

THE ROLE OF FACTORS INVOLVING THE ENVIRONMENT IN A FOREST  
LIVELIHOOD DECISION OF MALAWIAN VILLAGERS

By

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To my mother and father

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## LIST OF ABBREVIATIONS

CBNRM	Community Based Natural Resource Management
DFID	Department for International Development
EDTM	Ethnographic Decision Tree Model
FAO	Food and Agriculture Organization
GoM	Government of Malawi
IDS	Institute of Development Studies
IUCN	International Union for the Conservation of Nature and Natural Resources (Formerly World Conservation Union)
IUPN	International Union for the Protection of Nature
MDG	Millennium Development Goals
MMFR	Mulanje Mountain Forest Reserve
MMCT	Mulanje Mountain Conservation Trust
NSO	National Statistical Office
NGO	Non-Governmental Organization
PES	Payments for Environmental Services
REDD	Reduced Emissions from Deforestation and Degradation
SLA	Sustainable Livelihoods Approach
UN	United Nations
UNAIDS	Joint United Nations Program on HIV/AIDS
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
WCED	World Commission on Environment and Development
WWF	WorldWide Fund for Nature

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This research analyzed to what degree and in what form the environment occurs in local people's decision to produce charcoal, an illegal forest livelihood activity, in a protected reserve in Southern Malawi. Charcoal is a cooking fuel for urban dwellers and an important source of income for rural people living near forests.

Using a three-step process, I created and tested an ethnographic decision tree model about villagers' decision to make charcoal. Semi-structured interviews (N=16) were conducted with heads of households to create a questionnaire of the criteria relevant to the decision to make charcoal. Then, responses from 27 structured interviews were used to construct a preliminary ethnographic decision tree model. Finally, the tree model was tested using an additional 37 household heads. This model predicted the responses of the test sample with 79% accuracy. A second tree model was created using the data from all 64 structured interviews. This second described the data with 92% accuracy. Within both models, considerations involving the environment do occur but they treat the forest as a site of natural capital rather than as a resource deserving special protection.

Government ministries and non-governmental organizations (NGOs) targeting conservation in the area are encouraged to consider the multiple paths by which a household can arrive at the decision to produce charcoal; these multiple paths indicate that no single intervention will stop charcoal production. From a theoretical perspective the research suggests that despite an awareness of forest decline and acknowledgement of their role in the change, the villagers currently making charcoal feel unable to explore alternatives due to a lack of economic opportunities. A broader consideration of the political, economic, and ecological history of the region reveals that household decisions about charcoal production are constrained by several exogenous factors. Any interventions designed to reduce charcoal production ought to consider the political, economic, and ecological forces driving this industry.

## CHAPTER 1 INTRODUCTION

### **The Overlap of Poverty and Threatened Natural Resources**

The Millennium Development Goals (MDGs) were established by the United Nations (UN) in 2000 to define humanity's most pressing problems and lay out a strategy for addressing these concerns (UN 2000). Among goals regarding health, education, and the environment, the first goal is poverty reduction. By 2015, the signatories pledged to reduce by half the number of people living on less than \$1 per day. The creators of the MDGs highlighted poverty because it is a universal problem linked to health, biodiversity, and economic development.

In addition to alleviating poverty, the MDG's also seek to protect our natural environment. The 7<sup>th</sup> Millennium Development Goal is to "ensure environmental sustainability" and recognizes that humanity's continued existence depends on taking care of the environment (UN 2000). Specifically this goal targets the need to promote sustainable development, conserve natural resources, protect biodiversity, and improve water and sanitation conditions around the world.

As Roe and Elliot (2004) point out, the MDGs differentiate between alleviating poverty and protecting the environment. They argue that this separation of protecting the environment from alleviating poverty is a mistake because the two phenomena are inextricably linked. Alleviating poverty requires one to address environmental concerns; on the other hand, successfully achieving conservation requires one to address issues related to poverty. As Roe and Elliot propose in their title, by "rebuilding the bridges" between poverty alleviation and biodiversity conservation, progress can be made in both areas.

Of course, Roe and Elliot are not the first scholars to point out the connection between protecting the environment and alleviating poverty. Often couched in terms of “conservation and development,” examining these overlaps has been popular since the late 1980’s (Mulder & Coppolillo 2005). In their 2004 review, Adams and colleagues provide a useful framework for separating out the different ways that scholars have thought about the interaction between conservation and development. They suggest four different perspectives (Adams et al. 2004):

**Perspective 1:** Biodiversity conservation and economic development are two different goals which should not be confused or combined. According to this viewpoint it is a mistake to attempt to achieve both objectives at the same time. There may be certain situations where achieving conservation happens to generate some local poverty alleviation benefits, but for the most part resources conservation requires demarcated protected areas which are defended against the encroachment of surrounding poor people.

**Perspective 2:** Poverty constrains conservation. This approach takes conservation as its main objective but looks at poverty as a factor that may undermine efforts to achieve conservation. For example, while subscribers to Perspective 1 might create protected areas and defend them with fences and fines, subscribers to Perspective 2 might observe that it is too economically or politically costly to keep local people out of a protected reserve. Thus, in order to preserve the biodiversity, it may be necessary to address their poverty in order to protect the integrity of the reserve.

**Perspective 3:** Conservation must be designed so that it does not compromise efforts at poverty reduction. This viewpoint also takes conservation as its main

objective, but it includes the caveat that conservation efforts have a moral obligation to not worsen the conditions of people living in poverty. Instead of merely using development as a way to shore up conservation investments, this view recognizes the negative effects that conservation projects can have. For example, if creating a new protected area were to reduce the harvest area of a group of poor people, there would be a moral onus on the creators of the protected area to assist those people with replacing the lost portion of their income.

**Perspective 4:** Poverty reduction requires the conservation of living resources. In contrast to the previous two, this viewpoint sees poverty reduction as its main objective. It recognizes a functional biota as an essential tool for meeting the livelihood needs of poor people. Therefore any strategy designed to help the poor must also include an element of conservation. This viewpoint is often associated with work to protect living resources outside of protected areas.

This classification system has its roots in a much older debate (Adams et al. 2004). Beginning with the formation of the International Union for the Protection of Nature in 1948, there has been recognition of the need to understand and protect the world's natural resources at a transnational level, outside of political and national rhetoric.

As might be expected, scientists from around the world held a wide variety of opinions about the best interaction between society and the environment. One difference of opinion dealt with the appropriate balance between environmental conservation and environmental preservation. In other words should our goal in protecting the environment be to preserve nature in an "untouched" form or should we

aim to conserve nature in order to make it available for present and future human use?

In response to this debate, the Union itself changed its own name from International Union for the Protection of Nature (IUPN) to the International Union for the Conservation of Nature and Natural Resources (IUCN) in 1956, signaling a shift to the goal of conserving the functionality of nature so that it could be used by people.

The debate between preservationists and conservationists can be viewed through the lens offered by the four perspectives from Adams et al. (2004). If we see nature as an entity to be preserved in its pristine state, then Perspective 1 seems most appropriate. Rather than allowing human use to change nature, this perspective advocates preserving nature by clearly demarcating human and natural spaces. At the other extreme, if one sees the sole purpose of nature to be for the benefit of humanity, then Perspective 4 would be most appropriate. This perspective considers natural resource conservation as a tool for alleviating poverty.

The conservation/preservation debate can be traced through the history of international meetings about the environment. In 1972 the United Nations (UN) convened a conference in Stockholm, Sweden, known as the United Nations Conference on the Human Environment. This was the first conference in which global environmental issues were discussed under the auspices of the UN. During this conference there was debate as to whether or not to advocate a “no growth” policy; in other words to limit the amount of new industrialization which would take place. Representatives of more developed countries saw “no growth” as a necessary strategy for reducing environmental problems while representatives from less developed countries saw this as an unfair handicap to their own economic growth. On the four

perspectives classification system (Adams et al. 2004) this debate could be seen as two perspectives in the first category. On the one hand representatives from more developed countries were viewing conservation and development as separate issues and calling for more conservation at the expense of development. On the other hand, representatives from less developed countries were also calling for a separation of environment and development but asking for more development at the expense of conservation.

Subsequent conferences would see a change in this global trend. In 1980 the UN commissioned the IUCN, the WorldWide Fund for Nature (WWF), and the United Nations Environment Programme (UNEP) to create the World Conservation Strategy. This plan placed a much greater emphasis on “sustainable development.” In fact the strategy aimed “to advance the achievement of sustainable development through the conservation of living resources” (IUCN 1980). This emphasis on development represents a step toward closing the distance between the two opposing voices at the Stockholm conference.

Following the release of the World Conservation Strategy in 1980, the UN convened a commission in 1983 to flesh out a strategy for sustainable development. Formally known as the World Commission on Environment and Development (WCED), this commission has come to be known as the Brundtland Commission after its chair, Gro Harlem Brundtland. This commission defined sustainable development as “meeting the needs of the present generation without compromising the ability of future generations to meet their needs” (WCED 1987). This definition continued the trend away from preserving nature for its own sake and toward the idea that nature should be

treated in such a way that it fulfills our present needs and is still conserved for future generations.

The Brundtland Commission recognized that nature conservation for current and future use was an important goal and that in order to achieve that conservation it was necessary to carry out a certain kind of development. This strategy corresponds to Perspective 2 from the four perspectives outlined above: addressing poverty alleviation concerns is an important step in achieving the goal of resource conservation. This awareness corresponded with the beginning of a wide variety of projects that worked to combine conservation and development (Hughes and Flintan 2001). With this shift came an increased appreciation for understanding the experiences of local people living at the intersection of poverty and natural resource use.

### **Sustainable Livelihoods Approach**

The Sustainable Livelihoods Approach (SLA) was born out of a desire to understand poverty from the perspective of the poor. This undertaking recognized that elements of a researcher's perspective and expectations may cause him to misunderstand the situation of poverty. For example, a researcher seeking data about poverty level might choose to ask a person about his employment in a formal and singular sense: "What is your job?" This query often leads to confusion because the respondent may not have a "job" in the sense of a singular, formal source of income. Rather, he or she pieces together a set of activities that helps him or her "get ahead" or "get by." Many of these activities may not even involve cash income, dealing instead with exchange or subsistence value. Each of these different activities (for example, cutting firewood, making charcoal, or farming maize) is known as a "livelihood activity." The entire collection of activities is known as a "livelihood." (Chambers 1995).

Many SLA scholars refer to the definition of sustainable livelihoods given in a 1992 Institute of Development Studies working paper (Scoones 2009):

A livelihood comprises the capabilities, assets (including both material and social resources) and activities for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base (Chambers and Conway 1992).

This definition contains two important elements. First, it introduces the notion of the component elements in a livelihood, referring to them as capabilities, assets, and activities. These components will be discussed in a subsequent section. Second, it explains that the “sustainable” in the SLA refers to sustainability in two senses.

Economic sustainability relates to a livelihood’s ability to cope with stresses and shocks. Ecological sustainability has to do with ability of livelihood to not “undermine the resource base,” in other words to maintain the ecological integrity of the surrounding area.

The livelihoods framework has gone through several modifications over the years. The British Department for International Development (DFID) adopted a version of the framework for its own work on poverty reduction. One of the key tenets of that approach has been an emphasis on the local realities of people living in poverty (Scoones 2009). Rather than imposing a one-size-fits-all approach to understanding poor people and the way they make their living, the British SLA seeks to understand different people living in poverty as they understand themselves (Chambers 1995).

The livelihood components mentioned in Chambers and Conway definition became a central aspect of the DFID version of the SLA (FAO 2006). These components came to be referred to as “capitals,” and they occupied five different sectors: Natural, Financial, Human, Social, and Physical (Scoones 2009). Each of these

types of capital represents a unique kind of resource which could be combined and/or transformed as part of a livelihood process. The role of each of these capitals may best be illustrated by a story about a village woman working to meet the needs of her household.

### **Thokozani the Basket-Maker**

Thokozani lives in a village in rural Malawi where she is the head of a small household. She wants to weave baskets to obtain cash for her daughter's school fees. Thokozani goes down to the river with her friend Mphatso to cut reeds for weaving the baskets. While she's there, she is confronted by the chief who asks her if she has permission to cut these reeds. Thokozani explains that her father, who is a village elder, had given her permission. The chief accepts this response and Thokozani finishes cutting the reeds.

Thokozani and Mphatso carry the reeds back to Thokozani's house. The women will make more money if they weave a complicated pattern that they saw on display at a market the other day, but they don't know how to do it. Luckily Mphatso's mother passes by at this point and she does know the pattern. Mphatso's mother teaches the women the complicated sequence of weaves. Using their new skill, Thokozani and Mphatso weave several baskets. The next day they carry the baskets to their nearby trading center. Thokozani's aunt has a stall at the market and she is able to display Thokozani's baskets in a prominent location. Thokozani sells the baskets for cash which she will be able to use to pay her daughter's school fees.

### **The Capitals Involved**

In Thokozani's story there are several different types of capital involved that make it possible for her to carry out her livelihood. Natural capital refers to the stocks of

natural resources and ecosystem services used in a livelihood process. Trees, rivers, and wild game are all types of natural capital. In Thokozani's story the reeds she cut would be a form of natural capital. Although natural capital originates in natural spaces, it is still subject to human management choices.

In contrast to natural capital, produced capital, also known as physical capital, are human-made goods needed for a livelihood process. This is the type of capital we usually associate with the "means of production." Produced capital can be as complicated as the machines in a factory or as simple as the knife Thokozani uses to cut her reeds. The basket Thokozani creates is another form of produced capital.

In contrast to the tangibility of produced capital, human capital refers to qualities that are inside a human being. These qualities include both physical and mental capabilities (Scoones 1998). For example, in Thokozani's case the ability to find and cut appropriate reeds, the strength to carry those reeds, and the dexterity to weave them into baskets all represent aspects of her human capital. Thokozani and Mphatso both gained human capital when Mphatso's mother taught them to weave the new basket design. In fact this human capital was instrumental to their success.

Somewhere between the tangible produced capital and the intangible human capital is financial capital. This type of capital refers to the monetary assets used in or created through a livelihood process. It is often related to the flows of cash and credit that occur during the course of the livelihood process. In Thokozani's story financial capital occurs when she sells her baskets and generates cash income. Her use of this cash to pay her daughter's school fees represents another aspect of meeting her household needs through her livelihood process.

Social capital is also less tangible than natural or produced capitals. In the context of the Sustainable Livelihoods Approach, social capital refers to the set of social relationships and networks that a person draws upon in pursuing his or her livelihood strategy. For example, in Thokozani's story there are several examples of social capital. First, her relationship with Mphatso is one form of social capital. This relationship facilitates her entire basket-making process from acquiring the raw materials through selling the produced capital. Second, Thokozani's relationship with her father and her father's relationship to the chief were social capital elements that allowed her to access the reeds. Thokozani's relationship to Mphatso's mother made it possible to gain the skills (human capital) to weave a new pattern. Finally Thokozani's relationship with her aunt enabled her to sell her baskets.

Bebbington (1999) puts special emphasis on social capital because of the role it plays in mediating access to the other types of capital. For example in Thokozani's case social capital played a key role in access to natural capital (the reeds) and human capital (the basket weaving skills). Without the reeds or the basket weaving skills Thokozani would not have been able to produce attractive baskets. Based on observations like these, Bebbington suggests that social capital may play a particularly important role in livelihood processes.

### **Sustainability Science**

With the publication of a short article in *Science*, Robert Kates and colleagues (2001) announced the emergence of "sustainability science" as a new problem-solving discipline poised to meet the pressing issue of achieving sustainable human development. The discipline they outlined would require a new and more integrative type of research, which reached across the divide between social and natural science.

Although it aimed to address issues of global importance, sustainability science was intended to understand problems at a local and regional level.

Since the *Science* article in 2001, there has been increasing excitement about the role of sustainability science in addressing pressing human problems. In 2005, the National Academy of Sciences allocated a new section of its journal to report on successes and developments in the field of sustainability science (Clark 2007). In 2006, citing its origins in the work of the Brundtland Commission, a new journal named *Sustainability Science* was launched. In their introductory editorial Komiyama and Takeuchi (2006) emphasize the importance of building knowledge based on both social and natural science.

This research is situated in the field of sustainability science in that it used a scientific process to answer a locally relevant question about livelihood decisions at the edge of the Mulanje Mountain Forest Reserve (MMFR). Furthermore, this work has global significance in that it explores local perceptions of the environment in a livelihood decision. These findings could be important in designing interventions which seek to protect natural resources and alleviate poverty.

This study also qualifies as sustainability science in the transdisciplinary nature of its approach; a method from cognitive anthropology reveals information about an ecologically important decision process.

### **Research Question**

Government ministries and non-governmental organizations (NGO's) have made concerted efforts to educate local people about the environment with the expectation that this knowledge would influence behaviors such as deforestation. Furthermore the Malawi Department of Forestry has used guards and enforcement strategies in order to

protect forest resources. Have these efforts affected the decision process behind the adoption of forest-dependent livelihoods? Has knowledge of environmental consequences or fear of punishment affected the decision to make charcoal?

Specifically this research asked:

How do factors related to the environment enter into the forest-dependent livelihood activity choices of people living on the edge of a protected reserve?

The goal of this research was to answer this question by seeking out the factors behind the decision to pursue charcoal making around Mulanje Mountain in Southern Malawi. Following along the lines of the SLA, this research sought out responses to this question in the words of the people themselves.

## CHAPTER 2 MODELING A FOREST USE DECISION OF MALAWIAN VILLAGERS

The overlap between areas of high poverty and areas of high biodiversity is leading to an increasing recognition that sustainable ecological solutions must take into consideration the livelihoods of local people (Fisher and Christopher 2007; Sunderlin et al. 2005; Myers et al. 2000). Purely preservationist approaches often failed partly due to high levels of poverty around the endangered areas. To be effective, “fences and fines” require funds and functional governance; these two resources are often absent in less developed countries.

Among the different types of ecosystems, forests stand out as both important sites of ecological functions and important source of livelihood opportunities. In addition to housing biodiversity and providing ecosystem services at the local, regional, and global scales, forests are sources of fuel, fiber and food for the people around them. In particular, the poor people living near forests tend to benefit greatly from opportunities for subsistence and cash income (Angelsen and Wunder 2003; Fisher 2004; Fisher et al. 2005).

Forest dependent livelihoods are at the intersection of forest conservation and human well-being. On the one hand, livelihood processes and outcomes provide people with the support their household needs. On the other hand, the choices people make about using the forest can have a direct impact on the biodiversity and ecosystem services of the forest (Sunderlin et al. 2005). Furthermore, some of these choices can have long-term consequences on the ability of the forest to provide for household needs. Ideally livelihood choices will have beneficial impacts on both forest health and human welfare; however this is often not the case. In order to better understand the how

forest livelihood decisions are made, I examined the factors that affect local people's decisions to engage in forest-dependent livelihood activities. Specifically, this research sought to discover the role of factors related to the environment in local people's decision to adopt a forest-dependent livelihood activity.

To pursue this question it was necessary to decompose the decisions of local people into distinct components. This required 1) an approach to working with local people in order to learn about their decisions and 2) a method for visualizing these decisions for analysis.

Following the convention of Spradley, I differentiate between informants and respondents. Both terms refer to individuals who provided information for the study. Informants were those who participated in semi-structured interviews; guided by a set of basic questions, these interviews were largely shaped by the interests and expertise of the informant. Respondents, on the other hand, answered questions from a survey questionnaire. These structured interviews were largely constrained by my questions on the survey.

Spradley (1979) suggests that an informant's explanation of her world in her own terms can provide valuable insight into her cultural scene. Using this ethnographic approach my research assistants and I set out to discover how factors related to "the environment" were expressed when our informants described their activity decisions in their own terms. We represented this information in a decision tree model (Gladwin 1989) which gave a structured form to our informants' expression of their decision processes. These models were then interpreted to see if and how factors related to the environment occurred within the decision.

Discovering how factors connected to the environment occur in the livelihood decision processes of local people could be useful information for designing strategies which could conserve forest and alleviate poverty.

### **The Role of Livelihoods in the Forest-Poverty Link**

The Sustainable Livelihoods Approach (SLA) describes the ways in which local people “get ahead” and “get by” as a process of combining and transforming capitals in order to meet household needs. In this case, five different types of capital play an interactive role in the formation of livelihoods: financial, natural, produced, human, and social (Scoones 1998).

From the five types of capital, Bebbington (1999) suggests that social capital has a critical impact in shaping rural livelihoods. This is due to the role that social networks play in creating access to the resources that rural people need to successfully pursue a particular livelihood. By working within this framework, programs and interventions can be designed which may alleviate poverty without undermining the natural resource base.

### **Miombo Woodlands**

One area of the world which faces particularly strong challenges in developing sustainable livelihood strategies is the miombo region of Southern Africa. Miombo woodlands occur in an east-west belt across the continent from Angola in the west to Tanzania in the east (Deweese et al. 2010; Chirwa et al. 2008). In general, miombo soils are geologically old and nutrient-poor and support forests dominated by *Brachystegia*, *Julbernardia* and/or *Isoberlinia* trees. These three closely related genera are all deciduous members of the legume family. Within the miombo, trees usually occur far enough apart that there is not continuous canopy (Campbell 1996).

Throughout the miombo region, these forests are the primary source of domestic energy in the form of fuelwood and charcoal. These forests are also used for building materials, foods, and medicines (Campbell 1996). Often overlooked due to the slow growth, these forests play a crucial role in the livelihood strategies of the people living around them (Chirwa et al. 2008).

The sustainable development literature includes an ongoing debate about the severity of a “fuelwood crisis” (WCED 1987; Arnold et al. 2006; Zulu 2010). The question is whether fuelwood supplies in the developing world are being depleted more rapidly than they are being replaced. Some of the most recent research shows that although previous concerns about a “fuelwood crisis” may have been overstated, charcoal production from African woodlands probably represents an important cause of worry for future forests (Arnold et al. 2006). Because of the extremely high urban demand for charcoal, there is increasing pressure on African miombo forests to produce this commodity (Zulu 2010). In fact an environmental economic model of the forests within the Mulanje Mountain Forest Reserve predicted that if usage and management did not change, the miombo at the base of that mountain would be totally deforested by 2011 (Hecht 2006). As of my 2010 fieldwork there were still miombo woodlands at the base of the mountain, but I cannot speak to how much they had been degraded since 2006.

### **Charcoal: A Rurally-Produced, Refined Fuel**

Charcoal is an energy source made from the incomplete combustion of woody materials. Charcoal is made in many locations throughout the developing world because it is easily transportable and thus can be created near areas of plentiful wood and sold in urban areas. During the production of charcoal many of the soot-causing volatiles are

burned off. This means that charcoal burns more cleanly than wood and is thus preferable for indoor cooking.

Charcoal production has an important ecological impact because it uses live trees. To make charcoal, trees are felled, cut into 3-meter pieces, and put into a pit; grasses and dry wood are used to start a fire over the wood. A structure of grass and dirt is built around the wood so that smoke can escape while still maintaining a low-oxygen environment. The structure is left unattended to smolder overnight (Figure 2-1).

In the presence of high heat and low oxygen, the wood undergoes a process of pyrolysis, or the transformation of a complex substance (wood) into a simpler substance (charcoal) through the addition of heat. During the pyrolysis of wood several important transformations take place. First, as the wood reaches 100°C, the water inside converts to vapor and escapes as steam. Second, as the temperature increases beyond 100°C, the longer chain molecules in the wood begin to denature. Finally, as the temperature passes 280°C and peaks at 400°C, compounds such as methanol, acetic acid, and tar begin to volatilize and leave the wood as gas (FAO 1985).

If too much oxygen enters the pit while the charcoal is being made, the wood erupts into flames and burns to ash instead of being transformed to charcoal. If there is not enough oxygen in the pit, then there will not be enough heat generated for pyrolysis to take place and the wood will not convert to charcoal. Using only hand tools, grasses, and soil, small-scale charcoal producers in the miombo are able to create the critical conditions needed for charcoal production.

After uncovering the charcoal pit, the newly made charcoal is dug out of the pit, placed on the ground, and covered with soil. This puts out any flames that may erupt

upon contact with the oxygen-rich atmosphere. The soil also cools the charcoal so that it can be safely handled. If hot charcoal is packed into bags, it can ignite while being transported to market. After being cooled and pack into sacks the charcoal is transported by foot, bicycle, or vehicle for sale to urban consumers (Figure 2-1).

Due to high demand for charcoal and the fact that charcoal production requires live trees, charcoal makers in the miombo pose a serious threat to the long-term viability of several African forests. However, charcoal production does not occur in a vacuum. Charcoal production takes place as part of the livelihood strategies of people who live in and around these forests. To better protect miombo woodlands from excessive charcoal harvesting it is necessary to understand how one makes the decision to produce charcoal. This research sought to delve into this process and understand the perceptions of the producers through ethnographic interviews. By providing structured insight into the decision process of charcoal makers in the miombo, and by further asking if and how the environment appears in those decisions, we hoped to generate crucial insights for the design of assistance programs or other interventions aimed in conserving the miombo woodlands.

## **The Case of Malawi**

### **Physical Geography of Malawi**

Malawi is a small country in southeast Africa. It is bordered on the north by Tanzania, on the west by Zambia, and on the south and east by Mozambique (Figure 2-2). With a land area of 94,079 square kilometers, Malawi is approximately the size of the U.S. state of Pennsylvania (NSO 2009).

The most prominent geographical feature of Malawi is Lake Malawi, a long crevasse and the southern extent of the Rift Valley. The lake runs along the eastern

edge of the country and is an important source of fish and irrigation water. The lake is well known for its cichlids, a taxon of fish which includes many species with interesting adaptations. Several types of Malawian cichlids have exotic coloration and are exported for fish tanks around the world. Lake Malawi has been the site of several important studies about the biodiversity of its cichlid fish populations.

Most of the land cover in Malawi today is farmland converted from miombo. There are 4 main urban centers in Malawi, but 85% of the population of Malawi lives in rural areas (NSO 2009). *Nsima*, a food cooked from maize flour, is the staple food of Malawi and accounts for the widespread cultivation of maize across the countryside. In addition to its lake and farmland, Malawi also has remaining miombo woodlands. As of 2010 Malawi had about 3.2 million hectares of forested area or about 34% of its total land area. This figure is down from 3.9 million hectares (41%) of forest cover in 1990 (FAO 2011) and demonstrates the high rate of land cover conversion over 20 years.

### **People of Malawi**

As of the 2008 census, Malawi had a population of 13.1 million people. Since independence in 1964 Malawi's annual population growth rate has averaged around 3% (NSO 2008). This high rate of growth has led to increasing pressure on limited land and other natural resources. Population levels are not evenly distributed throughout the country's three regions (Northern, Central, and Southern). The Southern Region contains almost half of the country's population (NSO 2008). This disproportionate distribution affects population density as well; 184 people per square kilometer live in the Southern Region compared to the national average of 139 people per square kilometer (NSO 2008).

More than half of Malawi's population is under the age of 18 (NSO 2008). The two main drivers behind this distribution are a high birthrate and the high prevalence of HIV and AIDS. As of 2009 Malawi was estimated to have an infection rate of 11% (UNAIDS 2010). Because HIV is primarily transmitted through sexual intercourse in Malawi, AIDS typically kills adults, leaving behind orphaned children and grandparents. This inverted population structure impedes sustainable development because there are many children and old people who need to be provided for and few able people to do the work.

With regards to their cooking needs, 96% of Malawians rely on biomass fuel in the form of either firewood or charcoal. People in rural areas use primarily fuelwood (95%) while those in urban areas use a mix of charcoal (44%), fuelwood (35%), and electricity (20%) (NSO 2008; Zulu 2010).

Poverty in Malawi is widespread. The 2009 Welfare and Monitoring survey estimated that 39% of the population was below the poverty line and 15% of the population was ultra-poor, meaning that their total expenditures on food procured less than the minimum nutritional requirements (NSO 2009).

### **Forest-Use Decisions in Malawi**

With Malawi's rapid rate of deforestation, high level of poverty, and high population density and growth rate, it is increasingly important to understand the factors underlying forest-livelihood choice. Among Malawi's three regions, the disproportionately high population density of the Southern Region makes it an especially important site to study the way in which local people use the forest. An important set of factors in this regard is the decision processes behind the choice to adopt forest-dependent livelihoods. Insight

into these processes may help inform interventions which could reduce deforestation and decrease poverty.

The particular focus of this research is to understand how factors related to the environment enter into the decision process behind the forest livelihood activity of making charcoal. In order to pursue this question it is necessary to define what is meant by the term “the environment.” Because of the ethnographic approach of this study, I define “environment” as it would be used by the Malawians living around Mulanje Mountain Forest Reserve in Southern Malawi.

Throughout the Chichewa-speaking regions of Malawi, the English word “environment” is usually translated to the Chichewa word “*chilengedwe*” which also carries the meaning of nature, creation, or being indigenous (Paas 2009). This was consistent with the usage observed in the study area. In contrast to the human-shaped spaces of agricultural fields, village living areas, tea estates, and *Eucalyptus* plantations, there were spaces which the neighbors of the forest reserve considered to be “*za chilengedwe*” or “of nature.” These spaces included the miombo woodlands at the base of the mountain (*nkhalango*) and various spaces on top of the mountain (*ku phiri*). At the study site, charcoal production took place in the miombo surrounding the mountains. Thus, for the purpose of interpreting “factor related to the environment” we will look at factors related to the miombo forest at the base of Mulanje Mountain.

## **Mulanje Mountain Forest Reserve**

### **Background of the Forest Reserve**

Mulanje Mountain Forest Reserve (MMFR) was first protected under British colonial rule in 1927. Since its creation, the size of the reserve has been reduced 5 times to accommodate the increasing population around its borders (Bouvier 2006). The

focal point of the reserve is Mount Mulanje, a 580-square-kilometer massif, or sharply rising plateau. The mountain is made of granite which erodes more slowly than the bedrock of the surrounding plains.

While the plains at the foot of Mulanje are at an elevation of 1,000 meters, the plateau itself rises to 2,000 meters. Mulanje has several prominent peaks, the highest one, Sapitwa, is over 3,000 meters. A strong mythology surrounds Sapitwa, whose name is derived from the Chichewa word *osapitiwa* or “do not go there.” Local people warn of spirits who inhabit the peak and can bring supernatural help or harm to mountain visitors.

The base of the massif is ringed with miombo forests which are used by the local people in a variety of livelihood activities (Fisher, Chaudhury, et al. 2010). On top of the plateau, the surfaces which are not bare granite are covered by either grasslands or afro-montane forests. These forests contain a variety of species including the endangered and endemic Mulanje Cedar, *Widdringtonia whytei*. Known for its durable and attractive wood, Mulanje Cedar is a slow growing tree which regenerates poorly from planted seeds (Bayliss et al. 2007).

The Mulanje Mountain Forest Reserve provides important ecosystem services on local, regional and global scales (Hecht 2006). Locally, the trees on Mulanje are an important source of fuelwood for domestic use. Regionally, the mountain is the source of 15 regionally important rivers. These provide water resources for a large portion of Mulanje and Phalombe districts. The mountain also provides habitat for wildlife and pollinators. Finally, the forests on and around the mountain sequester carbon, impacting the global carbon balance and its effect on global climate change.

## Malawian Forest Policy and Charcoal

The introduction of multi-party democracy in 1994 led to several important changes in Malawian forest governance. A new forest policy (GoM 1996) and a law to support it (GoM 1997) were created within the first two years of the new government. Although the new policy created the framework for communities to participate in Community Based Natural Resource Management (CBNRM) there are strong limitations set on how communities might actually extract their forest resources.

Producing charcoal, for example, requires a special license which can only be issued by the Director of Forestry (GoM 1997). To date, no such licenses have been issued. Thus, although there is technically a legal way to produce charcoal, it is *de facto* an illegal activity. The current enactment of this policy essentially continues a policy from before multi-party democracy (Zulu 2010).

Despite the illegality of all charcoal production in Malawi, the practice is widespread. Malawi produces more than 230,000 metric tons of charcoal per year. This production is responsible for an estimated 15,000 hectares of deforestation. Almost 60% of that charcoal is produced in forest reserves such as the MMFR (Kambewa 2007). The enforcement around charcoal production, distribution, and sale is patchy. A man traveling from forest reserve to urban area usually encounters several different potential enforcement agents including police, soldiers, and Department of Forestry staff. In certain cases a bribe must be paid, in others the charcoal is confiscated.

There are also reports of harsh crackdowns on charcoal producers carried out by Department of Forestry staff and police with support from additional guards brought in from other areas. These enforcement efforts have led to beatings, incarceration, and hospitalization.

## **Study Villages**

Data were collected in two villages along the northern border of the Mulanje Mountain Forest Reserve. In order to protect the identity of their inhabitants, the villages will be referred to as Village 1 and Village 2. These villages were part of a group of four villages purposely selected by researchers in 2008 to represent the diversity of livelihoods and forest uses in the area north of Mulanje Mountain studies (Fisher, Reimer, et al. 2010; Fisher, Chaudhury, et al. 2010).

## **Village history**

Following the national trend of population growth, the Mulanje area has seen substantial population increases in the last 100 years. From the first post-colonial census to 2008 populations across Malawi have more than tripled (NSO 2008). When the first tea estates were established in the early twentieth century the region was very sparsely populated and heavily forested. Miombo forests stretched from the base of the mountain far out onto the surrounding plains. There was no need to harvest wood from the forest reserve because there was ample forest close to the villages. This provided the resources people needed for cooking, craft making, and building and roofing houses. Wild animals lived in the forest which made it a threat to human safety.

The chief of one of our study villages (Village 1) explained that around the time at which the government established the forest reserve on the mountain (1927) and the founders of the tea estate came to this area of Mulanje, there had been a small village near the current location of Village 1, but closer to the base of the mountain. According to the chief, the tea estate founders moved the residents of that village to its present site further from the mountain

The tea estates brought with them large-scale landscape changes. Tracts of land were cleared and planted with the perennial tea bushes. Areas of forest were also cleared to plant *Eucalyptus* trees, a fast-growing fuelwood used for curing tea. According to the Village 1 chief these changes caused certain animals which had been plentiful in the forest to leave the area. Over time as the human population increased and more people migrated to work on the estates, the forest cover around the village was diminished. As the forest resources around the village dwindled it became necessary to use the government forest reserve for resources. Furthermore, with increasing population, the farmland within the village area was now cultivated to feed more people. As a result households tried to achieve increasingly high yields from less land.

Village 2 has a similar history of steady population increase along with the creation and expansion of tea estates. In recent years, a change in the agricultural strategy of one neighboring estate has reduced the employment opportunities for these villagers. Because of market fluxes, several fields of macadamia and coffee were uprooted and replanted with *Eucalyptus*. This left many of the men and women who had worked as coffee and nut pickers without employment.

The people of Village 2 have also seen a gradual shift in their reliance on the forest reserve. When the reserve was first established there was ample forest cover close to the village, but as population has increased and forested area around the village has decreased there has been increasing need to use the forest within the reserve for livelihood resources such as house poles, firewood, and thatch grass.

## **The villages today**

Today, the residents of Villages 1 and 2 access the reserve for fuelwood, timber, and non-timber forest products. Harvesting resources from the forest reserve provides villagers with an important source of income to supplement their maize production (Fisher 2004). Furthermore, households at the edge of the forest make use of the reserve to compensate for food shortages due to weather related crop failure (Fisher, Chaudhury, et al. 2010). Landholdings among most villagers remain small and the neighboring tea estates occupy a large amount of the local land area with tea fields or *Eucalyptus* plantations. Approximately 20% of the households in our study villages report having a member who works on the tea estates.

Villages 1 and 2 were part of a previous set of studies by Fisher and colleagues in 2008. That work used quarterly surveys to measure how different households generated income from a range of livelihood activities. Table 2-1 summarizes the composition of the two villages based on the data from Fisher's studies (Fisher, Reimer, et al. 2010; Fisher, Chaudhury, et al. 2010). Health status, education level, ethnicity, and religion statistics of household head were computed from responses given by 100 households in 2008.

The most notable difference between Village 1 and Village 2 is their population sizes. Village 2 has four times as many households as Village 1. It also has on average more members per household and older heads of household than Village 1. Despite their different sizes, the villages are similar with regard to the number of female headed households (27%). This is very close to the national average of 25% (NSO 2009).

In both villages most heads of household started but did not finish Primary School. Similarly, in both villages about 10% of the sample started but did not complete

Secondary School. Interestingly, Village 2 has more heads of household who never attended school (12%) *and* more heads of household who completed secondary school (16%).

Most villagers in the study villages were either from the Lomwe (62%) or Mang'anja (30%) tribes. These are the most common tribes in the Southern Region of Malawi. There were also villagers who identified as Yao, Chewa, and Tumbuka, but they represented a small portion of the villagers in the two villages.

Finally, with regards to religion, most heads of household were Protestants (84%) followed by Catholic (13%). Village 1 showed the greatest range of religions; in addition to Catholics and Protestants, there were also Muslims (6%) and people with no religion (2%)

### **Methods**

Ethnographic Decision Tree Models (EDTMs) are flow-chart-like models which describe or predict the decision process of a group of people (Gladwin 1989). The models have a branching structure with reasons for and against a particular decision represented by discrete questions. Each one of these questions occurs at a node with “yes” and “no” arrows branching away from it. The pattern of nodes and branches continues until it finishes at an endpoint in the model. Each endpoint represents a discrete choice to do or not do the decision in question.

The models are based in choice theory created by Tversky and colleagues during the 1970's (Tversky 1972; Tversky and Sattath 1979). “Elimination by aspects” theory regards choices in terms of a process of elimination in which a decision is made by evaluating the options in light of an ordered series of attributes. Preference trees or “pretrees” create a way of logically ordering the components of a choice (Tversky and

Sattath 1979). Because of the way this theory structures the factors behind a choice it is necessary to translate each of the reasons for and against a decision into discrete criteria. In other words continuous variables such as amount of Malawi kwacha earned in the past three months would have to be converted into a yes/no variable such as “did you earn more than 300 Malawi Kwacha in the past 3 months?”

### **Previous Applications**

EDTMs have been used to understand a wide variety of phenomenon. For example Fairweather (1999) built an EDTM to differentiate between farmers’ reasons behind adopting conventional or organic agriculture in New Zealand. He was able to show that there were several pathways by which a farmer could choose to practice organic agriculture. The use of an EDTM allowed Fairweather to distinguish between four types of organic farmers which he terms, “hopeful,” “pragmatic,” “frustrated,” and “committed.” His model showed the different causal factors that could lead a farmer to each of these ways of relating to organic agriculture.

A key characteristic of EDTMs is that they are made by interviewing both decision makers who do and do not do the activity in question. Beck (2000) used an EDTM to shed light on the conditions under which psychotherapy counselors would possible child abuse. He found that factors behind the reporting decision included criteria like the possibility that reporting potential abuse might cause more harm than good. In a subsequent article Beck (2005) describes how EDTMs can be more broadly useful to psychological research. In this overview, he points out one limitation of the method; it relies on retrospective memory to build and test models. He suggests this shortcoming may be countered by the fact that EDTMs model the decision process of a group of people. Thus, even though there may be individual failures to remember every detail of

the decision process, there is a good chance that the collective memory of multiple informants will remember most aspects of the decision.

Johnson and Williams (1993) created a model of injection drug users' choice to share or not share needles. They found that the social roles different users played in the process of obtaining and using drugs influenced whether or not they were likely to share needles. Johnson and Williams built their model based on interviews with 33 injection drug user. Based on this sample they created a preliminary model, which they reported without validating it through testing on another sample. Fairweather (1999) also reported a preliminary model without validation. Most studies, however, treat validation as an important step in model building and analysis (Gladwin 1989; Beck 2005; Ryan and Bernard 2006; Heemskerk 2002).

The value of a validated model is that in addition to describing the choices made by the first sample, it can also be used to predict decisions that people will make in the future. These validated models are useful for policy makers, managers, and extension agents as they create programs and write policies designed to affect people's behavior.

One example of a study which presents a validated model looked at the decision of forest-dwelling people to mine gold in the Suriname Amazon. Heemskerk (2002) interviewed 41 miners and 34 non-miners about their mining livelihood choices. Based on these interviews she built a preliminary model which she then tested using a test sample of 13 miners and 9 non-miners. Using her model Heemskerk refuted the hypothesis that people mine gold because they are not making rational choices about the risks and benefits involved. In contrast, she showed that miners and non-miners have complex and rational choice processes that surround their decisions. Bringing

these choice processes to light set the stage for policies and programs aimed at reducing gold-mining by better meeting the needs of current and potential miners.

## **A Modification of Gladwin's Ethnographic Decision Tree Technique**

### **Gladwin's method**

Classical ethnographic decision tree modeling begins with the selection of an explicit decision to model (Gladwin 1989). The decision should be a concrete choice, usually between two alternatives. In our study we looked at the decision of households to produce charcoal in the forest reserve during the preceding three months. We chose to limit the choice to the preceding three months for three reasons.

On the one hand, we wanted to ask about a long enough period that we would capture a meaningful portion of normal life. On the second hand, we did not want to choose such a long period of time that it would be difficult for respondents to remember their activities. Finally, Fisher et al. asked about quarterly livelihood activities in 2008 and this seemed to have been an appropriate slice of time.

After selecting a concrete decision, informants are interviewed to determine the basic structure of their personal decision models. At this stage Gladwin emphasizes the importance of gaining the "insider's point of view" by using the ethnographic interview approach (Spradley 1979). Informants are allowed to become comfortable with the interview process so that they share their expertise about the decision in question.

Gladwin then describes two possible methods, a direct and an indirect method, for combining the individual decision of each informant into a single composite model. In the indirect method the researcher updates his composite model after each interview. In the direct method the researcher builds separate models of each decision and

combines them into a composite model after completing all the interviews from the first sample.

After this composite model is constructed a questionnaire is created with each question corresponding to a single node on the decision tree. This questionnaire is then administered to a second sample, generating the data necessary to test whether or not the responses of the second sample are predicted by the model. Gladwin's convention is that in order to be considered an "adequate decision tree model" the model should predict the responses of the second sample with 85-90% accuracy (Gladwin 1989).

### **Our modification of Gladwin's method**

During our semi-structured interview process we had difficulty getting people to speak directly about their personal decision process in making charcoal. This may have been because making charcoal is an illegal activity. Although many of our initial informants spoke openly about making charcoal, they did not give in-depth reasons for why they did it. However, both informants who did and who did not make charcoal were able to give reasons why others made or did not make charcoal.

This led us to ask contrast questions (Spradley 1979) that focused on why some people made charcoal while others did not. Gladwin recommends asking contrast questions in her discussion of retrieving the data needed to build decision tree models. Because we began by collecting free-listed reasons instead of reasons arranged in a structured format, it was not possible for us to use either Gladwin's direct or indirect method.

Instead we used Ryan and Bernard's (2006) variation on Gladwin's technique. In their study on recycling choices, they used a three-stage process to create a validated decision tree model. In Step 1 they conducted "free-ranging interviews" with a small

sample of informants (N = 21) to determine what the important decision criteria were for recycling a beverage can. These decision criteria were turned into questions. For example if a report of recycling “because I was at home” became the question, “were you at home?” The questions were compiled into a survey which also included a question asking if the respondent had recycled the last can he or she used.

In a similar fashion my research assistants and I reviewed the interview responses from our 16 semi-structured interviews and extracted the reasons people gave why they or others might choose to produce or not produce charcoal in the reserve. We converted these reasons into the 16 questions which can be found in the Appendix. The fact that we elicited 16 questions from 16 semi-structured interviews is purely coincidental.

Ryan and Bernard administered the survey constructed in Step 1 to a new sample of respondents (N = 70). Their responses were used to construct logical trees in which a pathway through a series of decision questions led to an endpoint of either recycling or not recycling the can. Ryan and Bernard describe their tree creation method as a trial and error process which they repeated until they achieved a tree which described the survey responses with a satisfactory degree of accuracy.

In our case we administered the survey to 27 respondents and I entered their responses into a spreadsheet program. This allowed me to sort the entries into groupings which had similar response patterns *and* made a similar decision regarding charcoal production. Through trial and error with this method I created a preliminary tree model which could be tested.

Ryan and Bernard then tested their model by giving the same set of questions to a larger sample (N = 386). These data allowed them to ask whether or not the patterns observed in the 2<sup>nd</sup> sample continued in the 3<sup>rd</sup>. We also administered our questionnaire to a 3<sup>rd</sup> sample (N = 37) to test whether or not their responses would be predicted by the preliminary model.

To create the second tree model I pooled the responses from the 2<sup>nd</sup> and 3<sup>rd</sup> samples into a matrix of 64 respondents. This made it possible to use the “rpart” function in the R software package to partition these respondents into groups which had similar responses to the decision criteria questions *and* similar responses to the charcoal behavior question (R Development Core Team 2009). These groups created the if-then rules which dictated the structure of the second model.

### **What is Ethnography?**

A crucial component of EDTMs is their basis in ethnography: a description of a culture in the terms of its own members (Spradley 1979). In my discussion of ethnography, I employ the term “informant” in the sense of a member of a culture who speaks with the researcher in native language in order to teach the researcher about the informant’s culture (Spradley 1979). The goal of ethnography is to describe the world as it is seen through the eyes of the informant. This allows researchers to gain an “insider’s view” of the situations in question. This approach is particularly useful when we seek to understand why a group of people behaves in a certain way. A fundamental assumption of ethnography is that the “insider’s view” is best gained by treating the members of a culture as the experts on the realms of knowledge which shaped their actions and interpretations of experience.

The ethnographic interview is a verbal exchange between the ethnographer (researcher) and his informant. The goal of this exchange is for the informant to teach the ethnographer about his or her culture. In these interviews we learned about the culture of villagers living along the border of the protected Mulanje Mountain Forest Reserve. In specific, we sought to learn how concerns related to the environment shaped the livelihood decisions of these people.

### **Role of Language in Ethnography**

Language is a shared system of symbols that allows us to make connections between a wide variety of objects. By engaging informants through the use of native language it is possible to gain insight into these connections. Spradley calls the related web of connections a “meaning system,” and relied upon observing semantic relationships in order to uncover it (1979). The underlying web of relationships which is revealed through ethnography is important for grasping the way in which the members of a particular cultural scene make sense out of their world.

In this way language serves as a shared system of symbols (words) such that the symbols that I use to discuss a particular object or phenomenon are understood by someone else using the same language. However, this quality of language may not extend to the various cultural scenes within a society. For example, in doing an ethnography of itinerant men or “tramps,” it might be necessary to learn their particular way of using the English language (Spradley 1979).

This study sought to understand the culture of forest-using Malawians. At a first cut it was necessary to approach this area of knowledge using the local language of Chichewa. However it was important to go even a step further in discovering the way in which Chichewa is used by these forest-users living outside of the Mulanje Reserve.

For example, for these people, *makala* (charcoal) carries a different set of meanings than it does for other Chichewa speakers living in a different cultural scene. For example, the urban family which uses charcoal for cooking sees charcoal in relation to its price, its availability, and its burning characteristics. The rural charcoal producer, on the other hand, sees charcoal in terms of the trees needed to produce it and the processes needed to produce and transport it. For these two Chichewa speakers the same word (*makala*) carries very different sets of associations.

Achieving a sense of the shared meanings that exists within the cultural scene of a community of rural charcoal producers requires that the researcher pay close attention to the words used by informants. For example, during the course of our interviews we discovered several slang terms for the process of making charcoal. This type of language gives insight into the ways in which charcoal producers understand themselves and their activities.

While my research assistants and I began our interviews talking to people about *kuwotcha makala* (burning charcoal), we learned that people who made charcoal for a living employed a different set of terms. For example, *kuwotcha nkhuti* (to burn a pit) was a common way of talking about making charcoal in the forest.

People also described the trip to go to the mountain in different terms, sometimes mixing in words derived from the English words “charcoal” and “jungle.” For example, “*Tiyeni tipite ku jungulo*” (Come on let’s go to the jungle (forest)) was the way one informant invites his friends to go on a charcoal making expedition.

Another informant reported his invitation to go make charcoal as “*Tiyeni kutchako*” (Let’s go to charcoal). “*Tchako*” is not a Chichewa word, rather it is a version of the

English word “charcoal” that is being absorbed into the language of this cultural scene. Coming to learn these ways of talking about charcoal helped our research team gain entrée and establish rapport with charcoal producers and their neighbors. Our comprehension and use of this type of language signaled to subsequent informants that other charcoal makers had discussed their practices with us.

### **Data Collection**

I collected field data from September 15, 2010 until November 15, 2010. During this time I lived in Village 1 and traveled to Village 2 by bicycle. I worked with two field assistants from the local area who greatly facilitated the research in two key regards. First, they assisted with gaining access to informants. Having grown up in and around the two study villages *and* having assisted Fisher with the 2008 study, my assistants helped me to make connections and develop rapport with informants and other villagers in both study sites.

Second, my research assistants were skilled in speaking, reading, and writing Chichewa and English. This made it possible for them to help me better ask questions and understand responses during interviews. It also meant that they were able to transcribe interviews in Chichewa and translate them into English.

### **Participant observation**

Living in one of the study villages facilitated three types of interaction which contributed to the study. First, direct interactions with villagers built trust and rapport which allowed me to ask sensitive questions both in formal interviews and during informal conversations. Making charcoal is an illegal activity and in recent years the law has been harshly enforced. Villagers’ willingness to admit their involvement in this activity during interviews demonstrates that we achieved a high degree of trust.

Second, interacting with my neighbors made it possible for me to make several trips to the forest to observe livelihood processes in action. Due to the illegality of charcoal production I never went to the forest explicitly to make charcoal, however I did accompany other villagers on trips to gather thatch, collect firewood, or see signs of earlier settlements within the reserve. During these excursions I crossed paths with other villagers on route to or in the process of making charcoal. This provided an opportunity to observe the activities and the effects of making charcoal on the forest.

Finally, living in the village made it possible to practice the linguistic skills necessary for social interaction and successful interviewing. During my two years in Peace Corps Malawi, I learned to speak Chichewa in the central region of Malawi. The Chichewa spoken in Mulanje is similar, but there are some subtle differences. For example the initial consonant of words like *mchere* or *mtengo* may not be pronounced in the South. Living with neighbors who spoke little to no English created an ideal environment for acclimating to the new language.

## **Interviews**

In order to collect the data necessary to build and test an ethnographic decision tree model, we conducted a series of semi-structured and structured interviews. The questionnaire that emerged from the semi-structured interviews and was used in the structured interviews is included in the Appendix.

All interviews were conducted in Chichewa at the home of the person being interviewed (informant or respondent). We recorded interviews using a digital voice recorder. Recording quality varied depending on background noise from wind, children, and other neighbors. Notes were taken at each interview and immediately after each interview, the researcher and research assistants met to discuss the content of the

interview. Interviews which yielded new or relevant information were transcribed in Chichewa and translated into English.

## **Sampling**

Our goal in selecting informants for the initial semi-structured interviews was to locate households in the two study villages which would give us a range of perspectives about deciding to produce or not produce charcoal in the forest reserve. We used the livelihood income levels from a 2008 survey we created a list of households which did and a list of households which did not produce charcoal in 2008 (Fisher, Chaudhury, et al. 2010; Fisher, Reimer, et al. 2010). Using these two lists we selected candidate households for our semi-structured interviews.

In order to alert candidate households of our interest in speaking with them, we wrote notes in Chichewa and delivered them the day before we came to their homes. If the selected informants from 2008 could not be found (i.e., they were no longer living in the study village) we contacted the next household on the list.

In order to gather cultural data about the history of the area and the history of charcoal production in particular, we conducted one expert interview with the chief of Village 1 and his brother. These informants were chosen intentionally because of their expertise in local history and village livelihoods. When gathering cultural data a nonprobability sample is sufficient because you are dealing with experts (Bernard 2000).

Our goal in the first 27 structured interviews was to learn how to order the decision criteria gleaned from the semi-structured interviews into a preliminary model. It was important to choose a sample which had no repeats from the first round of interviews (Gladwin 1989). We located households for these interviews by systemically moving

through different neighborhoods in each village, randomly selecting households with residents who were home. This was a simple form of neighborhood-level cluster sampling (Bernard 2000), and we did not re-use the sampling frame created from the 2008 survey respondents.

Our goal in the second round of structured interviews was to test the decision tree we had created during the previous round of structured interviews. Once again it was necessary to choose a unique sample; we used a neighborhood-level cluster sample approach to locate households we had not yet visited.

## **Results**

### **Interviews**

For the semi-structured interviews we were able to locate 16 of the 18 households selected, and of these we arranged to interview all 16 heads of household. This low refusal rate is consistent with the reports of other researchers doing fieldwork in non western societies (Bernard 1988). For both sets of structured interviews we also had a 0% refusal rate.

### **Model 1**

Figure 2-3 presents the ethnographic decision tree built with data from 27 structured interviews. It describes the choices made by those respondents with 89% accuracy. The model predicts the choices of the second sample of respondents (N=37) with 79% accuracy. While a predictive rate of 79% is high, it is lower than the 85% predictive rate which Gladwin recommends for a valid EDTM. Based on this outcome a second model was created (see next section); however, this new model needs to be validated by testing it on a fourth sample of respondents. In this paper I offer interpretations of both of these models.

## **Model 2**

A second tree was created based on the responses of all 64 structured interviews (27 + 37). This tree is presented in Figure 2-4, and it describes the choices of these respondents with 92% accuracy. However, the predictive ability of the model has not been tested. Nonetheless, following in the tradition of Johnson and Williams (1993) and Fairweather (1999), I believe there are still valuable insights that can be drawn from interpreting a preliminary model. These interpretations would be given more weight if future work is able to refine and validate this model by carrying out additional structured interviews at the study sites.

## **Discussion**

### **Insights from Semi-Structured Interviews**

There was a general sense among informants that the future of the forest was dim. Most informants saw that there would be a shortage of firewood and that it would be necessary to walk further to get it. There were also several mentions of the prospect of drought. This informant at Village 2 told us about the projected effects of current forest use on future forest function.

Researcher: What do you think will happen in the future?

Informant: There will be drought because if some trees are missing now it is likely that the trees available today may not be there tomorrow. So there will be drought and firewood and water will not be in abundance.

Researcher: What should people do to avoid this drought?

Informant: We should plant more trees, stop cutting down trees and avoid bush fires.

Wife, Household 61, Village 2

In addition to describing changes that were taking place in the forest this informant also recommended behaviors that could be enacted in order to prevent these negative effects. This litany of “plant trees, do not cut trees, and prevent fires” was a common

response to the question of how to prevent the forest from disappearing. The suggestions of planting trees and preventing fires are important ideas, but they are however outside the scope of this research. Focusing on tree cutting as a source of forest change it is interesting to explore our informant's explanations of why tree cutting occurred and how it might be reduced.

In several of our semi-structure interviews the need for cash emerged as a driving factor behind forest activity choices; this was particularly true for the deforesting activity of making charcoal. In the following interchange the informant explains his perceptions about the cause of forest change, the danger of forest change, and what would be required to prevent these changes.

Informant: There will be drought and famine in the future because we are depending on natural things so that forest will finish up and there will be nowhere to go.

Researcher: Okay, is there anything to do to avoid that?

Informant: To avoid the forest being destroyed?

Researcher: Yes.

Assistant: Is there anything to be done to renew the forest?

Informant: Yes it is possible. According to the assistance we can find we can stop going to the forest to work there. It is very true that many people can't stop, however they would stop that work if they had enough food. In that case only those seeking firewood would go to the forest. The small trees will have a chance to grow bigger and after a short time the forest will have come back.

Husband, Household 193, Village 1

Once again, this informant perceived the impending environmental trouble of "drought" and even "famine." This informant went further to reflect on what would be necessary for villagers to reduce their forest use. If, as this man told us, there is "assistance" which makes it possible for people to provide for their families without going to the forest, then people will limit their forest extraction to firewood for cooking food.

## **Model 1**

The ethnographic decision tree model (Figure 2-3) helps identify the factors behind the decision to produce charcoal. In discussing each of these factors, I will emphasize factors related to the natural miombo forest at the base of the mountain. I will also discuss the role of the five capitals that play a part in the Sustainable Livelihoods Approach (i.e., Physical, Natural, Human, Social, and Financial). Each criterion appears as one of the nodes on the model (Figure 2-3).

### **Criterion 1: Physical ability**

This criterion dealt with the physical capabilities of a person to carry out the task of making charcoal. A great deal of strength is required to climb the mountain, cut trees, dig a pit, manage the fire, and transport bags of charcoal. In our first interview we spoke with an older man who was not able to give us much information about the forest because he was now too weak to travel up and down the mountain. He told us that he was now selling off the fruit trees on his property for them to be made into charcoal.

Another informant spoke more generally about the role that physical ability plays in the decision process to make charcoal:

Assistant: Are there other reasons that people don't make charcoal?

Informant: There are also those without physical ability...They fail to make charcoal even though they are not afraid of the law. There are also others who do not know how to make charcoal. They want to do it, but they don't know how.

Husband, Household 81, Village 2

The physical ability to make charcoal is one aspect of the human capital involved in the process of making charcoal (Scoones 1998). This factor sheds light on the connection of health to livelihood choice. In addition to the effect we observed of age-inhibition on charcoal production it is a reasonable supposition that illness from HIV and

AIDS would be an impediment to production. Notably social capital cannot be used to overcome a physical inability to make charcoal.

## **Criterion 2: Knowledge of charcoal production**

Knowing how to make charcoal is another important element of the choice to produce charcoal. This human capital component of the decision was revealed by informants who discussed why charcoal production was prominent in this area but not in other areas. For example:

Researcher: Everybody is [making charcoal] here or everywhere?

Informant: Especially here [Village 1] and K..... Village. Otherwise other villages like [Village 2] and N....., it is not much there. Villages like M..... and L..... area they depend on us to teach them how to make charcoal.

Researcher: Will you [teach those villagers to make charcoal]?

Informant: Yes because that's where trees for making charcoal can be found now.

Husband, Household 198, Village 1

In discussing the prevalence of charcoal production in his village the husband at Household 198 observes that charcoal is not being produce in Villages M and L. It seems the residents of these villages lack the know-how to produce charcoal. This lack of knowledge is the limiting factor behind charcoal production, even though those villages have the trees needed for making charcoal.

It would be interesting to follow the spread of knowledge about how to make charcoal as the supply from our study villages begins to dwindle. A 2007 charcoal and wood report from the Mulanje Mountain Conservation Trust (MMCT) projects that as charcoal supply from areas such as Mbowera (an area to the West of Mulanje) dwindle, supply will come from villages along the MMFR (Chamwala et al. 2007). This is a good example of the potential of social capital to increase access to other capitals, in this case knowledge of charcoal production.

### **Criterion 3: Sufficient land to farm**

The lack of land for farming was given as one reason why residents of Village 1 engaged in charcoal production. One informant explained why people in his village make charcoal while those in other villages do not:

There is a land problem because the tea estate took a large area of land leaving people without much land to farm. Thus, people do not farm sufficient food every year. Thus people make charcoal to have sufficient food. In other places they have big farms such that they are able to harvest 20 sacks of maize per year. Thus they do not lack money because they can sell food to get it. Here we only harvest two sacks per year, which is food for two months only. Here there is no one with a sufficient farm. Everyone has around  $\frac{1}{4}$  acre to farm with.

Husband, Household 198, Village 1

For this household the shortage of land resulted in a low harvest of maize which meant that there was no surplus to be sold to generate the cash needed to meet household needs. As this informant points out the land farmed by the tea estates constitutes a major way in which the land of the area is being used. This shift in tenure of the best land in the area from village lands to tea estate took place several years ago according to the chief of Village 1 and his brother. At this time the population of the village was much smaller and there was still miombo woodland outside of the forest reserve.

The land shortage discussed by our informants is related to several of the types of capital. First, land is a type of natural capital. Second, crops are a form of produced capital generated from land. Third, land ownership relates to social capital in that land tenure occurs via a network of socially sanctioned arrangements. Land also functions as a nexus of other types of capital. The combination of labor (human capital), crop inputs such as seed and fertilizer (produced capital), and the natural capital of soil, water, and

sun leads to the production of crops. In addition to meeting subsistence needs, crops can also be sold to generate financial capital for fulfilling other household needs.

Despite the connection between land and natural capital it is not considered to relate to the environment because, in the eyes of our informants agricultural space is considered distinct from *chilengedwe* or natural spaces—such as the forest.

#### **Criterion 4: Food shortage**

As the husband in Household 198 explained, the lack of land to farm leads to a shortage of food production. Most maize in Malawi is planted at the beginning of the rainy season in January and harvested at the end of the rainy season in May. This means that the greatest food deficit is usually from February through April, the months right before the harvest.

This study asked participants to focus on the experiences of their households during the time period of August, September, and October 2010. This season is only three months after harvest and is not a time period in which food shortages typically occur. Thus, households which experienced food shortage during the period queried were likely to need further supplementation before the next harvest. Quotes in previous sections illustrated how the heads of Households 193 and 198 mention the need for money to buy food as the driving agent behind making charcoal in the miombo forest.

#### **Criterion 5: Selling other forest products**

Among the households which participated in our structured interview, 14 out of 64 sold some kind of non-charcoal forest product. The most typical product was firewood, but respondents also sold poles, bamboo, and thatching grass. One informant gave us insight into why charcoal was the most preferred product to harvest and sell:

Assistant: What is the difference between firewood and wood used to make charcoal, which is more profitable?  
Informant: Charcoal.  
Researcher: Why?  
Informant: Because one headload of firewood from here up to there can be at a price of 200 Malawi Kwacha, and after discount can be 150 Malawi Kwacha. So the same headload if put in a pit for charcoal production can produce maybe one bag and a half, which means we can have 500 Malawi Kwacha. You see the difference?

Husband, Household 193, Village 1

As this informant explained, a greater price could be obtained for the charcoal than for the wood from which that charcoal was made. This creates a greater incentive to produce and sell charcoal than to gather and sell firewood. Another difference between these two fuel sources is that charcoal is generally made from live wood while firewood comes from dead wood. This means that the sources of wood for the two products have different effects on the forest. Charcoal requires the cutting down of live trees while firewood does not.

Selling forest products relates to the use of the forest as a site of natural capital. Perhaps villagers who are accustomed to using the forest as a source of a commodity such as firewood or thatching grass are more likely to also use the forest for the commodity of charcoal.

### **Criterion 6: Formal employment**

Half of the households we talked to during our structured interviews reported having had one of their members formally employed during the previous three months. One of our informants from the semi-structured interviews explained to us why the lack of formal employment plays a role in his “being found in the forest,” in other words his working there as a charcoal producer.

Because we are found in the forest, like myself—I’m found in the forest because I’m not employed. I don’t work at any place, but I have got a family

which needs to be supplied with food. They depend on me, so I don't have any plans but to go in the forest and cut some trees. Of course we do have plans like running a business, but the problem is capital. We get little money from the forest. It can't make us to go ahead.

Husband, Household 193, Village 1

This informant does not “work at any place,” but he still has “family which needs to be supplied with food.” The distinction between cutting trees in the forest and “work” at a “place” makes clear that formal employment fits into a different category than work making charcoal.

It is interesting that this informant discusses “not having any plans” to make money except for going into the forest to “cut some trees.” This statement points to his lack of ways to get money from an organized business venture. He amends this statement by saying that he does have some business plans but lacks capital to carry them out. He notes the forest is not a source of capital to use for his business plans. They get only a “little money from the forest” which is not sufficient to help his family “go ahead.” In other words the forest does not supply a sufficient source of capital to allow for the start-up of a non-forest business.

The most prominent mode of formal employment among the 64 respondents was to pluck tea on the tea estates. This job requires a substantial investment of time for low wages. As one of our respondents explained:

My opinion is that many people burn charcoal to get money, because people receive small salaries in estates. To start early in the morning and finish at 5:00 in the evening you receive 135 Malawi Kwacha. While in charcoal burning by 12:00 noon you might be done with the job and be at home and you have made 300 Malawi Kwacha.

Respondent 27, Village 1

In comparison to working in the tea estates, charcoal has more flexible hours and better pay. This also suggests one reason why formal employment may reduce the likelihood of making charcoal. One individual working long hours on the tea estate could not simultaneously make charcoal. However, it is possible for different members of a household to share their livelihood tasks. Even though one member of the family is employed plucking tea, another member may be making charcoal in the forest.

### **Criterion 7: Neighbors produce charcoal**

This criterion was based on the observation that charcoal production seemed to be more common in certain sections of each village. Using participant observation in addition to ethnographic interviews (Gladwin 1989), we noticed that there was a greater tendency for charcoal burners to live near each other. This could have been because charcoal producers had similar social or economic status. Thus it made sense for them to congregate together. It could also be possible that the exchange of human capital such as the knowledge of making charcoal explains why people who are living in the same area are found to be making charcoal. Further research might investigate the cause behind this observation.

### **Criterion 8: Desiring to get rich from the forest**

This criterion was generated in our interview with the chief of Village 1 and his brother. The purpose of this interview was to uncover some of the history of the area and of charcoal production in particular. This interview revealed that in addition to being a means of meeting day-to-day subsistence needs, charcoal was also a way of “getting ahead.” Our informants explained the connection between charcoal production and iron sheets—a roofing material which indicates a higher economic status than a grass thatch roof.

Chief: If we had known about making charcoal--  
 Brother: Iron sheets.  
 Chief: [*Inaudible*]  
 Brother: Someone will buy iron sheets to put on his house.  
 Chief: [*Laughter*]  
 Brother: Where does he work?  
 Chief: [*Laughter*]  
 Brother: He makes charcoal! Yes. Therefore [an observer must know that] charcoal is a way to get money.  
 Researcher: OK. He sees his neighbor.  
 Chief: Yes he sees his neighbor.  
 Brother: Yes.  
 Chief: Many here [*gesturing*] with iron sheet houses are due to charcoal.  
 Brother: Just charcoal.  
 Researcher: OK  
 Brother: You'll find that there are single women who are building houses with iron roofs—women! They use money from charcoal. They carry firewood from the forest to the village and burn it here so that they make charcoal and sell it. They bring back one sheet at a time. After doing this for awhile they have enough for the whole house.

Village 1 chief and his brother

The chief's brother outlines a hypothetical example of a man who buys iron sheeting for his house. He asks rhetorically, "Where does he work?" with the implication being "what company employs him?" The comical answer is that he does not work for a company or have any official job, rather "he makes charcoal." The laughter associated with this twist indicates the unexpected humor in the idea that charcoal might actually be able to produce an income comparable to formal employment. Charcoal is not considered a "job" and yet people making charcoal appear to be doing some of the things that people with jobs do, like installing iron sheets on their houses.

Although charcoal may not have the same social status as other professions, it is still capable of generating sufficient wealth to help a producer increase his or her economic status. Furthermore, this possibility of increasing status through charcoal

production is a process observed by neighbors. Peers of this hypothetical charcoal producer see his iron roof and learn that “charcoal is a way to get money.”

Beyond the hypothetical, the chief and his brother gave a real example of the role of charcoal in wealth creation and the way this may have spread through neighborly observation. They point out that in their own neighborhood, “many here with iron sheet houses are due to charcoal.” Indeed out of the dozen houses near the chief’s compound, more than half had iron roofs. Not only has charcoal been useful for generating the money to put iron sheets on houses, its occurrence in a neighborhood suggests that there is some exchange of ideas about this way of moving ahead.

Finally, the chief’s brother points out that the money making power of charcoal is so strong that even single women— one of the most economically disadvantaged groups in rural Malawi— are able to use charcoal production as a means of putting iron-sheeted roofs on their houses. They have to work slowly and steadily, but “after doing this for awhile they have enough for the whole house.”

Like “Selling other forest products” (Criterion 5), “Desiring to get rich from the forest” (Criterion 8) has to do with the miombo forest and hence “the environment.” In this case the forest is seen not only as a source of natural capital, but a source of sufficient natural capital to raise one’s socio-economic status. This way of seeing the forest contrasts with a view of the forest or “the environment” as an entity that deserves protection or special treatment.

## **Model 2**

The second model is surprisingly different from the first. Its structure resembles a vine more than a tree. This may be an artifact of using a computer-based sorting algorithm rather than a linear structure within the data. Although the model describes

the data with high degree of accuracy (92%), certain elements of it are challenging to interpret. For example, in this model having neighbors who produce charcoal actually makes a certain subgroup of villagers *less* likely to produce charcoal themselves. Each criterion in the model is explained below in relation to the capitals and to the environment.

### **Criterion 1: Knowledge of charcoal production**

As in Model 1 this criterion appears early in the tree and is a useful way of sorting out people who do not make charcoal. Predictably, people who do not know how to make charcoal do not report having made it.

### **Criterion 2: Physical ability**

Also as in Model 1 this criterion appears in the tree. Once again, people who are unable to carry out the physically strenuous act of making charcoal do not report making it.

### **Criterion 3: Previously caught cutting firewood or making charcoal**

Households with members who had previously been caught making charcoal or cutting firewood without a permit were more likely to have made charcoal in the last three months. This was surprising considering some of the harsh enforcement practices which charcoal makers described to us. One informant recalled a crack-down effort on charcoal making:

Researcher: It was in June 2010?

Informant: Yes, but they have also done so some time before because they patrol the forest after every 3 months, beat people, and take them to the police. However, this team is additional to the regular team that guards the forest from time to time.

Researcher: So they beat people so much that they are carried to the hospital?

Informant: Yes.

Researcher: Do policeman allow this?

Informant: They take the police for security since the people are armed. So they want to prevent people from attacking them with their weapons when they whip you with their guava sticks. When they whip you, they take you to the [forestry] office and then to the police where you spend a night or when you are lucky you are asked to pay for discharge.

Husband, Household 198, Village 1

As this informant described the enforcement of the law against charcoal can involve a strong level of physical violence. The regular team of forest guards is supplemented with outside members and sometimes the police as well. This team carries sticks from guava trees because reportedly they bend without breaking and are thus useful for beating a person.

The informant at Household 198 told us about one case in which a boy was so “severely beaten [that he] was carried in a wheelbarrow because he was failing to walk.” With reports like these it is not surprising that 61 out of our 64 respondents reported being afraid of being beaten by guards in the forest. Despite this widespread fear, many of the household we spoke to continued to make charcoal.

It might be the case that people who have been previously caught tended to be charcoal makers because they have been making charcoal all along and have not been deterred by enforcement efforts. In other words perhaps charcoal makers were caught more because they were in the forest anyway. This could be an indicator that enforcement efforts are not being effective at reducing repeat offenses.

Like Criteria 5 and 8 in Model 1, this criterion has to do with the miombo forest, which is the way in which we have operationalized the environment. In this case the forest guards, responsible for catching offenders and enforcing rules within the forest, represent a second aspect of the forest. In contrast to the forest as a repository of natural capital, these guards show the forest as a site of rule enforcement and limited

access. In this case the forest is a controlled space where taking resources may come with dire consequences.

#### **Criterion 4: Accustomed to making charcoal**

This criterion was born out of the comment we heard from several informants that certain people made charcoal because it had become a habit for them. Indeed several of the members of households in Village 1 had been making charcoal for over 15 years. Our interview with the Village 1 chief and his brother gave us some important insights into how charcoal production came to be established in the area.

Researcher: What made people start burning charcoal?

Informant: Problems, financial problems.

Researcher: Do you remember the year they started [making charcoal]?

Informant: When they started...looks like 1960.

Researcher: 1960?

Informant: Yes, 1960.

Researcher: Before the independence?

Informant: And the person was one only...the whites asked him to make charcoal for them to iron their clothes.

Chief, Village 1

The chief went on to tell us how the knowledge of making charcoal spread from that single villager who started making charcoal several decades ago. He began a profitable enterprise in which he was soon joined by several of his neighbors. Many of these people continue producing charcoal to this day.

Our interview with one informant corroborated this story of the rise of charcoal production in the area:

Researcher: So maybe to talk of charcoal. We discussed it, but I didn't ask when you or your friends started burning charcoal?

Informant: I can say, like myself as an example, I have taken 18 years.

Researcher: 18 years?

Informant: Yes, burning charcoal because from the time I got married here I've never gone somewhere to work. My job is burning charcoal only. There are other people whom I found here burning charcoal [when I arrived] and they are

still burning. So these people have been burning charcoal for 20 or 30 years.

Husband, Household 198, Village 1

This description of people who have been making charcoal for over 20 years paints the picture of a livelihood activity that has become very ingrained for certain individuals. In this case, the informant at Household 198 is a good example of a person who has become accustomed to making charcoal. He has been doing it for so long that to choose not to do it now would require a serious shift in his habits.

#### **Criterion 5: Sufficient land to farm**

As discussed with regards to Model 1, this criterion appeared several times in our semi-structured interviews. Once again, it plays a large role in whether or not people choose to make charcoal in the forest. For those villagers who make it to this point in the tree, the model predicts that insufficient land will lead to charcoal production.

#### **Criterion 6: Selling other forest products**

Also discussed in Model 1, this criterion had to do with whether or not respondents sold non-charcoal forest products such as firewood, bamboo, or poles. Once again selling these other products made it more likely that a person would produce charcoal. It is also the case that within Model 2 selling forest products was a criterion that had to do with the miombo forest.

#### **Criterion 7: Environmental sensitization**

Informants in the semi-structured interviews explained they received information about the importance of the forest from various sources. The Chichewa word that informants used most often to talk about this information transfer was “*kuunikira*” which we have translated as “to sensitize.” Other definitions of *kuunikira* include “to illuminate,” “to enlighten,” and “to guide” (Paas 2009).

One informant told us about his experience receiving sensitization from the Department of Forestry:

Researcher: Can you explain a bit about the sensitization you received about the forest?

Informant: They sensitized us and advised us in these ways. The forests are useful because One, we get thatch grass from there, Two, we get firewood for cooking, and Three they protect water in rivers from drying up. This is the training we received.

Husband, Household 81, Village 2

As this informant explains, “sensitization” involves being informed about the ecosystem services provided by the forest. This sentiment about what made forests useful was echoed in many of our informants’ responses about the importance of the forest.

Interestingly, many of the respondents who reported having been sensitized about the importance of the forest also reported making charcoal. This suggests two possibilities. The first is that the sensitization campaigns are preferentially targeting people who make charcoal. The other possibility is that people might be making charcoal in spite of knowing the dangers to the future of their forest because of economic need. In this case more education about the importance of forests or sources of degradation would not affect the situation. Heemskerk (2002) found that among small scale gold miners in the Suriname Amazon, there was already a high degree of understanding about the risks and benefits of gold mining; therefore education about the environmental impacts of that livelihood activity were non-influential in changing behavior. In that case, effective interventions would need to address underlying issues of poverty and inequality.

Like Criteria 3 and 6 from Model 2, this criterion has to do with the environment as represented by the miombo forest. In this case, however, the forest is depicted as a site

of important resources that deserve and require protection. Notably, however, the respondents who moved through this node in the model were sorted in a counterintuitive fashion. Those who had been sensitized actually made charcoal. Those who had not been sensitized moved down the model to the next criterion.

### **Criterion 8: Neighbors make charcoal**

The final criterion in this model has to do with whether or not a villager is likely to make charcoal if his neighbors make charcoal. In the position where this criterion occurred in Model 1, having charcoal producing neighbors made a villager more likely to produce charcoal. This was consistent with the observation that charcoal producers tended to live in similar areas.

In Model 2, for villagers who made it to the very end of the model, having neighbors who produced charcoal made it more likely that they would not produce charcoal. Conversely having neighbors who did not produce charcoal made it more likely that they did produce charcoal. These confusing results may be due to the small number of respondents at this stage in the tree. In this case there are only 6 respondents who made it this far down the tree. It is likely that the pattern seen here is a result of the small numbers at this stage.

### **Comparing Models 1 and 2**

Looking at the two models together gives us a greater perspective into the charcoal-making decision. It also reveals certain strengths and shortcomings of these two models and of this method. Each model represents one way of partitioning a set of respondents into groups which have similar attributes and a similar outcome decision. Certain attributes play an important role in one model and not in the other. Other attributes occur in both models.

It is important to note that the trees themselves do not reflect the step by step decision process of the respondents; instead they display an efficient means of sorting the charcoal makers from non-charcoal makers based on their responses to questions from the questionnaire. Thus, it is not necessarily true that the criteria which occur first in a model are the first things that respondents considered when making their decisions. However, there is significance in the ordering of the criteria within the models. If a criterion occurs at the top of the model then it is useful for splitting the whole set of respondents. If a criterion occurs only at the end of a branch then that criterion is only useful for splitting the respondents which come down that branch.

Looking at Model 1 (Figure 2-3) and Model 2 (Figure 2-4) side by side gives us an opportunity to compare and contrast their depictions of the factors behind the decision to produce charcoal. In both models we see that the human capital concerns of knowledge and ability to make charcoal occur at the top of the model. This placement indicates that these two concerns are useful criteria for splitting large numbers of respondents into smaller groups. In both models these two criteria must be met in order for a person to make charcoal. This makes sense in light of the technical and laborious process involved. The positioning and predictive accuracy of these criteria emphasize the importance of these human capital criteria to the overall decision.

Another criterion that occurs in both models is whether or not a household has enough land to farm. In Model 2 this criterion separates out eight households who had enough land and correctly predicts that those households would not make charcoal. The remaining households who did not have enough land made charcoal unless they met a series of additional criteria. In Model 1, a land shortage does not lead directly to any

outcomes. Instead, it splits respondents into groups that when further subdivided will yield outcome predictions. In the study villages, land shortages are caused by increasing populations that cannot expand because of the strictly enforced boundaries of the tea estates and the forest reserve. Thus although having limited land is a factor influencing household decisions, it is not a factor which households themselves can control. The larger forces of immigration, overpopulation, and historical land ownership outweigh the influence that households can exert.

Both models contain the criterion of selling other forest products; selling other forest products makes a household more likely to sell charcoal. This suggests the importance of being (1) familiar with the forest and (2) familiar with market avenues for selling forest products. The occurrence of this criterion in both models only means that in both cases it was a useful attribute for splitting respondents.

## **Summary**

The unsustainable practice of using live trees for charcoal prompted this exploration into the decision-making process of those who choose this illegal and dangerous livelihood in a protected forest reserve. Semi-structured interviews with heads of households at the edge of the reserve uncovered a set of criteria behind their decision to produce charcoal. Using this set of criteria as a guide, a set of structured interviews were conducted to discover how those criteria might be ordered into a logical tree. The preliminary tree was then tested by conducting an additional set of structured interviews with another sample. The tree predicted the responses of the second sample with 79% accuracy, lower than the 85% cut-off associated with successful decision trees.

A second tree was created which described the choices made by the respondents from both sets of structured interviews. This tree described the responses of these households with 92% accuracy. However its predictive ability has not yet been validated through testing with an additional sample.

With regard to the environment, both trees include criteria which involve the miombo forest. However, these considerations of the forest do not include concern for the protection or preservation of the forest; in both models the forest criteria depict the forest solely as a source of natural capital. This finding is consistent with the finding from semi-structured interviews that although informants valued the forest and worried about its decline, most felt powerless to change their forest use habits without financial assistance or alternative employment opportunities.

Ultimately, protecting the forest reserve will require reducing or eliminating charcoal production. Because of the outside forces that influence the decision of charcoal producers, this will likely require a concerted effort from government agencies and NGOs to coordinate helpful interventions. But both the supply and demand sides of the charcoal system must be addressed because even if an intervention stopped charcoal production in a specific location, this reduced supply would lead to increased prices in corresponding urban areas. This increase in price would incentivize charcoal production in rural areas, including the target of the intervention and possibly villages throughout the region. Clearly the charcoal trade is a dynamic interaction between rural producers and their urban consumers.

Reducing urban demand for charcoal would require shifting residents to alternate sources of energy for heating and cooking. The Government of Malawi promotes

electricity as an alternative fuel source for urban cooking, but the high number of power outages and the current rates of electrification make this an unreliable alternative. Other alternatives to charcoal include solar cookers which have been promoted in African countries since the 1950s. Low adoption rates have been attributed to high costs of the stove (~US\$ 45), difficulty using the stove for cooking traditional foods like *nsima*, and the need for cultural shifts to facilitate stove adoption (Boahene 1998). Also, demand for charcoal is greatest during the rainy season when solar availability is at a minimum.

Another approach to reducing demand for charcoal would be to encourage people in urban areas to use less fuel when cooking. One promising technology is the use of insulated cooking boxes. These can be made with cheap and readily available materials and aid in the cooking of foods that need simmering, such as beans and rice.

Table 2-1. Summary statistics for the two study villages

	Village 1	Village 2
Number of Households	103	411
Members per household		
Mean (range)	4 (1-11)	6 (1-13)
Age of Head of Household		
Mean (range)	40 (19-80)	48 (24-105)
Female Headed Households	28%	26%
Education Level of Head		
No School	2%	12%
Some Primary	64%	57%
Completed Primary	24%	6%
Some Secondary	10%	10%
Completed Secondary	0%	16%
Health Status of Head		
Poor	2%	18%
Fair	16%	12%
Good	30%	47%
Very Good	48%	2%
Excellent	4%	22%
Ethnicity of Head		
Lomwe	48%	76%
Mang'anja	38%	22%
Yao	10%	1%
Chewa	4%	0%
Tumbukua	0%	1%
Religion of Head		
Catholic	18%	8%
Protestant	74%	92%
Muslim	6%	0%
No Religion	2%	0%

Created with permission from data used in Fisher, M., M. Chaudhury, and B. McCusker. 2010. Do forests help rural households adapt to climate variability? Evidence from Southern Malawi. *World Development* 38(9):1241-1250.

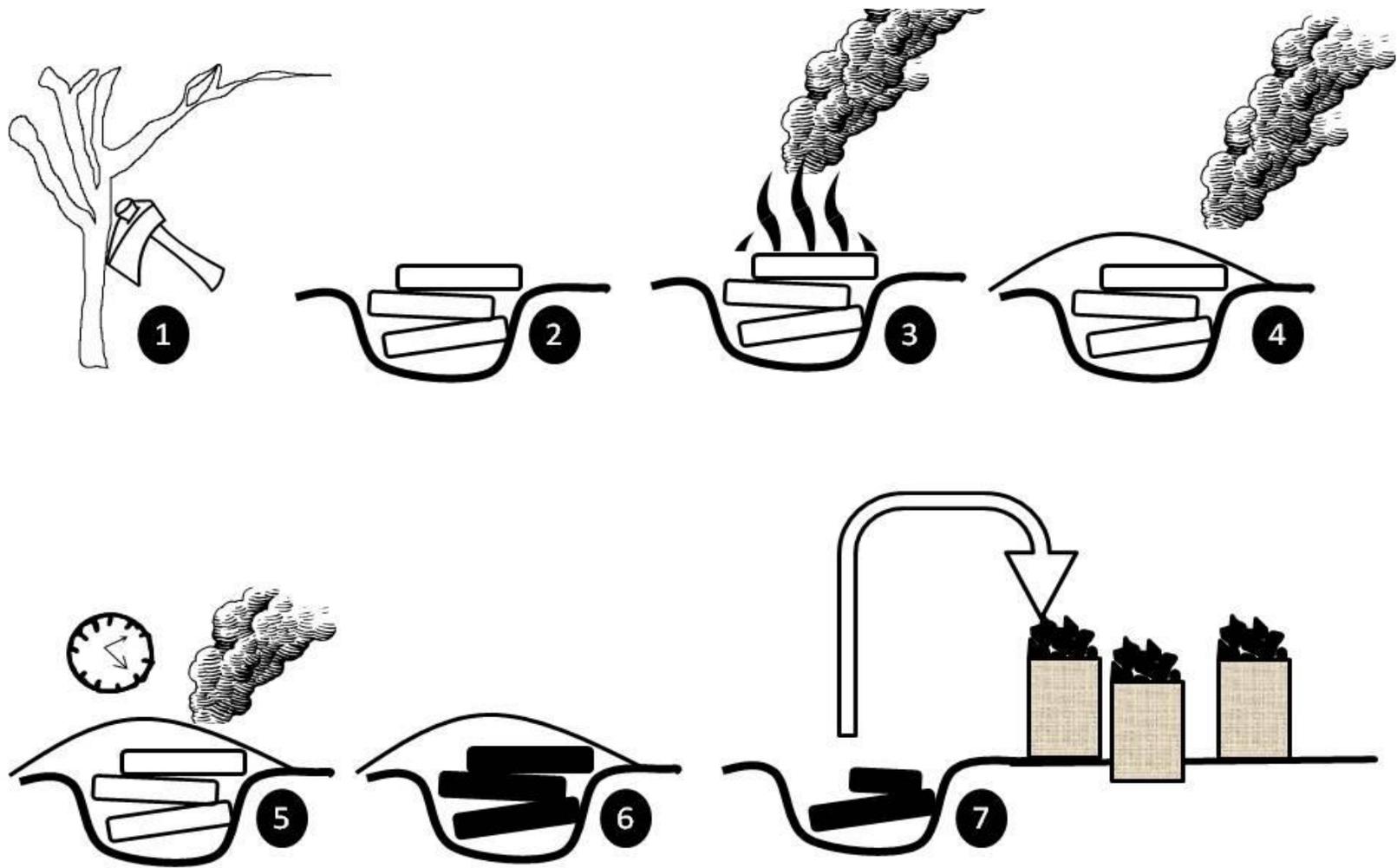


Figure 2-1. Diagram showing the process of making charcoal. Live trees are cut down (1), cut into pieces and put into a pit (2). Grasses and dry wood are used to start a fire on the wood (3). The pit is then covered with dirt (4) and left to smolder overnight (5). During this time the wood is converted into charcoal (6). After uncovering it the charcoal is put into sacks for transporting to market.

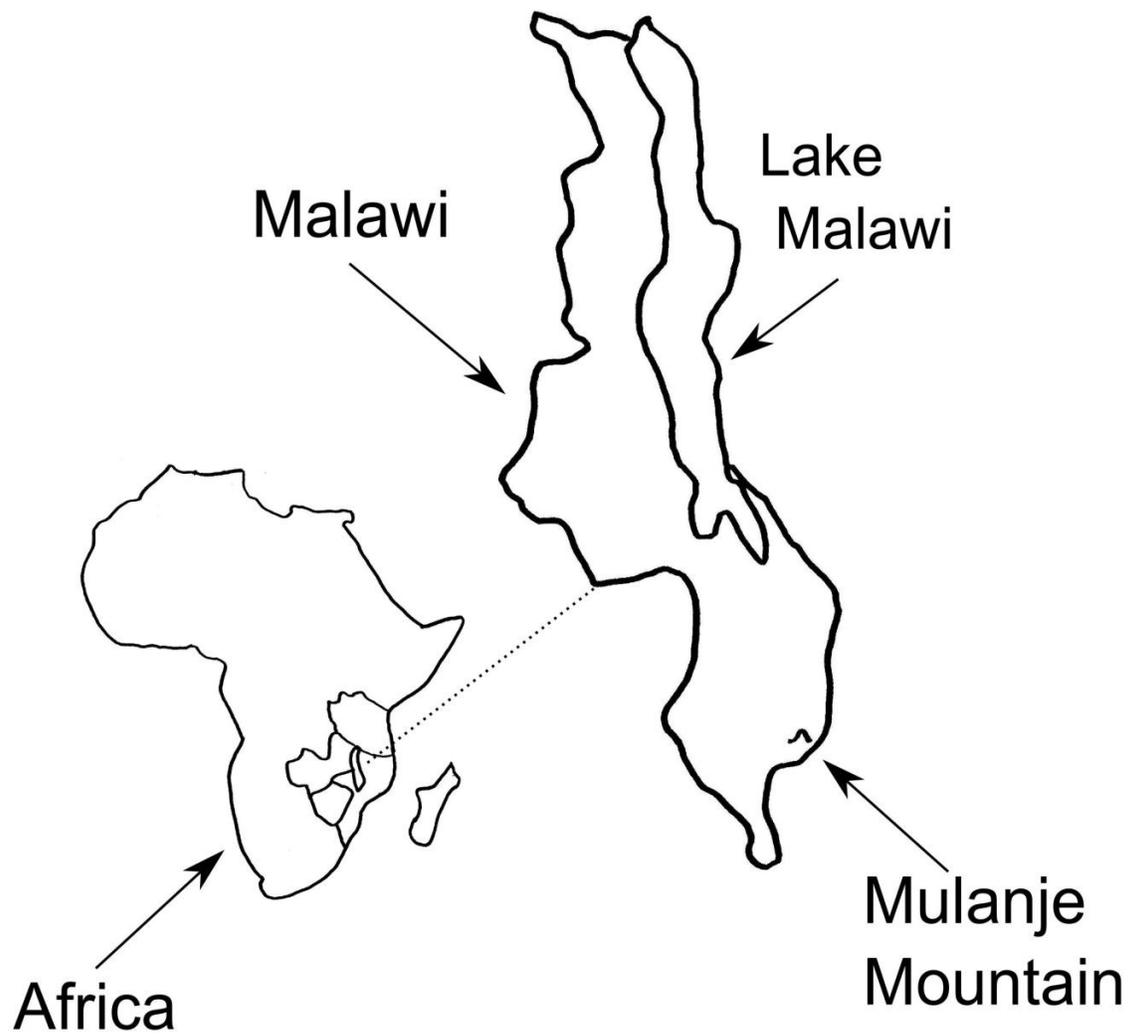


Figure 2-2. A map of Malawi. The line drawing of Africa in the lower left shows Malawi in the context of its surrounding countries: Mozambique, Zambia, and Tanzania. The line drawing of Malawi highlights two prominent features: Lake Malawi and Mulanje Mountain.

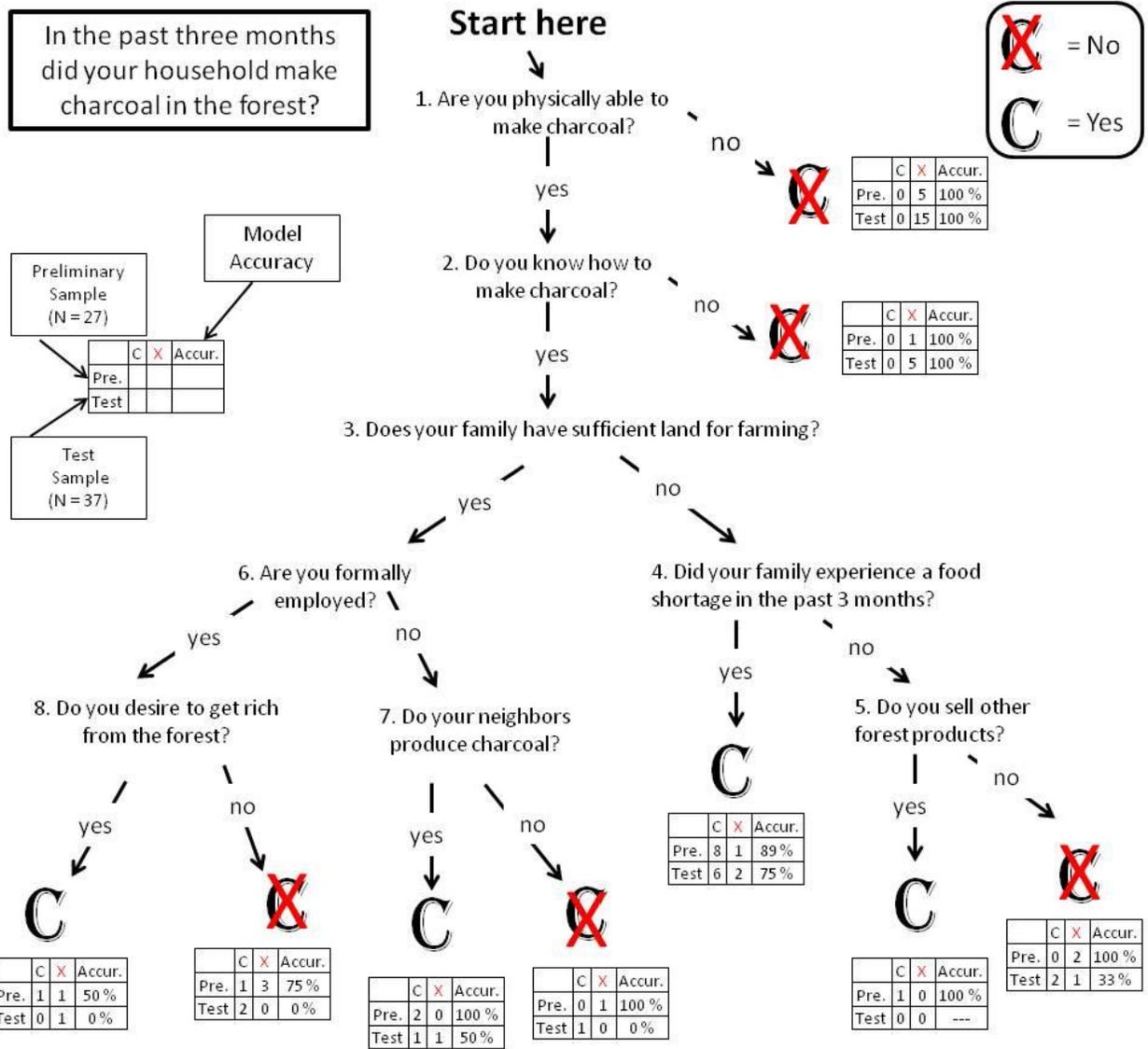


Figure 2-3. Model 1. Ethnographic decision tree model of households' decisions whether or not to make charcoal in the forest during the preceding three months. Starting at the top of the model, each pathway represents a set of choices that divide the respondents into distinct groups. The letter at the end of each pathway (either C or X) indicates the model's prediction for that group's decision. The table underneath each symbol reports the choices made by the respondents from each of the two sets of structured interviews.

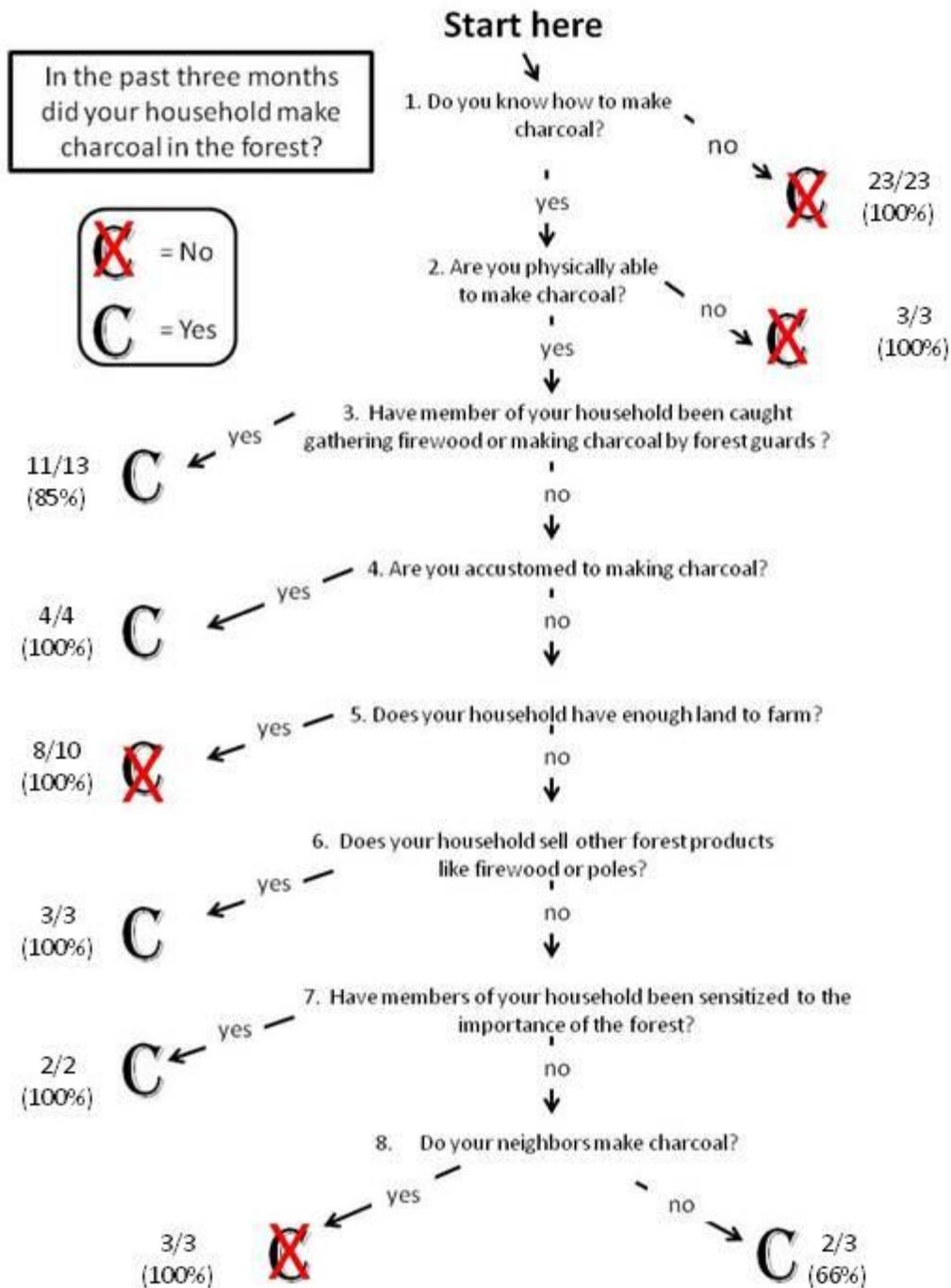


Figure 2-4. Model 2. Second ethnographic decision tree model of households' decisions whether or not to harvest charcoal in the forest during the preceding three months. This model was created to describe the choices of all 64 households. The ratio next to each letter is the number of households correctly predicted by the model out of the total number of households which went down that path.

## CHAPTER 3 CONCLUSIONS

There are several viewpoints recognizing the connection between alleviating poverty and conserving natural resources (Adams et al. 2004). With regard to forest resources, forest-dependent livelihoods certainly play a role in shaping this interaction. As Sunderlin et al. (2005) explain, interactions between people and forests can be beneficial for both, negative for both, or beneficial for one while negative for the other. We might imagine a range of forest livelihoods that would fit in each of these categories (Sunderlin et al. 2005). For examples see Table 3-1.

The results of this research suggest that charcoal around Mulanje is currently a win-lose situation with the forest losing biodiversity and tree cover while humans benefit temporarily. Since many of our informants told us the forest has undergone substantial change in recent years and continuation of current use patterns are expected to lead to forest loss, drought, and eventually famine, without intervention this livelihood will become a losing proposition for both human beings and forests.

With such bleak expectation for the current livelihoods there is a need for interventions which will slow the rate at which charcoal is produced by current as well as new producers. A first step in a successful intervention is to learn why people living outside the reserve choose to make charcoal. In particular, how might the environment occur within the decision to make charcoal in the reserve?

Both Non-Governmental Organizations (NGOs) and government ministries use environmental “sensitization” to raise villagers’ awareness of the benefits they receive from the forest, presumably to reduce the adoption of livelihoods which might harm the forest. Informants expressed an awareness of these benefits and the consequences

that over-harvesting would have on future benefits. Clearly these sensitization efforts have been effective at disseminating their messages. Nonetheless many villagers persist in making charcoal. What does this mean?

This research can answer that question by looking at factors related to the environment which occur in the decision to harvest charcoal. Are factors related to the environment present? If so, what form do they take? Does a concern for the environment lead to reduced adoption of charcoal production?

Through the creation of ethnographic decision tree models this research found evidence to suggest that factors related to the environment do appear in the decision to harvest charcoal as do factors involving human capital, land tenure, food security, and formal employment. In the instances in which the environment does appear in the model, it is as a source of natural capital—a resource to be transformed into other types of capital as part of a livelihood process.

Efforts to sensitize villagers about the importance of the environment have been effective at imparting the idea that the forest is a precious resource which is being depleted. However, most villagers feel helpless to change their forest-use patterns. Supporting their wish to change will require interventions which go beyond the current pattern of “sensitization” and rule enforcement.

This analysis hangs on the interpretation of EDTMs. These useful tools have certain limitations in their construction, validation and interpretation. A brief discussion of these limitations may be useful for future scholars.

### **Lessons Learned about Ethnographic Decision Tree Models**

The models employed in this research suffer from five key constraints as described in the sections below. First, they are dependent on interview data for their

construction and validation. Second, the way in which the models were created makes it possible to attribute co-occurrence but not causality to each of the nodes in the tree. Third, the method of model creation we used also makes it important to provide a clear explanation of what the model does and does not say. Fourth, during the creation of the model if we missed an important criterion in the first round of interviews then it would not have showed up in the questionnaire or in the final model. This could happen even if it was an important factor in the decision of our later respondents. Finally, the focus of the models on the household as an autonomous agent may fail to account for larger structural forces that are shaping the decision.

### **Interview Limitations**

The interviews used to create these models are problematic in three ways. First, they rely on informant's self-reporting about their activities. This generates the possibility that informants might not have been telling the truth. This response bias may have happened because informants were embarrassed by their actions, were afraid of being penalized, or possibly even sought the glory of claiming to do have done something illegal. There may have also been a phenomenon known as social desirability in which the informant attempts to please the interviewer.

Participant observation is one tool that can be used to counteract these shortcomings of interview data (Gladwin 1989). Some participant observation occurred in this research, but this was limited by lack of time at the study site. This limitation made it difficult to make connections between the self-reports and the observed behaviors of specific informants.

## **Model Creation**

The models were created by splitting the respondents into categories that most efficiently sorted them by their charcoal decision. In the case of “Knowledge of Charcoal Production” and “Physical Ability to Make Charcoal,” both of these categories were very effective at discriminating between charcoal-makers and non-charcoal-makers. This is demonstrated in the fact that 100% of respondents who failed these two criteria did not report making charcoal (Figure 2-3). This split makes sense because lack of knowledge or of physical ability would make it impossible to produce charcoal.

Subsequent partitioning of the data was more difficult as each potential split did not produce “clean” groupings of charcoal makers and non-charcoal makers. In these cases it was necessary to create branches that produced a “best fit.” This is a normal occurrence in creating decision trees because there is rarely a branching pattern that perfectly describes the data. The goal is to create a tree which represents the data with minimal errors.

Furthermore even though these models provide an interpretable ordering of the decision factors leading to a particular decision, they do not demonstrate strict causality between the criteria paths and the outcomes. It is possible that instead of causality we are observing a correlation between the pathway and the outcome. For example, based on Criterion 4 of Model 1 we know that almost all households who had a food shortage in the past three months made charcoal. While it is likely that this food shortage was the driving factor in the decision, the model does not prove that this is the case. It is possible that the decision was actually caused by a confounding factor such as need to pay school fees at that time.

Another example occurs in Criterion 3 of Model 2 (Figure 2-4). This criterion asked if members of the household had been caught gathering firewood or making charcoal by forest guards. Respondents who had been caught were actually more likely to be charcoal makers. This confusing finding makes sense in light of the fact that people who were making charcoal in the first place were more likely to have been caught. However, this criterion illustrates one danger of reading the model too closely as a causal indicator.

The flow of the model suggests that having been caught before is a reason that leads people to go in to the forest and make charcoal. Judging by the negative consequences of getting caught, this is very unlikely. Rather, it was being in the forest making charcoal in the first place that led those people to get caught. This difficulty with the direction of causation is one limitation of the way in which we constructed these trees.

### **Model Interpretation**

The criterion about having neighbors who produce charcoal occurs in both models. However, in Model 1 having neighbors who produce charcoal makes one more likely to produce charcoal, while in Model 2 it makes one more likely not to produce charcoal. How can we make sense out of this apparent contradiction?

First, it is important to note that the criterion occurs within different contexts in each model. For example, in Model 1 it is a useful criterion for splitting households with sufficient land but without members who are formally employed. In Model 2 it is a useful criterion for splitting households who do not habitually make charcoal, do not have enough farm land, do not sell other forest products, and have not been sensitized about the importance of the forest. These differences likely play a large role in explaining why

these two groups respond in opposite ways to the neighbor criterion. Simply put, respondents with different characteristics responded differently to the same question.

For example, the group which arrives at the neighbor criterion in Model 1 consists of households that had sufficient land to keep their members busy farming. Even though those villagers did not have formal employment the farm still provided them with a way to transform their labor into other forms of capital. In that case, making charcoal might not be an obvious choice unless there was sufficient peer pressure or encouragement from charcoal-producing neighbors.

In contrast, the group which arrives at the neighbor criterion in Model 2 consists of households which do not have enough land to farm. Members of these households are unaccustomed to making charcoal and have never been caught making it. Furthermore, these households do not sell other forest products and have not been sensitized to the importance of the forest. These households tend to make the opposite decision of their neighbors when it comes to charcoal production.

It is not immediately clear why this group from Model 2 would exhibit this pattern in their decision process. One possibility, which needs to be tested, is that households in this group are “borderline charcoal producers,” in other words they have recently started making charcoal or are likely to start in the near future. This possibility is supported by the fact that members of these households are not accustomed to producing charcoal and have not been caught before. However, these villagers have limited land holdings giving them a heightened need for financial income.

This “borderline charcoal producer” hypothesis could explain why some of these households produce when their neighbors do not; perhaps these are the first in their

area to adopt the practice. It is also consistent with households not producing amidst neighbors who do produce; households within this group are the last holdouts in the area and will soon begin producing charcoal themselves. This possibility warrants investigation in future research.

An alternative to these explanations is that the predictions of the models are an artifact of the data. In both models there is a low flow of respondents through the node in question. In Model 1 there are only three respondents from the preliminary sample and three respondents from the test sample who go through this node. In Model 2 there are only six respondents who go through this node. It is possible that by random chance, for the respondents who made it this far down the tree, their responses to this question best matched their charcoal decision.

If this discrepancy is caused by an artifact of the data then it points out an important issue with these models, especially the way they were created in this study. Because the preliminary models were constructed using the survey responses to questions elicited from ethnographic interviews with informants, we may have failed to capture some of the active choice process of the decision-making respondents. When dealing with situations where informants can more readily articulate their decision process, it is possible to create a decision model at each initial interview. Eventually such a process leads to a composite model which can then be tested via a survey.

The danger of creating models based purely on survey data is that it will not be clear if your tree actually matches the decision process which guides your informants. Based on this, it is recommended that, when possible, future researchers employ

Gladwin's direct or indirect method instead of the Ryan and Bernard variation we employed here.

### **Possibility of Missing Key Criteria**

Our initial semi-structured interviews were designed to give our informants an opportunity to share their thoughts about the forest, forest use, and the factors that might determine whether a household leaned toward or away from charcoal production. Using Fisher's 2008 study participants as a sampling frame we located households who had and had not harvested charcoal in previous years. We relied on the criteria which emerged from those interviews to design the questionnaire which would become the basis for both of our models.

During our structured interviews using that questionnaire we allowed respondents some latitude to explain their answers, but for the most part we did not probe deeper on any of our questions. Thus it is possible that our questions did not get at the issues that some of our respondents would have considered most important to their charcoal decision. This is a limitation of constructing these models according to the Ryan and Bernard (2006) method.

### **Agency over Structure**

With their intense focus on the individual, these models take focus away from the role of larger structural forces in shaping outcomes. It is important to recognize that each household in this study is embedded within a larger social, ecological, and economic context. Each criterion in the model relates in some way to forces outside the control of the individual household. For example, the land shortage criterion in Models 1 and 2 is a product of the history of land use and land ownership in the area.

## **Structural Forces**

As outlined in the Mulanje Mountain Forest Reserve section of Chapter 2, there are several key factors at play in the geographic area where the study took place. First, rising population continues to put pressure on limited farmland and forest resources. Second, the tea estates in the area are large users of land and water. They also provide economic productivity and employment opportunities to the area. Finally, the dual specters of poverty and disease have strong effects on the people living around the mountain.

The models reveal that structural forces contribute to several of the decision criteria. As previously mentioned, the land shortage criteria relates to both the tea estates and to increasing populations. Addressing issues of farm land access for households around the mountain is a complicated issue involving the tea estates, traditional authority, and district and national government.

The physical ability criterion, which also occurs in both of the models, relates to the health concerns, especially the high rate of HIV and AIDS. As an increasing number of people are physically unable to produce charcoal we would expect that the forest might improve, however the people's inability to contribute to household income would likely have a negative effect on human welfare.

## **Recommendations**

### **Interventions in the Study Villages**

Judging by past observations, more efforts to sensitize villagers about the importance of the forest will not reduce forest cutting. There is already a high level of awareness about the importance of the forest and the negative consequences of behaviors like cutting live trees to make charcoal. Furthermore, despite widespread fear of forest

guards, many villagers continue to make charcoal, even villagers who have been previously caught and even beaten. As charcoal-making informants told us again and again they know that cutting live trees will create problems for them, but that they cannot stop cutting without an alternative income source.

So what would be required of such an alternative income source? Such a source would need to specifically target charcoal-makers, thus providing those households with an incentive to stop making charcoal in order to pursue this income source. A food for work program was mentioned several times by informants. The effectiveness of this solution would depend on their need for food vs. cash. Future research might investigate whether or not “food” is the main driver for cash or whether it is other needs such as school fees or agricultural inputs.

This might be an excellent opportunity to explore some payment for ecosystem services (PES) opportunities such as the hotly debated reduced emissions through deforestation and degradation (REDD) proposal. The difficulty with implementing PES schemes is finding a way to distribute money to the people who are forgoing the forest opportunity. In many cases the payments do not reach the people who lose income opportunities by not using the forest.

### **Interventions in Neighboring Villages**

As our informant at Household 198 explained, there are several other villages next to the reserve where people do not know how to produce charcoal. In fact, he told us, one of these villages was his original home and he intended to go there to impart knowledge of how to make charcoal, because “that is where the trees for making charcoal can be found.”

This possible diffusion of this knowledge is a troubling prospect considering the ecological damage already being caused near the study villages. Interventions to prevent this might focus on reducing the incentives to transmit this practice to other villages. These villages are reported to be places where estate labor is plentiful and pays well enough to keep people from turning to the forest for supplemental income. Perhaps it would be feasible for conservation organizations to supplement a program at the estates to produce and market a “fair-trade” or green product which touts the role they play in reducing forest degradation and increasing wages.

Although the challenges to achieving forest conservation in the face of a rapidly increasing population and deep poverty are daunting, the importance of this undertaking should not be underestimated. It is hoped that by employing people centered methods such as that of the Sustainable Livelihood Approach it might be possible to design and test strategies for working with local people to reduce forest pressure and increase human welfare.

### **Interventions in Urban Areas**

As discussed in Chapter 2, lowering the production of charcoal in rural areas requires the reduction of demand from urban areas. Currently charcoal provides an affordable and reliable fuel source for cooking in urban households. It is considered a “middle class fuel:” less expensive than electricity and more clean-burning than firewood (Zulu 2010). Future research might look further into how these middle class urban households think about the forest, charcoal production, and their own charcoal use. Perhaps this group of people is in a better position to both care about the future of the forests *and* incorporate this concern into their fuel choice decision.

If urban households did become willing to pay for a more environmentally friendly fuel source, what alternatives are available? The logistics of generating and supplying electricity for a greater number of households make it an unlikely solution. Malawi's rapidly increasing rural population puts a high demand on agricultural land which might otherwise be used to grow biomass crops for fuel. One possibility would be to import and partially subsidize large quantities of fossil coal. Although undesirable because of the air pollution it causes, a temporary transition to this fuel might reduce urban demand enough to save some of the dwindling forests of Southern Malawi.

## **Research Implications**

### **Implications for Theorists**

The research suggests that despite an awareness of forest decline and acknowledgement of their role in the change, villagers are unable to explore alternatives to charcoal due to a lack of economic opportunities. This is consistent with Maslow's hierarchy of needs which predicts that people will work first to satisfy their basic needs before focusing on goals outside of their immediate purview (Maslow 1943).

Furthermore, these findings are consistent with post-materialist scholars who predict that seeing the environment as an entity that deserves protection is an action that is permitted by a certain level of economic development (Franzen and Meyer 2010).

### **Implications for Practitioners**

Violent enforcement activities and sensitization campaigns are likely to alienate people living near the reserve. If government agencies and NGOs want to reduce the pressure on the reserve, they might consider providing opportunities for cash that target those people who are involved in making charcoal.

For example, one resident of Village 1 suggested that charcoal burners should be hired to patrol the mountain, make firebreaks and prevent “poaching” of various sorts. Several other informants in Village 1 spoke about wanting to be more involved in the management of the forest. They spoke about the formation of a committee that would plant trees and protect existing resources from exploitation by outsiders.

These ideas sound similar to co-management approaches that have been tried in other areas around the world, in Malawi, and even in other sites around Mulanje. These informants however did not mention other co-management efforts taking place in their area. Thus they were unable to discuss the success of such efforts and their potential success in the study villages. However, the fact that idea was raised at all indicates an interest in this type of undertaking and a willingness to explore it further.

Unfortunately, according to the estimates of Hecht’s model there simply is not enough wood left in the reserve for it to provide enough resources for the population and be sustainably managed by the surrounding communities. As she points out, either the wood would run out due to overharvesting or it would be necessary to exclude certain communities from co-management in order to give their neighbors sufficiently large parcels for a sustainable supply (Hecht 2006). Perhaps these dire predictions could be slowed or countered through the replanting of trees in areas that used to be forest.

### **Summary**

This final chapter has reviewed the findings of this research, explored some of the limitations of the ethnographic decision tree method, and offered a few suggestions for interventions which might reduce deforestation in Malawi. To be effective, interventions should target both the supply and the demand sides of charcoal production. From the

supply side, alternative employment or economic opportunities ought to be targeted specifically at charcoal producers and their neighbors who are likely to choose to produce. Possible opportunity includes forest maintenance employment for trail maintenance, clearing firebreaks, and replanting trees.

From the demand side it is important to support the Government of Malawi in its efforts to provide the nation with affordable, dependable energy sources. While electricity will play an important role in Malawi's urban energy future, it is important to look for other sources as well. This may mean considering unfavorable possibilities such as the short term use of subsidized coal in order buy the forests some time.

This research focused on household-level decisions regarding charcoal production; however, few decisions are made within a vacuum. These respondents were strongly constrained by social, economic, political, and ecological factors in their village, region, and nation. In order to influence the decisions made within these households it would be important to provide an atmosphere which supports socially and ecologically-sound choices. The activities of the Malawi Government and NGOs play a crucial role in shaping this context. It is hoped that the findings of this research will inform policies which seek to promote ecologically-mindful decisions of Malawians living at the edge of forest reserves.

Table 3-1. Examples of different forest livelihoods

People	Forests	Examples
Win	Win	Eco-tourism concession run by local people Sustainably harvested tree-nut operation Medicinal plant harvesting co-operative
Win	Lose	Cutting down forests to plant cash crops Clear-cutting forests for timber Removing forests to create grazing pastures
Lose	Win	A tightly defended reserve with no access People forcibly relocated away from a forest Warfare preventing forest clearing
Lose	Lose	A highly overexploited forest A low productivity pasture land owned and run by elites A forest which has experienced severe drought and fire

## APPENDIX CHARCOAL DECISION QUESTIONS

These are the questions we created from the decision criteria mentioned in the 16 semi-structured interviews conducted between September 21st and October 11th, 2011. These questions were used as an interview guide for the structured interviews conducted from October 22nd to November 9th, 2011. Responses to these questions were used to construct Model 1 (Figure 2-3) and Model 2 (Figure 2-4) and also to test Model 1.

Note that not all of these questions appear as nodes in the models. Those questions which do appear in the models were the ones which were most useful for dividing respondents into choice-groups with common outcome decisions. Those which did not appear in the models were unnecessary for this process.

- 1a-- Were you formally employed during Aug, Sep, Oct 2010?
- 1b-- How were you formally employed during Aug, Sep, Oct, 2010?
- 2a-- Did you do informal wage labor during Aug, Sep, Oct 2010?
- 2b-- What kind of wage labor did you do during Aug, Sep, Oct?
- 3a-- Did you sell forest products during Aug, Sep, Oct 2010?
- 3b-- Which forest products did you sell during Aug, Sep, Oct 2010?
- 3c-- Was it necessary for your household to make charcoal during Aug, Sep, Oct 2010?
- 4-- Do you know how to make charcoal?
- 5- Are you physically able to make charcoal?
- 6-- Are you accustomed to making charcoal?
- 7-- Does your household have sufficient land for farming?

8-- In addition to formal employment, forest products, and wage labor, did your family have any additional ways of getting money during Aug, Sep, Oct 2010?

9-- Putting aside the law, do you think it is right to cut trees in the forest without permission?

10-- Did your household experience food shortages during Aug, Sep, Oct 2010?

11-- Have you been sensitized as to the importance of the forest?

12-- Have you been caught by guards in the forest before?

13-- Are you afraid of getting beaten by the patrolmen in the forest?

14-- If forest trees are cut, will they sprout again?

15-- Do you want to get rich from the forest?

16-- Do your neighbors or relatives make charcoal?

## LIST OF REFERENCES

- Adams, W. M., R. Aveling, D. Brockington, B. Dickson, J. Elliott, H. Jon, D. Roe, B. Vira, and W. Wolmer. 2004. Biodiversity conservation and the eradication of poverty. *Science* 306(5699):1146-1149.
- Angelsen, A., and S. Wunder. 2003. *Exploring the forest--poverty link, key concepts, issues and research implications*. Bogor, Indonesia: CIFOR.
- Arnold, J., G. Kohlin, and R. Persson. 2006. Woodfuels, livelihoods, and policy interventions: Changing perspectives. *World Development* 34:596-611.
- Bayliss, J., S. Makungwa, J. Hecht, D. Nangoma, and C. Bruessow. 2007. Saving the island in the sky: The plight of the Mount Mulanje Cedar *Widdringtonia whytei* in Malawi. *Oryx* 41:64-69.
- Bebbington, A. 1999. Capitals and capabilities: A framework for analyzing peasant viability, rural livelihoods and poverty. *World Development* 27:2021-2044.
- Beck, K. A. 2000. A decision making model of child abuse reporting. *Dissertation Abstracts International: Humanities & Social Sciences* 61(5A):1749.
- Beck, K. A. 2005. Ethnographic decision tree modeling: A research method for counseling psychology. *Journal of Counseling Psychology* 52(2):243-249.
- Bernard, H. R. 1988. *Research methods in cultural anthropology*. Thousand Oaks: Sage Publications.
- Bernard, H. R. 2000. Sampling. In *Social Research Methods: Qualitative and Quantitative Approaches*. Thousand Oaks: Sage Publications.
- Boahene, K. 1998. The challenge of deforestation in tropical Africa: Reflections on its principal causes, consequences and solutions. *Land Degradation & Development* 9:247-258.
- Bouvier, I. 2006. Mount Mulanje Land Cover Time Series Analysis. Short-term technical draft report for Compass II.
- Campbell, B. M. 1996. *The Miombo in transition, woodlands and welfare in Africa*. Bogor, Indonesia: CIFOR.
- Chambers, R. 1995. Poverty and livelihoods: Whose reality counts? *Environment and Urbanization* 7(1):173-204.
- Chambers, R., and G. Conway. 1992. *Sustainable rural livelihoods: Practical concepts for the 21st century*. Brighton: Institute for Development Studies.

- Chamwala, K., M. Kayembe, and D. Nangoma. 2007. Report on charcoal and wood survey. Mulanje: Mulanje Mountain Conservation Trust.
- Chirwa, P., S. Syampungani, and C. Geldenhuys. 2008. The ecology and management of the Miombo woodlands for sustainable livelihoods in southern Africa: The case for non-timber forest products. *Southern Forests: A Journal of Forest Science* 70(3):237-245.
- Clark, W. C. 2007. Sustainability science: A room of its own. *Proceedings of the National Academy of Sciences* 104(6):1737-1738.
- Deweese, P. A., B. M. Campbell, Y. Katerere, A. Siteo, A. B. Cunningham, A. Angelsen, and S. Wunder. 2010. Managing the Miombo woodlands of Southern Africa: Policies, incentives and options for the rural poor. *Journal of Natural Resources Policy Research* 2(1):57-73.
- Fairweather, J. R. 1999. Understanding how farmers choose between organic and conventional production: Results from New Zealand and policy implications. *Agriculture and Human Values* 16(1):51-63.
- FAO (Food and Agriculture Organization). 1985. Wood carbonisation and the products it yields. In *Industrial charcoal making*. Rome: Food and Agriculture Organization, Forestry Department.
- FAO. 2006. Better forestry, less poverty: A practitioner's guide. Rome: Food and Agriculture Organization.
- FAO. 2011. State of the World's Forest 2011. Rome: Food and Agriculture Organization.
- Fisher, B., and T. Christopher. 2007. Poverty and biodiversity: Measuring the overlap of human poverty and the biodiversity hotspots. *Ecological Economics* 62(1):93.
- Fisher, M. 2004. Household welfare and forest dependence in Southern Malawi. *Environment and Development Economics* 9(2):135-154.
- Fisher, M., M. Chaudhury, and B. McCusker. 2010. Do forests help rural households adapt to climate variability? Evidence from Southern Malawi. *World Development* 38(9):1241-1250.
- Fisher, M., J. Reimer, and E. Carr. 2010. Who should be interviewed in surveys of household income? *World Development* 38(7):966-973.
- Fisher, M., G. Shively, and S. Buccola. 2005. Activity choice, labor allocation, and forest use in Malawi. *Land Economics* 33(7):503-517.
- Franzen, A. and R. Meyer. 2010. Environmental attitudes in cross-national perspective: a multilevel analysis of the ISSP 1993 and 2000. *European Sociological Review* 26(2):219-234.

- Gladwin, C. H. 1989. *Ethnographic decision tree modeling*. Newbury Park, CA: Sage.
- GoM (Government of Malawi). 1996. National Forest Policy of Malawi. Ministry of Natural Resources. Lilongwe, Malawi: Government of Malawi.
- GoM. 1997. The Forestry Act 1997. The Malawi Gazette Supplement No. 5C.U.S.C. (1997). Zomba, Malawi: Government of Malawi.
- Hecht, J. 2006. Valuing the Resources of Mulanje and Mountain: Current and projected use under alternate management scenarios. Occasional Paper No. 14. Lilongwe, Malawi: COMPASS II.
- Heemskerk, M. 2002. Livelihood decision making and environmental degradation: Small-scale gold mining in the Suriname Amazon. *Society & Natural Resources* 15(4):327-344.
- Hughes, R., and F. Flintan. 2001. *Integrating conservation and development experience: A review and bibliography of the ICDP literature*. London: International Institute for Environment and Development.
- IUCN (International Union for the Conservation of Nature and Natural Resources). 1980. *World conservation strategy : Living resource conservation for sustainable development*. Gland, Switzerland: IUCN.
- Johnson, J., and M. L. Williams. 1993. A preliminary ethnographic decision tree model of injection-drug users (IDUs) needle sharing. *International Journal of the Addictions* 28(10):997-1014.
- Kambewa, P., B. Mataya, W.K. Sichinga, and T. Johnson. 2007. Charcoal- the reality: Charcoal consumption, trade, and production in Malawi. Technical Report to the Forest Governance Learning Group. Blantyre, Malawi: Malawi COMPASS II.
- Kates, R. W., W. C. Clark, R. Corell, J. M. Hall, C. C. Jaeger, I. Lowe, J. J. McCarthy, H. J. Schellnhuber, B. Bolin, N. M. Dickson, S. Faucheux, G. C. Gallopin, A. Grüber, B. Huntley, J. Jäger, N. S. Jodha, R. E. Kasperson, A. Mabogunje, P. Matson, H. Mooney, B. M. M. iii, T. O'Riordan, and U. Svedin. 2001. Sustainability science. *Science* 292(5517):641-642.
- Komiyama, H., and K. Takeuchi. 2006. Sustainability science: building a new discipline. *Sustainability Science* 1:1-6.
- Maslow, A. H. 1943. A theory of human motivation. *Psychological Review* 50(4):370-396.
- Mulder, M.B., and P. Coppolillo. 2005. *Conservation: Linking ecology, economics, and culture*. Princeton: Princeton University Press.

- Myers, N., R. A. Mittermeier, C. G. Mittermeier, G. A. B. da Fonseca, and J. Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403(6772):853-858.
- NSO (National Statistical Office). 2008. 2008 Population and Housing Census Main Report. Zomba, Malawi: National Statistical Office.
- NSO. 2009. Welfare Monitoring Survey 2009. Zomba, Malawi: National Statistical Office.
- Paas, S. 2009. Chichewa/Chinyanja-English and English-Chichewa/Chinyanja Dictionary. Zomba, Malawi: Kachere Series.
- R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria.
- Roe, D., and J. Elliott. 2004. Poverty reduction and biodiversity conservation: rebuilding the bridges. *Oryx* 38(02):137-139.
- Ryan, G. W., and H. R. Bernard. 2006. Testing an ethnographic decision tree model on a national sample: Recycling beverage cans. *Human Organization* 65(1):103-114.
- Scoones, I. 1998. Sustainable rural livelihoods: A framework for analysis. Institute of Development Studies Working Paper 72. *University of Sussex, UK*.
- Scoones, I. 2009. Livelihoods perspectives and rural development. *Journal of Peasant Studies* 36(1):171-196.
- Spradley, J. P. 1979. *The ethnographic interview*. Blemont, CA: Wadsworth.
- Sunderlin, W., A. Angelsen, B. Belcher, P. Burgers, R. Nasi, L. Santoso, and S. Wunder. 2005. Livelihoods, forests, and conservation in developing countries: An overview. *World Development* 33(9):1383-1402.
- Tversky, A. 1972. Elimination by aspects: A theory of choice. *Psychological Review* 79(4):281-299.
- Tversky, A., and S. Sattath. 1979. Preference trees. *Psychological Review* 86(6):542-573.
- UN (United Nations). 2000. United Nations Millennium Declaration. United Nations Document A/RES/55/2.
- UNAIDS (Joint United Nations Program on HIV/AIDS). 2010. Report on the Global AIDS Epidemic 2010. Geneva, Switzerland: United Nations.
- WCED (World Commission on Environment and Development). 1987. *Our Common Future*. New York: Oxford University Press.

Zulu, L. 2010. The forbidden fuel: Charcoal, urban woodfuel demand and supply dynamics, community forest management and woodfuel policy in Malawi. *Energy Policy* 38:3717-3730.

## BIOGRAPHICAL SKETCH

John Dudley Fort is the son of Dudley and Priscilla Fort of Sewanee, Tennessee. John attended Sewanee Elementary School from 1986 until 1993. John grew up with four siblings, an older sister (Teresa), two younger brothers (Carter and David), and one younger sister (Victoria). Highlights of John's early years include yearly summer trips to visit family in the Northeast and a week at Space Camp in Huntsville, Alabama.

John attended Saint Andrews-Sewanee middle school from 1993-1995. In the fall of 1995 John left Sewanee to attend George School, a Quaker boarding school in Newtown, Pennsylvania. At George School John completed the International Baccalaureate program. He also started a pilot program to compost the school's cafeteria waste.

After graduating from George School in June of 1999, John went on to attend Deep Springs College in eastern California. Deep Springs is a two-year accredited college in which students learn by participating in academics, labor, and self-governance. At Deep Springs John served for two terms as the student labor commissioner.

From Deep Springs John transferred to Swarthmore College, where he majored in biology. In his final semester John worked on an independent research project looking at the effect of acupuncture massage on the stress hormone cortisol.

Upon graduation from Swarthmore, John was accepted to serve in the U.S. Peace Corps. John was assigned to be a volunteer in Malawi, where he was an agroforestry extension agent working with the Malawian Department of Forestry. After 2 months of language and technical training in Dedza, Malawi, John was stationed in a small village

in Ntchisi. John finished his work with Peace Corps and returned to the United States in December of 2005.

After stints living in both Vermont and Tennessee, John moved to Tallahassee, Florida, to work in a plant-insect ecology lab at the Florida State University. John spent two years working at the lab and in the field conducting experiments and collecting data.

In June and July of 2009 John made a trip back to Malawi along with his sister Victoria. Victoria conducted her MPH research at the Mulanje Mission Hospital and John explored the Mulanje region as a potential site for his master's research. He established several contacts around the mountain and decided that it would be an ideal place to conduct his research.

In August of 2009 John moved to Gainesville, Florida, to begin his master's work at the University of Florida. He worked under Dr. Martha Monroe, a specialist in environmental education and communication. After completing two semesters of coursework John headed back to Malawi in September of 2010. He stayed in a small village at the base of Mulanje Mountain and conducted the research reported in this thesis.

While at the University of Florida, in addition to his research on livelihoods in Malawi, John also did research on the dynamics of multi-stakeholder working groups. These groups work to understand and protect first magnitude springs in Florida. This research experience introduced him to interviewing and qualitative analysis skills needed to complete the research for his master's degree.