluated their schemes.

A tricky element in these predictions will be the impacts on resource degradation and forest encroachment. Each scheme's expert might be able to give a figure for how much forested land they depend on – e.g. how much space is needed to support a beehive, in what area are they improving thatch management, or which encroachers were convinced to move out of the forest and onto other land. However they may be unable to say whether the degradation has simply been pushed to another place or the land that was cleared for agriculture was taken over by another group of people when the initial encroachers were convinced to move out. When the schemes increase incomes without directly creating an incentive to conserve or involving the individuals who now harm the forest, it may be hard to establish a direct link to forest conservation. To the extent that these schemes are being implemented through natural resources management or conservation projects, these issues may be monitored, so there will be some information about them. Under other circumstances, however, such information may be difficult to obtain.

We will also need to assess the adequacy of the water supply to meet projected future demand under the different schemes proposed. To do this, we will need to obtain several pieces of additional data related to water:

- water use by Eastern Products Tea Estates
- any data available on water flows in the rivers and streams on the Mulanje massif
- any data available (or possible to estimate) on other gravity-fed water use in the areas downstream from the mountain
- additional data on urban water use, available from SRWB in Mulanje and Phalombe or from their regional office in Thyolo

Based on population growth and information about current or planned expansion of gravity fed water systems, we will project domestic demand for water from the mountain. Based on discussions with the experts, we will project water demand for the different schemes. We will then compare water demand, including irrigated tea, with the best data available on water flows to determine whether there will be supply constraints in drought years. If it appears that there will be, our estimates for scenario 3 will have to spell out how water would be allocated when rainfall is low, or would have to choose among income-generating schemes (or allocate them spatially) to prevent the possibility of water use conflicts.

The projections of the experts will be compiled into a composite picture of the use and degradation of mountain resources in the future. In so doing, we will have to consider whether any of the projections preclude the possibility of others. This problem may arise with respect to water supply, particularly where aquaculture depends on the availability of a certain quantity of clean water. It might also arise if several schemes simultaneously assume availability of specific resources, such as forest grasses, without knowing that the other schemes have their eyes on the same resources. Where such overlaps seem to be an issue, we will go back to the experts to reconcile them, to determine whether the spatial location of some activities can be changed to eliminate conflict among them.

Based on the information of the experts, we will have a time line into the future for resource use and land degradation or conservation. The value of the resources used will be calculated based on projected prices, as in scenario 1. The impact on water quality will be projected based on the expected land cover, also as in scenario 1; this will enable us to assess the value of water from the mountain. As in scenario 1, the values of the mountain products will be summed for each year along the composite time line, to get the value of total mountain resource flows each year. Whereas in scenario 1 we expect that value to drop to zero in the future as the destructive uses wipe out the others, in scenario 3 we expect it to stabilize once the schemes are all fully up and running, assuming that they are as effective as they hope to be in eliminating destructive uses. The total flow level in a given year under scenario 3 may be lower than the flow levels in the short run under scenario 1, but the flow level under scenario 3 is expected to be sustainable where as that under scenario 1 will not be.

5.4 Task 2

To determine the feasibility of a water use fee that goes into a fund for conservation and monitoring of mountain resources, we will need to take several steps:

- To the extent that data allow, estimate how much, and under which economic and meteorological conditions, the tea estates can afford to pay for water. This will be difficult, since although they are generous with data on their water use, they probably will be less generous with financial data.
- Based on discussions with the experts in the context of scenario 3, estimate how much water might be needed effectively to guarantee source water protection for the tea estates (and for other users of gravity-fed water).
- Based on discussions with experts in ecological monitoring, estimate how much it would cost to set up a system to monitor water quality and quantity on the mountain.
- Combine the second and third steps to get a sense of how much money might be needed each year in a fund to protect the mountain's resources.
- Estimate how much the tea estates would have to pay per cubic meter of water to provide the fund with that much revenue.
- Based on our understanding of their financial positions, assess whether they are likely to be able to make such payments.
- Compare the suggested water payments by the tea estates with current payments by urban users served by the SRWB; presumably the tea estate payments will be lower, as the quantities they require as so enormous compared with other users.

6. DATA SOURCES

6.1 Consumption and Prices of Forest-based Resources

Rural consumer price indices are available from the NSO website. We do not know what market basket of products underlies the consumer price index, so we do not know yet whether there are specific underlying price data of use to us.

The Tea Association of Malawi has contracted with Kadale Consultants to assess the cost of living in the tea-producing areas in order to set wages for tea estate workers. Their data may be more useful than the consumer price index, because they will be more specific to areas like Mulanje. Work has just begun on this study; the contact people at Kadale are Zoe Bell or Jason Agar. We should be able to access that study to assess whether it provides us with useful price index or price data.

MACA, a Mulanje-based organization of people producing and selling curios, may have information about prices, revenues, cost structure, and quantities sold for artisanal crafts.

The NSO surveys of rural production do not include mountain resources, focusing only on grains.

The 2004 Integrated Household Survey (IHS), scheduled for release in October 2005, includes a number of questions that will provide information of use to us:

- How much they paid to traditional healers in the past twelve months if they stayed with the healer (p. 11 of survey questionnaire)
- How much time each household member spent the previous day collecting firewood or other fuels or collecting water (p. 13)
- How long they walk to collect firewood, the share of firewood used that they purchased, the value of all firewood used in the past week (p. 18)
- Consumption in the past week of gathered wild green leaves and wild fruit, how much came from purchase, how much came from own production, and how much came from gifts and other sources (pp. 22 and 23)
- Whether they gathered or purchased any wood poles, bamboo, or grass for thatching or other uses, the total value, and the value of the share that they purchased (p 28)

Other data from the survey may also be of value, though not as directly. The survey covers 960 census enumeration areas, with 20 households in each area. The NSO indicates that it can reliably be disaggregated to the district level, but not further.

Orr (2000) collected data on use of certain mountain products by species, and estimated mean use per capita for 1996-7. He extrapolated this based on population and compared that with the supply of resources based on NDVI imagery for different vegetation classes, estimating mean annual increment from the images and assuming that that represented sustainable yield. We may want to use his per capita use figures in our work.

The PLUS Study (Orr et al, 1998) asked questions about the household asset base, access to non-agricultural income, and detailed use of resources from protected areas. Their sample included 127 households in five villages in the Mulanje area. They developed a subsistence standard of living based on annual per capital maize consumption, as a unit of well-being measurement, and an analogous standard natural resource-based biomass consumption measure. Unfortunately, the study report only includes the value of gathered goods in terms of the maize and biomass equivalents, but does not include much of the underlying consumption data. If we can find those data, they may be useful for our purposes. They do provide estimates of the use of key resources in each village, though the sample sizes for some of the resources are quite small, presumably because over the period about which they were asking for information very few people had need of those items. They give a figure for national per capital use of wood, at 388 Kg/year. We might find it useful to apply this figure, although the IHS data for Mulanje and Phalombe may be more reliable for this purpose.

Konstant (2000) provides estimates of current use and prices for a large set of mountain resources, and discusses the potential for expanding on each of these.

Many other reports will provide information about the specific resources which is the subject of their work; for example Kadale (2005) on honey, SSC (2005) on aquaculture, and so on. Many more single-subject studies will be identified once work begins on implementing this study.

6.2 Land Use/Land Cover

Forest cover data for Mulanje Mountain are available for 1984 and 1994 from the PLUS study (Orr et al, 1988), and from the MMCT EMP for 2002. DAI is also working on similar land cover assessments from the 1970s to the present, which may be more useful if they are available. The DAI study should include areas surrounding the mountain as well as the forest reserve itself, which will make them more interesting than the PLUS and EMP data.

6.3 Water Data

We will need many kinds of data on water, including the location and types of water points, water use, payments for water and prices, water flows, watershed boundaries, and perhaps others.

Water points: The Water Supply and Sanitation Conservation Comittee, Oxfam, and WaterAID have produced a national spatial database on water points. We have a copy of these data.

COMWASH, a Canadian project on water supply, has data on water points and springs that could be used for water supply for Phalombe and Thyolo. They also have digital data on the network layout for the gravity-fed water systems in those districts.

Water use: SRWB has consumption data for urban water but not for rural.

Jim Melrose has given us preliminary data on water use for irrigation on the Lujeri Tea Estates, and has promised to send us updated data when he refines his spreadsheet. We will seek similar information for Eastern Products.

We may have to estimate rural water use from gravity-fed systems based on the number of people served by those systems and standard use figures put at 20 to 27 liters per capita per day. The Water Department or national water strategy documents may have other estimates that they consider more reliable.

Water payments and prices: The SRWB has an automated system for tracking urban water use, payments due, and payments (for urban areas only; others do not pay for water). We should be able to obtain this from their regional office in Thyolo. They have already given us the schedule of prices for the water they sell in urban areas.

Several donor projects are asking rural water users in the areas in which they work to contribute to the cost of maintaining their water systems. These amounts are negligible, but we should be able to obtain data on them.

Jim Melrose of Lujeri has given us data on their payments for water permit fees. They do not pay for water based on consumption. Presumably the same is true for Eastern Products, though we will have to discuss this with them.

Water flows: From the 1950s to the 1980s the Water Department apparently managed a 3,000-point water flow monitoring system, but updates since then only include a few key rivers. The Ruo is one of them. We may be able to estimate flow in other rivers around the Mulanje massif based on the recent flows in the Ruo, although we might want some advice from a hydrologist on the reliability of such an estimate. COMPASS staff is already working on obtaining the existing flow data from the Water Department for other purposes.

Water flow could be combined with water use to get a rough sense of how much of the available water is being used and to project the potential for water shortages with population growth. Time series on water flows should give a sense of whether supply is already being affected by degradation of forest cover.

We should be able to place watershed boundaries based on spatial data already available on the location of rivers and streams and the contour lines.

6.4 Meteorological Data

We have not systematically investigated the availability of rainfall and temperature data, but these should be available from the appropriate government agency. The tea estates also collect detailed weather data for their areas, which would be available for our use.

6.5 Financial Data on the Tea Estates

Some data are available from industry studies (Agar 2002, Chirwa and Kydd 2005).

Some industry-wide statistics (sale prices for Malawi tea, quantities exported) are available from the International Tea Association (ITC 2004).

Additional data on water use for irrigation and possibly on financial status should be available from Lujeri and Eastern Products.

6.6 Financial Details on Activities that Depend on Mountain Resources

These will come from a wide range of sub-sector studies and other reports, some of which have already been identified and some of which will have to be identified when the study is implemented. Studies already identified include:

Overview studies considering many schemes: Konstant (2000), Orr et al (1998), Orr (2000), Orr et all (2000)
Honey: Kadale (2005)
Timber and other wood resources: FORINDECO (2000)
Aquaculture: SSC (2005)
Smallholder Tea: Agar (2002), Chirwa and Kydd (2005)
Ecotourism: Environment and Development Group (1999)

7. STAFFING AND SCHEDULE

This study will be led by Dr. Joy Hecht, with technical input from several other sources:

- The skills of a hydrologist familiar with conditions on Mount Mulanje will be needed to design an algorithm to link land cover with stream flows and water quality. The hope is to team with a Malawian hydrologist from one of the universities or from the Water Department who can provide that assistance.
- A significant portion of the spatial data manipulation will, it is hoped, be undertaken by DAI staff in Bethesda, in the broader context of their work mapping natural resources in Malawi. If all goes according to plan, we will be able to work with them to do the GIS implementation of the algorithms linking population growth to resource degradation and land cover to stream flows, once the conceptual structure of those algorithms has been designed through discussions in Malawi.
- Some time from a GIS expert in Malawi, presumably through COMPASS II, will be needed to ensure that Dr. Hecht can work with the spatial data once they are available.
- If we undertake primary data collection work in markets in the mountain region, we will need to recruit Malawians who can undertake this work. Students engaged in relevant fields of study may be appropriate candidates for this work; otherwise we will need to identify data collectors elsewhere.
- If feasible, we hope to involve one or more Malawian students in this study. Tasks in which they could be engaged include primary data collection (as already mentioned), gathering and systematizing data on the schemes considered in scenario 3, and contributing to the analysis for the study. The goal of this involvement would be for students to learn about the issues and to use the study data to complete theses or other school projects. We will discuss this possibility with professors at the universities as planning is advanced.
- If desired, we will involve MMCT staff in implementation of this study; having this be a joint project between COMPASS and MMCT may strengthen the impact of the results and open additional doors within Malawi for implementing the work. The modalities of their involvement should be discussed with Carl Breussow and other MMCT staff.

The anticipated level of effort for Dr. Hecht is 80 days, a small portion of which will be used in the United States prior to her return to Malawi. This assumes that the time of DAI/Bethesda GIS experts will not have to be covered within the LOE that may be available for this study, although some of Dr. Hecht's time may be spent working with them prior to her return to Malawi to discuss the algorithms that we hope they will be able to implement for us.

It would be desirable for several tasks to be carried out before Dr. Hecht returns to carry out the study:

- Discuss with Carl Breussow the possibility of making this a joint COMPASS-MMCT study. This can be done by email between Carl, Todd Johnson, Dr. Hecht, and other COMPASS and MMCT staff over the next month or two.
- Obtain several data sets, particularly the 1998 and 2004 integrated household surveys from NSO, the Water Department data on river and stream flows, rainfall and temperature data, and others that may be identified later. For the NSO IHS data, we have been instructed to write formal letters explaining which information we want and how we will be using it. This should probably be done by COMPASS staff in Blantyre.
- Make contacts with the universities to determine whether students could be involved in carrying out this work. This should probably be done by COMPASS staff in Blantyre or, if MMCT wishes to be actively engaged in the study, by one of their staff.
- Make contact with the Water Department and appropriate universities to identify a Malawian hydrologist who can provide technical input into the project. This should be done by COMPASS staff.
- Comb the libraries and donor projects in Malawi to identify additional studies which may provide data on activities that involve sustainable or destructive use of the mountain resources. If a suitable student can be identified to work on the project, this may be an appropriate task for him or her to carry out. Alternately, it might be possible for an MMCT staff member involved with the project to do some of this work.
- Comb databases available through the internet or through research libraries in the United States for relevant studies. This will be done by Dr. Hecht before her return to Malawi.

- Work with DAI/Bethesda to determine whether or to what extent their GIS team can provide the spatial data needed for this study, and to discuss implementation of algorithms linking population, land degradation, and water systems once the content of those algorithms has been determined. The technical details of this work will be done by Dr. Hecht; the institutional issues involved in relying on them will be worked out between COMPASS and DAI.

The date for Dr. Hecht's return to Malawi for implementation of the study will depend on how soon the major data sources become available, particularly the GIS data from DAI/Bethesda and the 2004 IHS. Her return is tentatively projected for November or early December of 2005. If appropriate, her work may be divided into two missions, to avoid significant down time around the Christmas and New Year's holidays; the study might be postponed until January 2006 for the same reason.

ANNEXES

Annex 1: References

Agar, Jason, June 2002. "The Tea Sector in Malawi." (Blantyre: Kadale Consultants Ltd and Imani Development (Malawi) Ltd.) Produced for the Integrated Framework for Trade-Related Technical Assistance to least-developed countries (IF) process, run jointly by the World Trade Organization, the World Bank, and other organizations. Available on the web at: http://www.integratedframework.org/files/Malawi_ch5_tea.pdf.

ARD, Inc. "Biodiversity Conservation: A Guide for USAID Staff and Partners." Prepared for USAID. No date. On the web at http://www.usaid.gov/our_work/environment/biodiversity/pubs/biodiversity_guide_2003.pdf

Bayliss, Julian, April 2005. "An Ecological Monitoring Programme for Mount Mulanje Forest Reserve." Designed for the Mulanje Mountain Conservation Trust, Wildlife Conservation Society.

Central Africana, Ltd, 1991. "Tea: A Handbook to Malawi's Tea Industry." Prepared for the Tea Association of Malawi, Blantyre.

Chapman, J.D., 1995. *The Mulanje Cedar: Malawi's National Tree.* (Blantyre: The Society of Malawi)

Chirwa, Ephraim W. (Department of Economics, Chancellor College, University of Malawi) and Jonathan Kydd (Imperial College, London), April 2005. "Study on Farmer Organizations in Smallholder Tea in Malawi." Paper prepared through the Farmer Organizations for Market Access Project, funded by DFID through the Crop Post Harvest Research Programme. Available on the web at http://www.imperial.ac.uk/agriculturalsciences/research/sections/aebm/projects/farm_org/TeaReport.pdf.

The Environment and Development Group, September 1999. "Ecotourism Consultancy, Final Report." Prepared by The Environment and Development Group, Oxford, UK for the Mount Mulanje Conservation Trust.

FORINDECO, March 2000. "Forest Productivity (Plantations and Mulanje Cedar)." Second Draft Report. Prepared for the Mount Mulanje Conservation Trust.

Garson, M. S. and R. D. Walshaw, 1969. *The Geology of the Mlanje Area.* (Zomba, Malawi: The Government Printer) Bulletin No. 21 of the Geological Survey Department, Malawi Ministry of Natural Resources.

Genetic Resources and Biotechnology Committee (GRBC), National Research Council of Malawi, Office of the President, October 2002 . "Procedures and Guidelines for Access and Collection of Genetic Resources in Malawi." Revised Edition.

Gregersen, H.M., J.E.M. Arnold, A.L. Lundgren, and A. Contreras-Hermosilla, 1995. *Valuing forests: context, issues, and guidelines.* FAO Forestry Paper 127. (Rome: FAO)

Hecht, Joy, Ed., January 1999. *The Economic Value Of The Environment: Cases From South Asia.* (Kathmandu, Nepal: IUCN/The World Conservation Organization) Available on the web through http://users.rcn.com/jhecht/professional.

International Tea Committee, 2004. *Annual Bulletin of Statistics 2004.* (London: ITC, Ltd. 2004)

Jere, Peter, Knox Varela, and Ben Voysey, March 2000. "Synthesis study of initiatives on co-management of natural resources in Malawi." National Forestry Program Working Paper Series No. 1. National Forestry Programme Coordination Unit, Ddepartment of Forestry, Lilongwe. On the web at http://www.undp.org/seed/forest/docs/comantworkingpaper1.doc.

Kadale Consultants, February 2005. "Honey Sub-Sector: Initial Report." Prepared for COMPASS II.

Konstant, Tracey, February 2000. "Non-Timber Forest products: Current and potential value on Mulanje Mountain." Draft Final Report. Prepared for the DFID/MMCT Mulanje Massif Project.

Landell-Mills, Natasha and Ina T. Porras, March 2002. *Silver bullet or fools' gold? A global review of markets for forest environmental services and their impact on the poor.* Instruments for sustainable private sector forestry series. (London: International Institute for Environment and Development) Available on the web at http://www.iied.org/docs/flu/psf/psf_silvbullet.pdf.

Mauambeta, Daulos and Patrick Mphaka with Makhunya Bingolosi, Justine Mbetewa, and Misozi Khonje, Wildlife and Environmental Society of Malawi, August 2004. "Natural Resources Based Enterprises and Income Generating Activities: A Feasibility Study." Results of the Consultancy on Resource Management Activities and Service Development for Viable Income Generating Activities (IGAs) Around the Mulanje Mountain Forest Reserve (MMFR). For the Mount Mulanje Conservation Society.

MET-CHEM, November 1994. "Feasibility Study for Mulanje Mountain Bauxite in Malawi." Volume 1: Executive Summary. Prepared by MET-CHEM, Canada Inc. for the Malawi Mining Investment Development Corporation (MIDCOR)

Mulanje District Assembly, 2002. "District State of the Environment Report: Mulanje." Prepared with assistance from the Mulanje Environment District Office.

Orr, Baron, Barbara Eiswerth, Tim Finan, and Luke Malembo, March 1988. "Malawi Public Lands Utilization Study: Final Report." Produced by the University of Airzona Offce of Arid Lands Studies and the Forestry Research Institute of Malawi, for the Malawi Environmental Monitoring Programme, Ministry of Land, Housing, Physical Planning, and Surveys.

Orr, Barron Joseph, 2000. *More Users and More Uses: Choosing between land and forest in Malawi's protected areas.* Doctoral Dissertation, Graduate Interdisciplinary Program in Arid Lands Resource Sciences, Graduate College, University of Arizona.

Orr, Sheena, Jo Makawa, and Doreen Chanje, July 2000. "Economic Activities and The Role of MMCT." Prepared by Kadale Consultants for MMCT.

Republic of Malawi, July 2002. "Mulanje District Socio Economic Profile."

Republic of Malawi, August 2002. "Phalombe District Socio Economic Profile."

SSC System Science Consultants Inc., May 2005. "Master Plan Study on Aquaculture Development in Malawi." Draft Final Report. Prepared in the context of the National Aquaculture Strategic Plan 2005-2015, through the Japan International Cooperation Agency and the Malawi Department of Fisheries.

Winrock International, November 2004. "Financial Incentives to Communities for Stewardship of Environmental Resources: Feasibility Study." Prepared for USAID by Winrock International, Arlington Virginia. Available on the web at http://www.winrock.org/GENERAL/Publications/FinancialFINALrev.pdf.

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