ABSTRACT

A PARTICIPATORY ASSESSMENT OF FOREST RESOURCE USE
AT MT. KASIGAU, KENYA

by Humphrey Wafula Kalibo

This study examines local views on forest resources by residents of Makwasinyi and Jora at Mt. Kasigau, southeast Kenya, and asks: 1) how do the residents view their landscape and the distribution of different land cover types; 2) what kinds of forest resources do the residents obtain from their mapped landscape? Between May and August 2002, I carried out participatory mapping sessions, focal group interviews, transect walks across firewood sites, and observations of people’s activities in relation to their uses of woody plants. The seven village maps compiled reveal a diverse landscape with montane forest, homes and farms across a transition, and bushland. I recorded high plant diversity, with 105 woody plants used for food and/or fodder, construction, technology, remedy, fuel, and ecosystem services. The findings provide strong rationale for information sharing among stakeholders and the inclusion of local resource knowledge in adaptive collaborative management plans for Mt. Kasigau.
A PARTICIPATORY ASSESSMENT OF FOREST RESOURCE USE
AT MT. KASIGAU, KENYA

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Chapter One

INTRODUCTION

Forests are unique because of the diversity of plant resources and land services they provide, and their potential to be renewable under sustainable management practices (Adamowicz et al. 1993). Material resources are those tangible and useable goods provided by forest systems, such as fuelwood and building materials, while services are actual aesthetic and life support functions, such as water quality and quantity (Daily 1997; Hannon 1998; Norberg 1999), that satisfy human wants directly or indirectly (de Groot et al. 2002). The materials and services provided by forest lands are particularly important in developing countries where some people still rely on them directly as sources of food, fodder, medicine, shelter, building materials, and as centers of certain cultural practices (Ramnath 1997; Wiersum 1997; Mandondo 2001). Increasingly, there is concern that the rising number of poor forest dependents, people who live exclusively in forests or within 1-5 km, may lead to the degradation of forest lands (Byron & Arnold 1999). Deforestation is one of the most evident forms of forest degradation and has far-reaching environmental repercussions, which may be manifested at local, national, regional, and global scales (Laurance 1999).

Effective forest management, therefore, must assure communities a continued supply of materials and services and at the same time ensure that forest resources remain sustainable. Local communities are an integral part of forest ecosystems and are central to effective sustainable practices that ensure their renewability (Armitage 2003). They are aware of local ecological conditions since they have the closest physical contact with their environment, can devise management plans well adapted to their local needs, and are the most affected by the inception of any biodiversity management plans (Tisdell 1995; Baland & Plateau 1996; Wiersum 1997; Agrawal & Gibson 1999). Lykke (2000) further argues that when communities participate in the management of their resources, there is a likelihood of success as people are more willing to obey their own
regulations than those imposed upon them from outside. Forest management plans, therefore, need to integrate local communities as focal participants in the records of resource diversity and plans for sustainable management. “[M]ost decisions on natural resource management are made at [the] farm or community level” (Kammerbauer et al. 2001:77), an observation that further strengthens the potential role local communities can play in resource management.

One such approach aimed at integrating communities in the resource conservation agenda is *adaptive collaborative management* (e.g., Lee 2001). Adaptive management depends on a continually evolving understanding of cause-effect relationships in both biological and social systems to facilitate management (Lessard 1998). Adaptive management considers the actions of both past and current management decisions (Parma & NCEAS [National Center for Ecological Analysis and Synthesis] Working Group on Population Management 1998) and sees monitoring and evaluation as central components in meeting management objectives (Armitage 2003). The approach also recognizes the importance of all stakeholders in the development of a conservation policy (Gunderson et al. 1995; Lee 2001). These stakeholders, including government agencies, non-governmental organizations (NGOs), scientists/researchers, commercial agencies, as well as the local community need to reach consensus and settle differences associated with resource use (e.g., Western & Wright 1994; Castro & Nielsen 2001; Martin et al. 2001a). Adaptive management is an interactive process that promotes information sharing among such stakeholders and the need to learn from local communities on how they view and conserve their resources (Kasusya 1998).

My study examines local views on land resources at Mt. Kasigau in southeastern Kenya, with an emphasis on how adjacent communities utilize forest resources. Local community management is of paramount importance in Kenya because forests cover less than 2% of the country’s total area and show a highly fragmented distribution (Wass 1995). Like other forests in the Eastern Arc, Mt. Kasigau is of great local importance as the only source of water to the surrounding communities.
The mountain is also globally recognized as part of the Eastern Arc and Coastal forest biodiversity hotspot; a conservation priority because of its high levels of species diversity, high numbers of endemic species, and high perceived threat by human activities (Myers et al. 2000; Brooks et al. 2002). The isolated and small forests on Mt. Kasigau lack formal protection and hence rely on local communities for their sustainable management. I focus on how residents in the villages of Makwasinyi and Jora at Mt. Kasigau view the distribution of forest resources across their landscape and utilize different forest resources. The ethnobotanical data compiled for this study contributes to adaptive management plans by elevating the importance of local resource knowledge in this region of global conservation significance.

Presentation of Study

This study is organized into eight chapters. In Chapter Two, the study begins with a literature review on ethnobotanical research and forest material resources and ecosystem services that are recognized by local people. The Chapter also discusses adaptive collaborative management as an approach that recognizes local views and encourages information sharing amongst different stakeholders, and ends by highlighting the importance of participatory research in engaging local people in resource management. Chapter Three presents the research questions, the conceptual framework, and summarizes the rationale for the whole study, while Chapter Four describes the area of study by providing a brief ecological and historical context as well as the livelihood strategies of the study populations. Chapter Five describes the participatory methods used, the types of data collected, the village respondents, and the methods for analyzing the compiled data. Chapters Six and Seven, respectively, present the results and discussion. Chapter Eight concludes the thesis by presenting some of the locally recognized woody plants for food and/or fodder, construction, technology, remedy, and firewood as priority species for protection.
Chapter Two

LITERATURE REVIEW

“Co-management, the sharing of responsibility and/or authority between the government and the local resource users/community,” (Senaratna 1999:11) is a feasible alternative to manage natural resources because it facilitates the resolution of resource use conflicts (Notzke 1995). In order for collaborative resource management to occur, it seems reasonable to expect significant sharing of information and values among stakeholders, especially local communities. Three areas of research form a context for understanding the local communities’ use of forest resources around Mt. Kasigau and the significant role they can play in the management of this forest. The literature review first explores ethnobotanical research on material resources and ecosystem services provided by forests, thereby substantiating their potential value to local communities. Second, I focus on the concept of adaptive collaborative management as a relatively “new” approach for the conservation of natural resources and one that supports the incorporation local viewpoints in the management process. The literature review ends by discussing participatory research methodologies as tools useful in gaining information from local communities, thereby integrating their knowledge and viewpoints in adaptive collaborative management plans.

Traditional Knowledge and Forest Resources

Ethnobotanical research that validates traditional knowledge is important in understanding ways in which local people perceive and use their plant resources. For example, based on their findings on agroforestry studies in Sumatra, Indonesia, Martin et al. (2001a) present three approaches that can help in understanding how local communities use and classify their natural resources. The historical approach, based on recording testimonies from knowledgeable elderly people, outlines how a community’s agro-ecological systems and forest utilization practices evolve over time.
Second, an *ethnoscientific approach* explores how people categorize vegetation types, life forms, and special plants. Aumeerudy (1994) adds that the ethnoscientific approach is also used to classify indigenous knowledge within a framework of symbolic representations, analyzing rituals, legends and sayings that express the symbolic meaning and value of different elements of the environment. Cotton (1996) refers to this type of traditional classification as *cognitive ethnobotany*. The ethnoscientific approach further explores how local people name plants, mostly according to the ways they are used, thereby becoming an important way of understanding local perception of biodiversity (Martin et al. 2001a). Third, an *ecological approach*, which employs the use of forest architectural profiles, helps researchers to understand the structure, ecology, and dynamics of forests (Martin et al. 2001a). The first two approaches are especially important for this research because they focus on local perceptions, and apply participatory methods in order to provide opportunities for information sharing and discussion of local resources (cf. Alcorn 1995). All these approaches can guide researchers in their collaboration with local communities on how they use and value local forest resources.

Cotton (1996) describes ethnobotanical surveys, participant observations, semi-structured and formal interviews, and questionnaires as useful research methods to obtain and compare local perspectives on resource use among communities. Cunningham (2001) views participatory methods as an important component of all ethnobotanical research especially in gathering qualitative data from a diverse group of participants. Voucher specimens of locally recognized useful plant species help to keep permanent records for possible sharing of information between research institutions and local communities, and among all stakeholders interested in the conservation of plant resources (Cotton 1996; Cunningham 2001). Ethnobotanical research describes the plant parts used, whether leaves, roots, branches/stems, flowers, or whole plant, and how they are used (Prance et al. 1987;
Cotton 1996). Ethnobotanical research must promote dialogue and collaboration between the researchers and the researched to allow continual exchange of information on forest resources.

- Material Resources from Forests as Recognized by Local People

Forests, whether natural or managed, have a number of material benefits associated with them. Material resources are tangible goods that communities obtain from forests, and include timber where whole trees are extracted to provide construction materials, and non-timber forest products (NTFPs) that include resins, dyes, fibers, essential oils, food products, and medicines (cf. Daily 1997; Pimentel et al. 1997; Ros-Tonen 2000). The harvest and trade of material goods from forests can contribute significantly to local economies, especially in developing countries where poverty and food insecurity are still major problems (e.g., Grundy et al. 1993; Owubah et al. 2001; Oyewole & Carsky 2002; Cocks & Wiersum 2003). Pimentel et al. (1997), for example, estimate that 32,000 tons of wild honey are produced by forest adjacent dwellers in India, generating about $35.2 million per year, while in Nigeria, the value of bush meat harvested annually is about $30 million. Even in Poland, a developed country, wild fruits are important both for local consumption and for export (Martin et al. 2001b).

The diversity of material resources provided by forests, therefore, implies that there is need for appropriate methods to collect, classify, and present ethnobotanical data in a manner useful to a wide range of stakeholders interested in forest conservation. Based on local forest use in rural communities in Bolivia, Brazil, and Venezuela, Prance et al. (1987) describe local community uses of forests to include material resources such as food, construction materials, technology, commerce, and remedy. In Kenya, Medley (1992) found that the Pokomo along the Tana River have 82 uses of woody plants, including food, construction materials, technology (e.g., ropes, traps, canoes), commerce (e.g., mats, baskets), and medicine. Studies carried out by Zhunge and Tisdell (1999) and
Long and Zhou (2001) among the Jingpo and Jinuo communities in southwestern China, respectively, show that forests also provide fuelwood, an important source of energy for most rural communities (Pimentel et al. 1997). Studies in India (e.g., Poffenberger 1994; Ramnath 1997; Hedge & Enters 2000; Sekher 2001) also show a wide range of material resources obtained from the forest, as do studies in different parts of Africa (e.g., Jungerius 1998; Lawton & Klemens 2001; Mandondo 2001), Latin America (e.g., Hazanaki et al. 2000; Coomes & Burt 2001; Dalle et al. 2002), and Southeast Asia (e.g., Van On et al. 2001). Together, these studies corroborate to identify principal categories of material uses by local populations, useful as a guide for compiling ethnobotanical data.

- **Ecosystem Services from Forests as Recognized by Local People**

  Ecosystem services are the physical and biological conditions and processes through which natural ecosystems, and the species that make them up, sustain human life and the habitability of the planet (Daily 1997; Norberg 1999; Batabyal et al. 2003). Prance et al. (1987) and other similar ethnobotanical surveys (e.g., Hellier et al. 1999; Hazanaki et al. 2000) categorize ecosystem services as “other” uses in their evaluation of resource diversity provided by forests. Field studies (e.g., Wass 1995; Kappelle et al. 2000; Byers et al. 2001) show that forests provide numerous services. Costanza et al. (1997) recognize 17 different ecosystem services provided by different biomes and show that forests provide the most diverse services to humans. However, some services are of more value to the local populations than others. Local communities readily recognize the role that forests play in the protection of watersheds, protection of soil from erosional agents, and creation of an aesthetically pleasing environment (“auspicious forest”) (e.g., Daily 2000; Long & Zhou 2001). Forests also mark physical boundaries between villages thereby helping define local territory, and act as buffers against fires that may result during land preparation (Byers 2001; Long & Zhou 2001). Ng’weno (2001) found that the Digo of Kenya maintain traditional forests called *kayas* for use as
burial and sacred sites, ceremonial areas, and as windbreaks. Bird-David (1990:190) shows a close cultural link that exists between the forest and the Mbuti Pygmies and other traditional communities of Central Africa as they see the forest as “the parent” and themselves as “children in the forest world.” At the national/international level, tourism and other recreational values are derived from forests (Pearce 2001), contributing substantially to the economies of some countries and accordingly, at times, to the local communities. For example, although most of Kenya’s wildlife is found in the savana, forests also support a substantial portion of the wildlife (Mugabe et al. 1998). Wildlife forms the backbone for the tourism industry, Kenya’s second most important foreign exchange earner after agriculture. Similarly, Burgess et al. (1996) and Newmark (2002) provide examples from East African forests showing that forests are important habitats for wild animals some of which are endemic to the region.

**Adaptive Collaborative Management**

The numerous material goods and ecosystem services that forests provide to local populations imply that forests are under competing claims not only from the local people themselves but also from commercial agencies and outside authorities (e.g., Burley et al. 2001). Sometimes this competition leads to a loss of forest area or an exploitation of available resources, a condition that consequently heightens resource conflicts (Ramnath 1997). It is therefore important that management approaches promote information sharing and dialogue between these competing claims to minimize potential conflicts. Burley et al. (2001) advocate for collaborative approaches in forest management that recognize traditional strategies to resolve resource conflicts. One such approach that recognizes local communities as important partners in resource conservation is adaptive collaborative management (ACM).
Centralized command-and-control regimes that once dominated conservation and management practice are now under question (Holling & Meffe 1995). Building on the work of Peluso (1992) on community resource conservation in Java, Anderson (2001) denounces state control as a dictatorial practice that may lead to conflict, which can in turn deter conservation practices. Holling & Meffe (1995) argue that command and control management, while yielding short-term economic gains, is inflexible and increases the vulnerability of ecosystems to perturbations that can otherwise be absorbed by more flexible planning. Command and control regimes also fail to recognize village/local power structures so that conservation-related benefits rarely trickle down to the communities (Anderson 2001), leading to conflicts and continued degradation of the local resource base by competing interest groups (Western & Wright 1994).

Adaptive collaborative management (ACM) is one response that involves multiple stakeholders such as government agencies, non-governmental organizations (NGOs), scientists/researchers, businesses, and most importantly, local communities in conservation plans and evaluations (Ewel 2001; Wilhere 2002). A diverse mix of participants in resource conservation and management plans facilitates information sharing and consensus building. Also called cyclic-incremental management (Brussard et al. 1998) or flexible management (Wilhere 2002), ACM is a learning-by-doing approach that considers resource management actions as experiments that should be continually evaluated and reexamined to yield reliable information useful in resource management (Gunderson et al. 1995; Lee 2001). Brooke & Rowan (1996) state the need to consider resource management as a learning process, rather than as a series of blue prints, so that failures are not negatively seen as drawbacks but as stimulants to search for better management alternatives.

Adaptive collaborative management, therefore, is an interactive process founded on the premise that we live in a world that is full of uncertainty, and that our knowledge of the world is always incomplete (Lee 2001; Habron 2003), thus requiring continual learning of the environment and how
humans use resources. As a process, adaptive collaborative management relies on the acquisition of reliable information through research and monitoring to assist in the planning and management of natural resources (Lessard 1998; Ewel 2001; Wilhere 2002).

Adaptive collaborative management also involves continuous dialogue between the various stakeholders to reach consensus on resource use because these stakeholders have different motivations related to the utilization and conservation of resources (McNeely 2001; WRI 2003). Adaptive collaborative management is, ultimately, a political process aimed at apportioning resources among these competing claims (Armitage 2003). Collaboration among these stakeholders implies that there is a willingness to resolve differences and negotiate an acceptable agreement regarding resource use and management (Johnson 1999). Adaptive collaborative management, therefore, offers an alternative approach to mitigate problems associated with competition over scarce resources.

Information collection on the way people perceive, use, and conserve available resources is an important first step in achieving the goal of adaptive collaborative management (cf. Parma & NCEAS [National Center for Ecological Analysis and Synthesis] Working Group on Population Management 1998; Lee 2001). Ewel (2001) advises researchers to efficiently gather information that can provide significant contributions to resource management. Agrawal (2000) stresses that local populations must be incorporated in information collection to secure their trust and also reduce the high costs associated with information collection. Consequently, there is need for research methodologies that ensure full participation, narrate local knowledge, and capture the breadth of understanding present in all communities (Rocheleau & Slocum 1998). Participatory ethnobotanical research gains local knowledge by encouraging local participation in the research (Cotton 1996), thereby yielding information that is an important step in realizing the goal of adaptive collaborative management.
Participatory Research Methodologies

Participatory research is centered on the premise that “ordinary people are capable of critical reflection and analysis” of their actions, “and that their knowledge is relevant and necessary” (Thomas-Slayter 1998: 11). Participation implies the inclusion of people in the research process through holding formal and informal meetings in which “stakeholders influence and share control over development initiatives and the decisions and resources which affect them” (World Bank 1996: xi). Goma et al. (2001:180) define participatory research as “research in which stakeholders participate and benefit jointly from the outcome.” Researchers become facilitators of the research process, learn and share knowledge with the people, and are immersed in the local language and culture (cf. Macharia 2002). Ultimately, participation can promote collective analysis of decisions, thereby contributing to efficiency and effectiveness in community development projects (Pretty 1995).

Thomas-Slayter (1998) discusses methods that evolved to enhance local people’s participation in research and development projects. She outlines Participatory Action Research (PAR), Methods of Active Participation (MAP), Participatory Rural Appraisal (PRA), Training for Transformation (TFT), Productivity Systems Assessment and Planning (PSAP), and Participation and Learning Methods (PALM). These methods use different tools that focus mainly on discussions, drama and role-play, and different exercises that ensure optimal inclusion of communities under study. Participatory Rural Appraisal emerges as a popular approach to research that is now practiced in at least 130 countries to gather data on health, education, agriculture, environment, and other issues related to human well-being (Chambers 1994; Pretty et al. 1995). Defined as “an intensive, systematic but semi-structured learning experience carried out in a community by a multidisciplinary team which includes community members” (Webber & Ison 1995: 108), PRAs provide an
opportunity for local analyses and local action (Cornwell & Jewkes 1995; Martin & Sherington 1997).

PRAs are cost-effective because they utilize locally available resources, can easily be understood by the local people (Brown et al. 2002), can generate information rapidly (Humble 1998), and instill a sense of ownership of development projects by communities, thereby increasing local support for these projects (Bock 2001). The experiences of Razakamarina et al. (1996) in Madagascar reveal that PRA can promote unity among community members, foster collaboration among different development agents external to the community, and empower informants by giving them tools to communicate their concerns to the outside groups. Nemarundwe and Richards (2002) state that the interdisciplinary nature of PRA teams with different skills, experiences and perspectives promotes a diversified understanding of the way of life of a community, and add that PRA allows for identification of individuals with different skills and leadership capabilities. Such talents can be tapped to benefit the community as a whole. Further, using participatory methods allows “a community to better understand the status of its natural resources (scarcity, degradation, encroachment of competing interests), and potential natural product development opportunities” (Brown & Hutchinson 2000: 2).

PRA methods include participant observation, participatory mapping, transect walks, historical timelines, preference ranking, and semi-structured interviews with key informants (Table 1). Participant observation, by definition, provides opportunities for the researcher to live with people and participate in their daily activities (Jackson 1983; Thomas-Slayter et al. 1993). Participatory mapping, the depiction of village resources, territory, or distribution of demographic data and/or services on a locally drawn map, uses visualization techniques that allow respondents, men and women, to choose their own symbols to represent aspects of their lives in a shared medium that can be amended, discussed, and analyzed (Cornwell & Jewkes 1995; Mikkelsen 1995). The maps
Table 1: Participatory methods for qualitative research used in the study of forest resources at Mt. Kasigau.

<table>
<thead>
<tr>
<th>Method</th>
<th>Purpose</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant Observation</td>
<td>Researchers observe behavior in real-life settings of the respondents e.g., in the farms, collecting firewood, a communal project, etc. to have an understanding of their beliefs, relationships, conflicts, and problems facing them.</td>
<td>Jackson 1983; Thomas-Slayter et al. 1993; Cotton 1996</td>
</tr>
<tr>
<td>Participatory Mapping; Gendered Resource Mapping</td>
<td>Provide sketch maps of resources within a community and show how men and women perceive them. The maps can identify the distribution of land-cover types, specific landscape features, and/or focus on the distribution of important resources.</td>
<td>Thomas-Slayter et al. 1993; Pretty et al. 1995; Razakamarina et al. 1996; Aversa et al. 1999; Tuxill &amp; Nabhan 2001; Parpart 2002</td>
</tr>
<tr>
<td>Transect Walks</td>
<td>Provide visual information about resources, topography, and land use practices across village landscapes. They also provide an opportunity to talk to residents about problems they face regarding their accessibility to resources.</td>
<td>Mikkelsen 1995; Pretty et al. 1995; Razakamarina et al. 1996; Hellier et al. 1999; Tuxill &amp; Nabhan 2001; Parpart 2002</td>
</tr>
<tr>
<td>Historical Timelines</td>
<td>Show events (chronologies) of significance in a community, activity change over time, and the reasons for these changes.</td>
<td>Thomas-Slayter et al., 1993; Mikkelsen 1995; Pretty et al. 1995; Parpart 2002</td>
</tr>
<tr>
<td>Preference Ranking</td>
<td>Highlights criteria of how choices are made by the informants regarding resource use. Participants assess different items or options using criteria that they themselves identify.</td>
<td>Pretty et al., 1995; Cotton 1996; Razakamarina et al. 1996; World Bank 1996; Nematundwe &amp; Richards 2002</td>
</tr>
<tr>
<td>Semi-structured Interviews (SSI) e.g., Focused Group Discussions (FGDs)</td>
<td>Process of talking with individuals or groups to gain insight into topics such as resource use. Participants can introduce and discuss various issues affecting them. The interviews reveal personal or group opinion regarding an issue e.g., accessibility to, and use of a particular resource.</td>
<td>Thomas-Slayter et al. 1993; Mikkelsen 1995; World Bank 1996; Tuxill &amp; Nabhan 2001</td>
</tr>
</tbody>
</table>
show a local landscape as an arena where men, women, and even children complement and/or compete with one another over their access to resources (Thomas-Slayter et al. 1993). Interviews with individuals, key informants, and focus groups can generate diverse information as people from different backgrounds as defined by wealth, education, politics, etc. can participate (Mikkelsen 1995; Tuxill & Nabhan 2001). Further, analyzing the historical context of a particular community helps to understand the evolution and development of their resource utilization patterns. For example, by recording testimonies from elderly knowledgeable people, Martin et al. (2001a) show how forest use evolved over time in Sumatra for domestic and commercial purposes. Historical timelines used with PRA methods can be important for ethnobotanical research as they can provide a brief history of the local community’s relationship with the past environment as it compares with the present.

Many studies show that women play an important role in resource conservation, yet their efforts are rarely recognized (e.g., Meinzen-Dick et al. 1997; Rocheleau & Edmunds 1997; Locke 1999; Agarwal 2001; Meinzen-Dick & Zwarnteveen 2001). Further, women play a critical role in rural extension projects (Sigot 1995; Armitage & Hyma 1997). Participatory methods in research should, therefore, be gender-sensitive so as to recognize women’s unique contributions in resource conservation, and also to record differences between men and women’s views of similar resources (e.g., Little 1994). Wickramasighe’s study (1997) of gender and forest management in Sri Lanka shows that participatory ethnobotanical studies should record the differences of resource use based on gender, as men for example, would collect firewood mainly for sale, while women would use the firewood for domestic purposes. Goebel et al. (2000: 392) share this view and add that this “differentiated use” of resources can be further exacerbated by community class differences based on wealth, where poorer households would tend to collect and sell materials, say, forest products, to the richer households. Because men control decisions regarding resource uses, participatory methods should further consider areas where men and women access their resources, and how
women’s limited accessibility to some resources affects how they use their time and the amount of resource collected (Wickramasighe 1997).

Styger et al. (1999) and Luoga et al. (2000) provide a rationale for research to document knowledge distribution according to gender and age among men and women. Similarly, Kristensen & Balslev (2003), working on use and availability of woody plants in Burkina Faso, show that participation by different age groups gives a wide range of community views on resources. Such studies reveal important trends in local views and perceptions that may be useful in the management of local resources. Moreover, comparative studies of areas with different ecological and socio-economic conditions as those done by Dunn and Agom (1992) and Styger et al. (1999) are also important in understanding intervillage similarities and differences regarding local perceptions and views of available resources.

While studies benefit from the advantages associated with PRA methodologies, they are subject to their drawbacks as well. Being qualitative in nature, participatory methods do not yield information that can be easily compared as each research setting and participants have unique and different views (cf. Freudenberger 1995, Pretty 1995). Brown et al. (2002) warn that although these methods are initially designed to include all people in information collection and sharing, there is a tendency to be biased against certain groups of people, especially women or the poor. For example, Tuxill & Nabhan (2001: 36) state that interviews can be “easily dominated by a few prominent or assertive individuals such as local political leaders or village elders” thereby excluding full participation from the rest of the participants. The methods also emphasize the local context and ignore the impact the national and/or global power structures that are also important in influencing local resource use decisions (Parpart 2002). Participatory methods may raise expectations among participants that are never met thus leading to frustrations (Humble 1998), and are seen as subjective (Pretty 1995). To subvert the misconceptions about investigator bias and hence subjectivity of PRA
data, Pretty (1995) suggests 12 criteria that can be used to judge trustworthiness. These include prolonged and/or intense engagement between the various actors, persistent and critical observation of phenomena by researchers, parallel investigations and team communications, triangulation, analyzing expressions of difference by the various actors, revision of different hypotheses as insight grows, and sharing information with the participants from time to time to allow for constructive criticism. Others include review of information by colleagues not directly involved in the research, contextual visualizations to capture people’s personal perspectives and experiences, keeping up-to-date reflective journals of daily events and changes in methodology, sharing information with a disinterested person as a way of verifying collected information (inquiry audit), and assessing whether the information collected can prompt stakeholders (including those not directly involved in the research) to know and act.

The idea behind these criteria is for researchers to make objective observations and build rapport with the communities under investigation so that they can be able to analyze consistency of information collected over time. For example, persistent and critical observation allows researchers to understand a phenomenon and the context within which it happens, while parallel investigations using the same methodology that lead to same or similar results would imply a degree of trustworthiness of the information collected (Pretty 1995). Triangulation, the cross-checking of facts using a range of methods, type of information, analysts, socioeconomic groups, locations, and investigators, strives to encompass a wide spectrum of community members to assure validity and reliability of data collected using PRA (Aversa et al. 1999; Tuxill & Nabhan 2001). Scoones (1995) and Aversa et al. (1999) further warn that PRA approaches are slow, laborious and complex, and can easily be mixed with politics. Investigators, therefore, need to be patient and avoid engaging in local politics as much as possible.
Chapter Three

STATEMENT OF THE RESEARCH PURPOSE

Ethnobotanical research clearly shows the importance of forests to local communities for material goods and ecosystem services, and the need to validate their knowledge and promote their involvement in resource management. Local communities are especially interested in those resources and services that directly benefit their livelihoods, and resource managers need to adapt management to reflect such local views. Participatory ethnobotanical methods can be used to sustain local interests in collecting information about natural resources, and these data can and should be shared among other stakeholders interested in resource conservation. There is strong rationale for incorporating local knowledge and local people in the formulation of adaptive management plans.

The goal of my study was to gain a local understanding of forest resources at Mt. Kasigau as a basis for adaptive collaborative management (Fig. 1). I focused on the residents of Makwasinyi and Jora, two villages at the base of the mountain, with the aim of documenting how they viewed patterns of resource diversity across the landscape and especially the role of indigenous forest resources to their livelihoods. As a biodiversity hotspot, Mt. Kasigau is attracting much attention from conservation and development agencies interested in the conservation of the Eastern Arc forests. The study provides an important source of local information on forest resources that supports community involvement in the designation of local management priorities.

In order to gain a local understanding of forest resources at Mt. Kasigau, the study addressed two research questions (Fig. 1):
Fig. 1: Research framework for a participatory study of local forest resource management at Mt. Kasigau, Kenya.
1 How do the residents of Makwasinyi and Jora view their surrounding landscape and the distribution of different land-cover types?

The landscape is comprised of different land-cover types that include montane forests, grazed bushland, agricultural fields, and homesteads. My purpose was to come up with local resource maps drawn by men and women, showing land cover and especially human settlements in relation to the land resources the residents recognize and use. The study looked for the similarities and differences between men and women on how they viewed their land resources and the benefits they derived from them. Historical maps and the construction of village timelines with elderly men and women provided comparisons between current and past landscapes and some reasons for the documented changes.

2 What kinds of forest resources do the residents of the two villages derive from their mapped landscape and the respective land-cover types?

This question investigated how local residents used woody plants across the landscape and in the mapped landcover types. I focused mainly on the uses of indigenous woody plants, although non-native and non-woody plants mentioned by respondents were also recorded. In each village, I documented the total number of useful woody species across different habitats, which included the bushland, farms, homes, and lower montane woodland, and the relative importance of different plants for particularly important uses.

The overall purpose of the research was to generate ethnobotanical information on how residents of Makwasinyi and Jora view the patterns of forest resource diversity across the mountain landscape (Fig. 1). The study recorded valuable material resources and ecosystem services that are locally recognized and how these were distributed in relation to the two villages. The ethnobotanical data provide an important contribution to literature on the use of woody plants by the Kasigau Taita in the Eastern Arc Mountains of Kenya and Tanzania. By documenting local landscape views and plant uses, this study begins to validate local knowledge on the importance of forest resources to the livelihoods of village residents in Makwasinyi and Jora. This information can be shared among other stakeholders, including the Forest Department, the East African Wild Life Society, and the Taita Discovery Center, that are interested in the management and sustainable use of forest resources at Mt. Kasigau. Such an adaptive collaborative management framework that is sensitive to local viewpoints on resource diversity can lead to sustainable use of forest resources, thereby assuring communities access to available material resources and ecosystem services from the forest.
Chapter Four

STUDY AREA

Mt. Kasigau is located in the Taita Taveta District in the Coast Province of Kenya between 38° 37’ and 38° 42’ E, and 3° 46’ and 3° 52’ S (Fig. 2). Forests in Kenya are small and show a highly fragmented distribution (Wass 1995) with most of the forest cover found in the central highlands and the western region (Fig. 2). The hill forests, including Mt. Kasigau, are very small (see Mbuthia 2003). For example, closed forest on Mt. Kasigau was estimated at <2 km² (Rodgers 1993). At the time of the study, the Taita Taveta District Forest Officer estimated that Mt. Kasigau had an indigenous forest cover of 203 ha of gazetted forest (pers. comm., July 2002). The District Forest Officer further hinted that there are plans by the Forest Department to negotiate with village residents around the mountain on ways to extend the gazetted forest area to below 1000 m to include part of the montane woodland not currently under protection. In Kenya, a gazetted forest is an officially recognized forest area that is protected (from public use such as extraction of material resources and settlement) by the official government department-the Forest Department in the Ministry of Environment and Natural Resources.

Rising to 1641 m, Mt. Kasigau is the most northeastern mountain in the biologically rich Eastern Arc mountain forests of Kenya and Tanzania (Wasser & Lovett 1993; Fig. 2). The Eastern Arc mountain forests are among the 25 globally recognized biodiversity hotspots because they contain numerous endemic plant and animal species and are under threat from human activities especially agricultural expansion (Newmark 1998, 2002; Myers et al. 2000). Lovett (1998) reconstructed the climatic and geologic history and found that these forests have been geographically isolated for millions of years following tectonic uplift in the Central Africa Plateau.
Fig. 2: Location of Mt. Kasigau in Kenya showing: a) the fragmented distribution of forests in Kenya (taken from Wass 1995), b) the forests of the Eastern Arc Mountains of Kenya and Tanzania (taken from Lovett 1998), and c) the topographic map of Mt. Kasigau (contour interval is 20 m), showing the villages of Makwasinyi and Jora.
Mt. Kasigau lies in a vast bushland that is “dominated by thorny *Acacia* species or by the gnarled and twisted *Commiphora* genus, …. grasses and small herbs [that] may grow into a luxurious sea of greenery up to 2 m high, …. and strange looking baobab (*Adansonia digitata*)” (Morgan 1973: 61). This region receives low rainfall. Measurements recorded at the nearby Rukinga Ranch showed an average annual rainfall ranging from 300 mm to 500 mm (unpublished data from the Taita Discovery Center 2003, cited in Medley 2004). The evergreen forest on the mountain captures moisture from the Indian Ocean, causing a cloud at the summit that condenses to form water catchment areas above 1200 m., thereby providing the only source of drinking water to the surrounding communities. Newmark (2002) estimates that the Eastern Arc forests of Tanzania provide water to nearly a quarter of the country’s population, and contribute significantly to discharge in some of the major rivers draining the northeastern region of the country. Piped water from the catchment areas in the evergreen forest of Mt. Kasigau is available to the villages, and from Makwasinyi, there is a piped water system that serves the neighboring village of Bughuta. Each village, with the exception of Jora, has its ‘own’ water catchment from where pipes are installed directing water to large tanks below for water storage. In each village, water kiosks are constructed at specific locations where residents pay a small fee to get water. The fee was said to cater for the maintenance of the pipes. Jora shares the water catchment with the Rukanga water supply, and consequently, suffers persistent water shortages compared to Makwasinyi or Bungule.

The study recognized useful woody plants in three ecological zones: the montane forest, a transitional area at the base of the mountain that includes homes and farms, and the bushland (Fig. 3). For example, *Trichocladus ellipticus* (Mazido) occurs in the montane forest at about 1000 m, *Melia volkensii* (Mkurumbutu) occurs mostly around homes and farms, and *Acacia bussei* (Mngololi) occurs
Fig. 3: Landscape photographs of Makwasinyi and Jora, showing the altitudinal changes in forest resources on the mountain.
in the bushland. Additionally, non-native species such as *Thevetia peruviana* (Msoda), *Tamarindus indica* (Mkwachu), and *Morus alba* (Mzabibu) are planted around the homes, and *Acalypha fruticosa* (Jija) and *Acacia robusta* (Mghunga) mostly occur along streams (cf. Beentje 1994). *Adansonia digitata* (Mlamba), seen as symbols of peace and reconciliation, grows around the homes and farms, and seems much more common in Jora. A recent ecological survey by Medley (2004) reveals a rich vegetation diversity with 177 tree species recorded in thirty-five 0.1 ha plots measured at different elevations: 82% are native trees and 18% are non-native.

- **Subject Population: the Kasigau Taita**

  The Taita are part of the Bantu-speaking people, inhabiting the coastal region of Kenya (Mkangi 1983). They are comprised of three sub-groups, namely the Wataita ‘proper’ that inhabit the more moist Taita Hills in Wundanyi, the Wasagalla of Sagalla Hills near Voi, and the Kasigau Taita (Wakasigau) of Mt. Kasigau (Mkangi 1983). The Kasigau Taita settled in five villages, namely Bungule, Jora, Kitege, Makwasinyi and Rukanga, at the base of the mountain. There is also a village in the bushland below Jora, called Ngambenyi, that comprises mainly of the Wakamba speaking people originally from the Eastern Province of Kenya. These villages, with the exception of Makwasinyi, are found in Rukanga, one of the three sub-locations that make up Kasigau location. The other sub-locations are Bughuta and Makwasinyi (TTDDP 2002).

  According to elderly respondents, the Kasigau Taita initially settled and farmed on the mountain in the early part of the 20th century, but were relocated to Malindi during WWI when the British accused them of collusion with the enemy German forces. This account seems to correspond with earlier ethnographic accounts by Bennett (1969:72) who describes the general resistance among various tribes of Kenya towards the British rule, and singles out the Taita as having “provoked colonial punitive expeditions [from the British] in the years before the First World War.” According to the elders, a friendly confidant from the Wagiriama, the people occupying Malindi, secretly told
the relocated Kasigau Taita of a plot to poison their water supply. They fled Malindi and received approval to resettle near the sisal estates at Mwatate and eventually were allowed to return to Kasigau in the 1930s. Therefore, a fairly well understood settlement history of the Kasigau Taita seems to start after returning from their “exile.” Preliminary results from an ongoing historical study by Dr. Chapurukha Kusimba of the Chicago Field Museum of Natural History suggest a much longer history of human habitation on the mountain.

Economically, the livelihoods of the Kasigau Taita depend mainly on small-scale farming practiced in the lowland farms cleared from the upper bushland. Staple food crops include cassava, maize, beans, pigeon peas, and a variety of vegetables grown in home gardens. No cash crops such as the extensive sisal plantations that exist in Mwatate (Mkangi 1983) are found in Kasigau. Most households also keep chicken and goats to supplement and/or diversify their income and food sources. Cattle ranching in the bushland is another productive enterprise undertaken by the Kasigau Taita. Residents talked of communal grazing grounds and water points that allow herdsmen to graze in the bushland for several days. Because of the existing dry conditions, food crops do not do well and result in food shortages. In fact, during the field study period, there was a lunch program for the primary school pupils using corn from the United States under the World Food Program (Medley 2004). Evidence from one of the two mountain farms (Fig. 4) suggests that higher elevations could be more productive due to greater moisture availability, as is the case for the Taita Hills in Wundanyi (Mkangi 1983; Fleuret 1985; Fleuret & Fleuret 1991). However, managing a mountain farm in Kasigau is controversial and problematic due to its isolation and problems with wild animals especially pigs and baboons. Furthermore, accessibility to these farms by potential customers, i.e., village residents who could buy some of the produce, is difficult due to the steep slopes leading to damage of some of the harvested crops.
Fig. 4: A mountain farm in Makwasinyi showing various crops including pumpkins, cassava, and many fruit trees (not visible). Unlike lowland farms, mountain farms are productive due to higher moisture, but managing the farms is difficult because of wild animals, especially pigs and baboons. The farms are also isolated from the rest of the village.
Sale of locally made handicrafts also contributes to the livelihoods of the Kasigau Taita. Women with weaving skills, for example, sell woven bags (*viondo*) to other village residents and also target tourists who visit the mountain from the nearby Taita Discovery Center (TDC). Skilled men, including carpenters as well as herbalists also sell their products to others. A herbalist in Jora, for example, said he had a “patient” he regularly checked on in the neighboring village of Bughuta. Additionally, most young men seek employment in cities such as Nairobi or Mombasa (Mkangi 1983) or in the nearby mines. Still, others practice retail business such as shops and hotels, and a few others are employed in the community-run cottages (*bandas*), where dividends are shared among village members.

Rukanga is the main commercial and administrative center for the Kasigau Taita as it is served with the Post Office, a Health Center, a high school, and the Chief’s Office. Daily transport is also available from Rukanga to the major urban centers of Voi and Mombasa, and the Taita Taveta district headquarters in Wundanyi.
Chapter Five

DATA AND METHODS

The study adopted qualitative research methodology, using participatory techniques (e.g., Table 1) to examine how the residents of Makwasinyi and Jora view their landscape and utilize forest resources. Between May - August 2002, I compiled an inventory of useful woody plants on the mountain and around the homesteads, farmlands, and the bushland, conducted participatory mapping exercises with focal groups of men and women, and held semi-structured interviews with local experts on special kinds of plant uses. All interviews followed the requirements of informed consent and confidentiality described in my Human Subjects Proposal approved by Miami University (Appendix I). Prior to the research, I also received approval from the Ministry of Education, Science, and Technology to conduct the fieldwork (Appendix II). Plant species names were confirmed from a concurrent study conducted by Kimberly Medley of Miami University and Norman Gachathi, a botanist from the Kenya Forestry Research Institute (KEFRI), and from an earlier study by Onesmus Mwangangi (2001) of the East African Herbarium. Additionally, I separately received confirmations for 42 voucher specimens from the East African Herbarium (Appendix III). I used Kiswahili language throughout the study period because all respondents understood this language. In some cases, the respondents used Kitaita, the local language, which was then translated by the research assistants to Kiswahili or English.

A Landscape View of Forest Resources

- Participatory Mapping with Men and Women

I undertook concurrent resource mapping sessions with one group each of men and women participants in order to understand the way village residents viewed the landscape in Makwasinyi and Jora. I worked with local coordinators to receive permission from the village heads and assemble
residents for the mapping exercises. In Makwasinyi, there were about 17 women participants and about 8 men, and in Jora, about 18 women and 6 men. The local coordinator in each village notified men and women participants one or two days before the mapping exercise, and kept the invitations open to all interested and available participants.

On the mapping day, the participants assembled at a central location, which was a women’s tree nursery in Makwasinyi, and in Jora, a rental hall also run by women. Men and women met at the same time and locations for the mapping sessions because of their central locations and to allow the coordinators to plan for meals with participants during and after the sessions. It was also convenient for me as the principal investigator to moderate the mapping sessions for both men and women at the same time. However, apart from Makwasinyi where women and men drew a past village map together, other mapping exercises were carried out separately. In each village, the exercises lasted for two days where past and present village maps were drawn on separate days.

Before the mapping exercise, I explained to the participants what it was like to do a village mapping exercise, and provided examples of completed village resource maps done in South America (Tuxill & Nabhan 2001), as well as in Zimbabwe (Nemarundwe & Richards 2002). The participants first did a pilot mapping session on the open ground using local materials such as stones, twigs, and soil (sensu Pretty et al. 1995) to represent different features and land-cover types present, but this approach was difficult due to the prevailing windy weather. I then provided them with large sheets of blank paper, pencils, erasers, and sharpeners.

On the first day, men and women participants separately drew maps of the present landscape as they viewed it with the help of [a] group member[s] who knew how to read and write. Choosing the ‘principal artists’ was entirely a group’s responsibility. For example, in Makwasinyi, the women chose a secretary to a local Church to draw their map, while in Jora, the men selected a man who was a retired primary school teacher. One or two other group members assisted these ‘principal
artists’ since completion of one map was an enormous task, and the groups had several people who could confidently write. Placement on the maps of different landscape features was achieved by consensus among the group members. The participants also identified on the maps where they obtained different material resources such as construction materials, firewood, and/or services like the water supply and grazing areas. Depending on the level of consensus among participants regarding placement of various landscape features on the maps, the mapping sessions lasted between two and three hours. The maps were later recopied by one of the assistants using a felt pen to avoid the loss of data.

My analyses focused on how women and men were similar and different in the diversity of resources they identified on the landscape. Of interest was the arrangement of the different land-cover types, the placement of natural and human-constructed features, and the locations where certain forest resources occur. I also recorded unique landscape features identified by men and women in each village, and any evidence of conflict or shortages in their views of local resources.

**Change Through Time**

A second mapping session in each village focused on drawing maps of the past landscape as far back as participants could remember (sensu Pretty et al. 1995). Most of the participants had taken part in the previous mapping sessions and hence understood the process of compiling a village resource map. In Makwasinyi, men and women jointly drew one past map and in Jora, men and women drew separate maps.

My analyses of these maps focused on the distribution of different land use activities and where participants identified particular resources. For Jora, the analysis also focused on gender differences where I compared past landscapes compiled by men and women and how they differed
in their features and interpretations of major changes. The creation of the maps was complemented by their discussion of landscape changes over time.

I later set up focal group interviews (sensu Mikkelsen 1995; Tuxill & Nabhan 2001) with village elders to further elaborate a description of the past. The coordinator in each village chose one elder who in turn proposed another elder that was then approached to participate in the interview. The groups included two men and one woman in Makwasinyi and two men and two women in Jora. The interviews, lasting about two hours, were held at one of the elders’ homes whereby I asked them to discuss the landscape changes experienced over time. I also requested and received the elders’ permission to tape the conversations. The elders came up with different times (years) in the histories of their villages that had significant events they could remember. I followed up on these times by asking them to recount any events they could remember, and used the information to construct a rough timeline for each village. Thus, the timelines do not necessarily represent the views of all the elders in the two villages, but rather reflect the views of the participants.

**Community Use of Forest Resources**

My second research question investigated patterns of diversity in forest resources by recording the plants that were used in each village, determining the relative value of plants mentioned for particular uses, and comparing the relative value of landscape areas based on the distribution of documented forest resources. I focused on the use of woody plants, although I also recorded uses of some non-woody forbs, vines, and grasses that were mentioned by the respondents. During the field research, I conducted non-formal surveys and participatory observations in both villages in order to learn the Kasigau Taita names of plants and their uses. I also identified, with the help of local assistants and household members, tree species collected in firewood bundles and local handicrafts found in people’s homes. These methods were
complemented by focus-group discussions with women groups, village elders, and local experts who included herbalists, carpenters, and herdsmen (Table 2). Finally, I joined women on transect walks in the bushland to record the firewood species collected and compiled a ranking of their relative value.

I classified the uses of plants into five material use categories that included food and/or fodder, construction, technology, remedy and fuel, and ecosystem services that the plants provide through mostly non-extractive uses (Table 3). I recorded both the plants the participants said were actually used in the different use categories and those they said were potentially available, especially for construction, technology, and fuel categories. As a measure of resource diversity, I compiled a listing of all plants that had recognized uses, the number of uses provided for a given plant, and the number of plants that were recognized for certain uses. Botanical names of these plants were confirmed through a collaborative study on “Biogeographical Patterns of Plant Diversity on Mt. Kasigau, Kenya” by Dr. Medley of Miami University.

Respondents in each village often gave several plants for a given use, especially for construction, technology, and fuel use categories. I recorded from the interviews the good and bad attributes mentioned by respondents in order to consider their relative importances. For example, during the transect walks with women across different firewood sites, I recorded the attributes of each fuel species and developed qualitative rankings based on the number of good attributes reported for each tree. In the construction category, I recorded from participants a list of desirable attributes for building trees that served different functions such as cross poles, posts, rafters, struts and wallplates. Similarly, I recorded responses from local experts concerning the good attributes of trees for technological uses such as furniture, pounding sticks, and bows and arrows. I also visited and compiled the relative contribution of different tree species towards the construction of houses based on counts compiled with residents at four homes under construction in Makwasinyi and Jora.
Table 2: Focus groups interviewed on plant uses in Makwasinyi and Jora.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description of Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women Self-help</td>
<td>A group of women who engage in some income-generating activities, e.g., sale of firewood, and help members in times of need. Membership is open, so men are eligible. In Makwasinyi, they maintain a tree nursery while in Jora they have rental rooms and a conference hall.</td>
</tr>
<tr>
<td>Herbalists</td>
<td>Men and women with locally recognized expertise on herbal medicine.</td>
</tr>
<tr>
<td>Traditional experts</td>
<td>Individuals with specialist knowledge on the use forest resources. They include men who make traditional furniture, bows and arrows, local beehives, pounding sticks and other ‘technological goods,’ and women with knowledge of making crockery or locally woven products such as bags (<em>viondo</em>), grain winnowing baskets, and mats.</td>
</tr>
<tr>
<td>Carpenters</td>
<td>Skilled men who make household furniture such as doors and window frames using specialized tools such as jackplanes and saws. Some have formal training in carpentry from regional polytechnics, and make wood products for sale and family use.</td>
</tr>
<tr>
<td>Herdsmen</td>
<td>Men with fairly large numbers of cattle. They graze the cattle in the surrounding bushland either by themselves or as groups. Some hire young men in return for a small monthly wage.</td>
</tr>
</tbody>
</table>
Table 3: Categories of material resources and ecosystem services from forests recorded among the Kasigau Taita residents in Makwasinyi and Jora. Use categories correspond with similar ethnobotanical studies (e.g., Prance et al. 1987).

<table>
<thead>
<tr>
<th>Material Resources</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food/fodder</strong></td>
<td>Wild fruits and tubers, alcoholic beverages, flavorings, and fodder for livestock.</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td>Small and large stems used for building, including poles, wallplate, crosspoles (<em>fito</em>), struts, and rafters. These plants have desirable qualities such as resistance to pests, straightness, and flexibility.</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>Plants used for household items including pounding sticks and pounding pots, doors and doorframes, windows, cupboards, chairs, traditional beehives, bows and arrows, three-pronged stirrers (<em>piricho</em>), machete handles, brooms, combs and walking sticks.</td>
</tr>
<tr>
<td><strong>Remedy</strong></td>
<td>Plant parts used to prepare medicines for diseases, injuries, and other health problems.</td>
</tr>
<tr>
<td><strong>Fuel</strong></td>
<td>Plants selected for firewood and/or charcoal because of their desirable attributes.</td>
</tr>
</tbody>
</table>

**Ecosystem Services**

These plants provide certain services that contribute to land quality, cultural beliefs, or property recognition.
At the end of the study, I ranked with the participants the overall importance of plants based cumulatively on their uses in all use categories. Thus, in each village, I assembled men and women participants at the central locations used earlier in the mapping sessions and asked them to compile a list of important trees (free listing, sensu Cotton 1996). The participants then voted on each species by raising hands when they agreed that the plant in question was used in each of the use categories, and a cumulative value was recorded based on the scores obtained in these categories. Using their votes, I ranked the relative importances of the trees based on the number of votes for all use categories. Finally, I determined the relative importance of different land areas that included the mountain, homesteads, farms, and bushland based on the number of useful woody plants reported by the residents that occur in each habitat.
Chapter Six

RESULTS

A Landscape View of Forest Resources in Makwasinyi and Jora

- Participatory Mapping with Men and Women

Present maps of Makwasinyi (Fig. 5) and Jora (Fig. 6) compiled by men and women show a diverse landscape composed of both human-made and natural features. Both men and women mapped a narrow forest zone on the mountain from which a number of seasonal streams radiate, bushland in the lowland, and human-dominated farms and human settlements with roads and the piped water supply. Men and women further recognize the presence of unique natural features on the landscape. In Jora, for example, women show the Mwandolo caves northeast of the village and men show Ding' Ding’ and Mwangondi rock outcrops to the west (Fig. 6b). Features that define boundaries between landcover types include seasonal streams and some tree species. For example, men participants in Makwasinyi mapped *Acacia robusta* (Mghunga) along Kwamundungi Stream in the Muirenyi catchment as the boundary between Makwasinyi and Kirongwe sub-villages (Fig. 5a), and men in Jora map their boundary with Bungule at Ngware Point where there is a large Mlamba (*Adansonia digitata*) (Fig. 6a). For men in Jora, the strip of black cotton soil (*Mweda ghwa Ilenyi*) forms a boundary between farms and the Ilenyi bushland (Fig. 6a) where the Wakamba village of Ngambenyi is located. Men and women in Makwasinyi also mapped black cotton soil to the northwest of the village.

Men and women in both villages also identified areas on the maps where they get forest resources (Figs. 5 & 6). Men, for example, showed locations where they get trees for building while women mapped major firewood collection sites in the bushland and/or at montane locations. Men
Fig. 5: Participatory maps of the present landscape drawn by men (a) and women (b) in Makwasinyi. Map symbols defined on the legends or labeled on the map show the major land-cover types (forest on the mountain, homesteads, agricultural lands, and bushland), road and water networks, and special features. Sub-villages shown on the map include Kirongwe and Makwasinyi. Men show areas for timber and local hives while women show major firewood sites, an area with traces of clay for pottery, and grass for thatching. The map also shows watering sites and cattle shades distinguished by men and women. The view is looking to the south.
The map is approximately 5 km across
The map is approximately 5 km across
Fig. 6: Participatory maps of the present landscape drawn by men (a) and women (b) in Jora. The symbols show the major land-cover types (forest and rock on the mountain, homesteads, agricultural lands, and bushland), road and water networks, and special features. Three sub-villages of Cairo, Madukani and Mwakuri make up Jora Village. Men show timber for building on the mountain, the cattle bomas in the bushland, and a strip of black cotton soil in the farmland. Women show structures at the water collection sites, the animals in the bushland, and the village grain mill. The view is looking to the north.
The map is approximately 3 km across (Mazola to Nguare Point)
The map is approximately 2 km (Cairo to Murakuri).
in Makwasinyi show a riverine woodland area near *Mwakoma stream* where they get *Commiphora baluensis* (Mwaghare) for building and where they put local beehives. Women identify an area just below the evergreen forest where there are traces of clay, which they said was used especially in the past for making crockery. They also map an area close to the clay site where there are trees such as *Ficus ingen* (Mgandi) and *Ficus thonningii* (Mvumo) that provide fiber for making woven bags (*viondo*). Men and women both show the importance of higher elevation water catchments. In Jora, men identified two different water catchments: one at *Mulemwa* on the Rukanga side that currently provides water to Rukanga and Jora, and a potential site called *Mbanga Mwaboli* near the exposed rock (*Lwala*) (Fig. 6a). One of the two men who “discovered” the latter site said that it “has so much water such that if we are helped to direct this water [to our village], we could be as self sufficient in water as those in Bungule [a neighboring village].” Women identified the piped water catchment at *Mulemwa*. Men in Jora also distinguish three different areas in the bushland with building trees, and these include *Mlawasi* and *Ilonyi* close to the farms, and *Itoronyi* that is further into the bushland. Women only record *Itoronyi*. Women in Makwasinyi also show a location to the west where grasses such as *Mwavina, Mwamabemba, Kinyika,* and *Sangambululu* are collected and used for thatching houses (Fig. 5b).

Both men and women obtain forest resources higher on the mountain. For example, the *Mratinyi* and *Shapurinyi* areas in Makwasinyi and Jora, respectively, provide men with trees for building, and the latter is also used for grazing (Figs. 5a & 6a). In Makwasinyi, women map a clay site near the evergreen forest (Fig. 5b). In Jora, men show *Mazidonyi* site in the evergreen woodland where *Trichocladus ellipticus* (Mazido) provides a potential source of trees for building. Further, men and women map the presence of watering holes and livestock grazing sites in the bushland. In Makwasinyi, these include *Mwangarare, Longolongo, Magbanga,* and *Mkandanga* water holes, and
Makwasinyi and Kirongwe cattle shades (bomas), and in Jora the Jogolo boma and one water hole mapped by men to the southeast of the village in Kasigau ranch.

Despite some similarities in their mapping of landscape features, the men and women maps are different, mostly related to their different activities. Women show tree species in the bushland that provide firewood while men mostly show building trees in the same habitat. Women provide more detail for the farm fields and especially show the presence of trees on those farms. Men show fewer trees across the farms, and only mention *Melia volkensii* (Mkurumbutu) in the farms as an important tree for building. Additionally, men and women show differences in the extent of the landscape they map. For example, men in Jora map a larger landscape in the north-south direction to include the Wakamba village of Ngambenyi in the Itoronyi bushland to the south (Fig. 6a). In the west, they include the sub-village of Mazola near Rukanga and extend to the boundary with Bungule at Ngware Point further east. Women map a comparatively smaller landscape that excludes Ngambenyi village and only extends to the west sub-village of Cairo and the east sub-village of Mwakuri. In Makwasinyi, women compress their landscape to include resource locations such as firewood sites at the black cotton area to the east and beyond Tombolo to the west, both of which are quite far from Makwasinyi. Men also recognize the black cotton area that provides them with building trees, but exclude Tombolo village. Their map only extends to the forest near Kirongwe where there are more building trees.

Finally, men and women differ in the relative importance they place on landscape features. Women, for example, represent water tanks and kiosks as large conspicuous features on the landscape, suggesting the importance women place on water access and availability. In Jora, where there is a persistent shortage of water, women further emphasize this problem by including a queue at the main water collection site near Madukani (Fig. 6). Men represent the water kiosks and water tanks with smaller symbols, and instead place more emphasis on the water pipes, perhaps indicating
their interest in, and work on, water distribution. Only the women in Makwasinyi mapped the tourist cottage with a conspicuous symbol even though a cottage exists in both villages. Jora women instead map the village corn (posho) mill that is next to the cottage. Men and women also differ in how they draw the actual land cover. Men show the bushland and montane habitats as fairly open forests while women show the same habitats as comparatively closed. Only the women in Jora show the presence of wild animals as a potential danger in the bushland (Fig. 6b).

- **Change Through Time**

Participants documented that significant landscape changes occurred in both villages since the resettlement of Mt. Kasigau in the early to mid 1930s. Some of these changes are reflected in the location of different land-cover types and land use activities on the historical maps (Figs. 7 & 8). Men and women mapped farms, people’s homesteads, and livestock grazing areas high on the mountain. Small clusters of homes and farms occurred as discontinuous settlements close to streams for accessibility to water. Also found on the mountain were swampy areas and water catchments from which emanated Kwamdungi (called Mwerenyi and Ndiwa at higher locations) and Mratinyi streams in Makwasinyi (Fig. 7) and Mwakoro stream (called Mwangeta, Mwasungia above) in Jora (Fig. 8). Kwamdungi and Mwakoro drained into the lowland composed of a dense bushland with wild animals (Fig. 7 & Fig. 8a). All the groups mapped a road that connected the settlements and almost divided the landscape between the mountain and the lowland (Figs. 7 & 8). However, while the road in Jora links the village to others such as Rukanga and Bungule, the one in Makwasinyi seems to be restricted to the village territory, thus leaving only the mountain routes as the main routes linking the village to other areas (Fig. 7). Participants mapped a few small farms in the lowland (Fig. 7 & Fig. 8b) but described that these efforts were thwarted by wild animals, especially elephants.
Fig. 7: A historical map of Makwasinyi compiled by men and women for about 1949-1957 showing human settlements, farms, and the forest above and the bushland below. Participants also mapped the location of a school at Kwamndungu and another near the east pass to Bungule, swamps at high elevations, and routes to Mwatate and Rukanga. A few farms are located in the bushland, but wild animals were a major threat. The view is looking to the south.
Fig. 8: Historical maps of Jora/Ndomokonyi village from the 1930s-1950s drawn by men (a) and women (b). Both men and women said that Jora was originally called Ndomokonyi. Map symbols show the homesteads and the agricultural lands on the mountain, and a dense bushland. Participants also mapped culturally important features like a ceremonial area called fighi at the village entrance, as well as a rainmaking site on the mountain. The view is looking to the north.
The map is approximately 3 km across (Mazola to Nyware Point)
The map is approximately 3 km (Cairo to Muakuri)
The maps further show a number of unique features that men and women recognize. Unique natural features recognized include rock outcrops and caves, and for Makwasinyi, an exposed rock layer (Lwala) near the summit (Fig. 7). In Jora, men and women mapped the Ding’ Ding’ and Mwang’ondi rocks to the west and the Mwandolo caves to the east (Fig. 8) while in Makwasinyi, the main rock outcrops were Ighwe Ilacha ja Itsume (Tall Rock of Itsume) and Ajaya, located, respectively, near the mountain homes and to the west of the village (Fig. 8). In Makwasinyi, mountain caves like Mbanga ya Kitito and Mbanga ya Kirongwe were also used as dwelling places while Mbanga ya Sasa was infested with porcupines (sasa). Features unique to Makwasinyi include a traditional playground (Kishawi) and two migratory routes with resting points at Kizinga and Funyanyeni. Participants said that these routes were used by residents to return to Kasigau from Mwatate after their exile at the coastal town of Malindi. Participants also said that the routes later acted as shortcuts to Rukanga, Mwatate, and other places. Men and women in Makwasinyi also map two schools, one near Kirongwe and the other built in 1948 at the center of the village near Kwamndungi stream (Fig. 7). In Jora, both men and women map a rainmaking hut at higher elevations and the men map a sacrificial place (fighi) located at the entrance of the village (Fig. 8). Participants described fighi as a place near the village entrance with many trees where sacrifices were made to protect the village residents and their property from evil spirits. Also mapped close to the fighi were two cleansing pots (Fig. 8a) along the stream at Mashaka and Mwashindi, which residents described as places where those who made sacrifices in the fighi were cleansed before rejoining other village residents. Livestock sheds were fortified and close to homes (Fig. 8a) for protection from wild animals, notably leopards (ighwe). Men in Jora further mapped a shortcut route to Rukanga close to the Mazidonyi site. Women show drinking water collection points along
streams and a village shop, and men locate a communal grinding stone near the village used by residents to grind grains.

The mapping participants provided different explanations for the downward movement of human settlements and farms. Residents in Makwasinyi cited the need for close proximity to family burial plots that were said to have been below the mountain farms. Women said the shift was necessitated by the presence of firewood in the more dry lower elevation areas; they would no longer have to carry the heavy loads of firewood up to their mountain homes. Elderly residents also said they experienced a reduction in the availability of water and some food crops, and cited a corresponding increase in the dangers associated with wild animals on the mountain especially during droughts as that experienced between 1950-56 in Jora (see Fig. 10). However, they recalled that in the past, there was abundant rainfall that favored sugarcane (maghuwa), sweet potatoes (makaji), bananas (maroghni), coconut (mnazi), and maize (mapemba) to thrive in the mountain farms. Presently, sugarcane, bananas and pumpkins were only found in two mountain farms in Makwasinyi, both above 1000 m, during the study period (see Fig. 4).

Availability of rainfall, according to elderly respondents, has declined drastically at present compared to the past, and according to an elderly woman in Makwasinyi, “the less clouds we have on the mountain” transformed Kwamndungi and Mwakoro to seasonal streams. Another Makwasinyi resident reminisced: “When I was growing up, we could see several streams. They were small, but they used to flow with very clear water. Now I don’t see any of these streams.” Concerning the difference in water flow in the main stream of Mwakoro in Jora, one respondent said: “This stream used to flow with water towards Itoronyi (bushland), and we did not know where the water stopped because of wild animals. Now, as you see, there is no water in the stream.” Less cloud cover on the mountain also led to a
paucity of clay (see Fig. 5b), which was used by women especially in Makwasinyi for making pottery. The women described four rules to safeguard against further decline in the traces of clay currently available: they should not harvest clay when expectant, in the monthly cycle, after interaction with spouses, and when carrying babies who have not developed teeth.

Finally, residents in both villages reported a decline in the availability of useful construction species, especially of *Melia volkensii* (Mkurumbutu) and *Terminalia prunioides* (Mshoghoreka). The decline was reported to be felt especially around homesteads where people continue to expand and build more houses. More people now build semi-permanent houses made of iron sheets and adobe, and sometimes of bricks as opposed to traditional houses primarily made of mud and grass-thatched roof, essentially reducing pressure on building poles. However, most respondents felt that at present there is pressure on the useful woody species, especially those for building and construction, because of “the many people we have now” compared to the past. Comparing the past and present, an elderly respondent in Makwasinyi observed that “in the past, you could not go for long distances to get a good tree. Now to get a good tree, especially Mshoghoreka [*Terminalia prunioides*], you have to search a little longer.” Carpenters added that the reduction of useful species was due to many other carpenters present who, due to unemployment, also compete amongst themselves for the same species to make furniture for a living.

Village timelines for Makwasinyi (Fig. 9) and Jora (Fig. 10) based on interviews with elderly respondents mostly supported the mapped landscape changes and interpretations, and show strong similarities between respondents in the two villages. According to elders from both villages, human settlements and farms began to shift towards the lowlands around 1957 and by 1975, people had completely shifted from their mountain homes and were fully settled in the lowland. The elders described relatively wet seasons in the past to drier
Fig. 9: Historical timeline for Makwasinyi village showing important events since initial human settlement in 1934.
Fig. 10: Timeline of important events in Jora since initial human settlement in 1936.

1936: mountain settlement; lots of rain and food; Voi-Rukanga-Bungule road built, used by British colonialists to hunt wild animals esp. elephants

1950-56: severe drought and famine (Njala ya Ngano) hence livestock sales; vegetation cover reduces

1960-70: rain just enough; settlement in present locations; sale of pottery, livestock and viondos to augment food supply

1978: Jora primary school built; saves pupils from going to Rukanga or Bungule schools

1983: very severe drought; vegetation and water are scarce; edible plants especially Mtunguru extensively used

1996-97: El Nino rains hence plenty of food; wild animal menace is minimal

2000: weather conditions ‘normal;’ rain is erratic, useful tree species like Mkurumbutu are becoming scarce

1937-38: cattle die of an epidemic; downslope movement of settlements and farms; first school and medical center at Rukanga, services free

1957-58: heavy rain hence plenty of food; plenty of pepper for sale; most farms and homesteads in lowland; water pipe constructed to central water tank

1970s: sugarcane and permanent streams begin to disappear; better housing hence intensive use of species like Mkurumbutu; piped water available at central location (Madukanî)

1986: lightning sparks fire that burns part of the forest on the mountain, evil spirits are believed to be the cause, inmates from Wundanyi Prison help put out the fire
conditions at present, with the exception of the heavy rains during the El Niño of 1996-1997. The residents see a lack of adequate rainfall as “normal” weather conditions (Figs. 9 & 10). Accompanying the progressively drier conditions was an increase in threats from wild animals and food shortages. For example, there was an incident that occurred in Makwasinyi at some point during the field study period where a woman narrowly escaped death from an elephant that was foraging close to her home early in the morning. Similarly, in Jora, the mother to the research coordinator said that there are times when she hears animals close to the home at night. During droughts, participants said village residents devised coping mechanisms such as the use of edible plants like *Maerua triphylla* (Mtunguru), and the sale of livestock, pottery, and locally woven bags (*viondo*) to generate funds for food. These items were sold amongst residents themselves. According to residents, some men also became herdsmen at Taita Ranch and/or participated in the food-for-work program where they constructed the Rukanga road in exchange for food.

People’s recollections of rainfall events are somewhat consistent with historical precipitation patterns that have been recorded for Voi, the nearest weather station to Kasigau. For example, rainfall data compiled over an 86-year period (1904-1990) by the World Weather Center (Worldclimate.com) shows average rainfall at 553 mm. Specific years cited by participants as either wet or dry are supported by annual records reported by ICIPE (icipe.org) for 1977-1997. For example, in both Makwasinyi and Jora, participants noted a severe drought in 1983, and this concurs with the historical records as only about 20 mm or rainfall was recorded for this year. Similarly, participants in both villages reported of plenty of rainfall for 1996 and 1997, and this also concurs with averages compiled from ICIPE that show annual precipitation of 627 mm and 776 mm, respectively, which was well over the average. These data are also supported by unpublished rainfall data for Rukanga by the Taita
Discovery Center (cited in Medley 2004). Flood and drought events between 1928 and 1965 recorded for different parts of Kenya by Ojany and Ogendo (1988) also support the views recorded at Makwasinyi and Jora especially for the years between 1936 and 1960. For example, floods occurred in 1937 along the Nyanza Gulf and Tana River Basin (Ojany & Ogendo 1988) at the same period (1936) that is described by the Kasigau Taita as rainy, and a severe famine between 1952-1953 among the Kipsigis of Kenya due to drought concurs with a dry period between 1950-1956 reported by the Kasigau Taita (see Fig. 10).

Community Use of Forest Resources in Makwasinyi and Jora

- **Measures of Resource Diversity**

  The participants mentioned a total of 105 useful woody plants, 89 in Makwasinyi and 86 in Jora (Appendix IV). Most of the plants, 94 (89.5%) had two or more uses, and only 11 (10.5%) had single uses. Of the 89 plants in Makwasinyi, 9 (10.1%) had single uses and the rest (89.9%) had multiple uses, while in Jora, seven plants (8.1%) had single uses and 79 (91.9%) had multiple uses. Plant identifications grouped these plants into a total of 39 families (Makwasinyi = 36, Jora = 35). Of these, Mimosaceae, with nine plants in Makwasinyi and 12 in Jora, had the highest number of useful woody species identified by research participants, mostly attributable to the high diversity of useful *Acacia* species (12 species) (Appendix III). Other important families included Euphorbiaceae (9 species), Anarcardiaceae (6 species), Combretaceae (6 species), as well as Burseraceae, Caesalpiniaceae, and Capparaceae with five species each. Indigenous woody plants represented 91% of the plants, but I also recorded some useful non-native plants (8 in each village) that were planted or naturalized in the area. Useful grasses mentioned by village residents for thatching houses included *Kinyang’ombe, Mwakiserere* and *Mwavina*, found in both
villages, Kinyika and Sangambululu in Makwasinyi, and Iwondo, Msangari, and Nyasi ya Msundunyi in Jora.

The villagers reported a high number of different plants under each use category (Table 4) and also described some creative material resources and ecosystem services (Table 5). For the two villages, I recorded a total of 57 woody plants used for food and fodder, 52 for construction, 61 for technology, 50 for remedy, 51 for fuel, and 43 for ecosystem services (Table 4). Villagers described 10 different uses as food and fodder, nine construction uses, 27 technological uses, 44 remedies, two main fuelwood uses (firewood and charcoal), and 19 locally recognized ecosystem services (Table 4). Edible plant parts for humans and livestock included fruits, seeds, leaves, stems, and tubers. Some plants parts were only eaten by humans (Makwasinyi = 18, 40.9%, Jora = 16, 33.3%), by livestock only (Makwasinyi =16, 36.4%, Jora = 19, 39.6%), or were eaten by both people and livestock (Makwasinyi =10, 22.7%, Jora =13, 27.1%) (Table 4). For fodder, herdsmen described preferred species that were observed to have noticeable positive effects on their livestock. For example, in Makwasinyi, one herdsman favored Acacia tortilis (Mwaghuba) because its leaves are palatable to goats, and they make slaughtered ones fatty, while Ndashi (Combretum exalatum and C. hereoense) were observed to add little nutritional value to animals and are browsed only during drought. Most of the construction uses for trees were for buildings, although others, including fencing and grain and firewood storage structures (cheda) were also mentioned. The technology category was the most diverse, where participants reported 27 different types of uses that varied greatly to include furniture, household ‘appliances,’ woven products, musical instruments, and sleeping materials such as local pillows (Table 5). Plants that cure and/or prevent human diseases accounted for the highest number of remedy
Table 4: Actual and potentially available plants for material goods and ecosystem services recorded by village residents of Makwasinyi and Jora.

<table>
<thead>
<tr>
<th>Material Resources</th>
<th>Number of Species</th>
<th>Makwasinyi</th>
<th>Jora</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Potential</td>
<td>Actual</td>
</tr>
<tr>
<td>Food/Fodder</td>
<td>57</td>
<td>18 (40.9%)</td>
<td>16 (33.3%)</td>
</tr>
<tr>
<td></td>
<td>Food</td>
<td>16 (36.4%)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Fodder</td>
<td>10 (22.4%)</td>
<td>13 (27.1%)</td>
</tr>
<tr>
<td></td>
<td>Both</td>
<td>44</td>
<td>48</td>
</tr>
<tr>
<td>Construction</td>
<td>52</td>
<td>43 (82.7%)</td>
<td>1</td>
</tr>
<tr>
<td>Technology</td>
<td>61</td>
<td>41 (67.2%)</td>
<td>2</td>
</tr>
<tr>
<td>Remedy</td>
<td>50</td>
<td>39 (95.1%)</td>
<td>1 (2.5%)</td>
</tr>
<tr>
<td></td>
<td>Human</td>
<td>1 (2.4%)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Animal</td>
<td>1 (2.4%)</td>
<td>2 (6.1%)</td>
</tr>
<tr>
<td></td>
<td>Both</td>
<td>41</td>
<td>33</td>
</tr>
<tr>
<td>Fuel</td>
<td>51</td>
<td>24 (61.5%)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Firewood</td>
<td>2 (5.1%)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Charcoal</td>
<td>13 (33.3%)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Both</td>
<td>39</td>
<td>5</td>
</tr>
<tr>
<td>Ecosystem Services</td>
<td>43</td>
<td>32</td>
<td>0</td>
</tr>
</tbody>
</table>


Table 5: Uses recorded for each of the plant use categories identified in the villages of Makwasinyi and Jora

<table>
<thead>
<tr>
<th>Material Resources</th>
<th>Types of Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food/fodder</strong></td>
<td></td>
</tr>
<tr>
<td>• Bark boiled as tea leaves</td>
<td>• Rafters</td>
</tr>
<tr>
<td>• Edible fruits for humans and livestock</td>
<td>• Sawn timber</td>
</tr>
<tr>
<td>• Edible seeds for humans and livestock</td>
<td>• Struts</td>
</tr>
<tr>
<td>• Fruits chewed as gum</td>
<td>• Temporary cooking and grain storage in farms</td>
</tr>
<tr>
<td>• Fruits used as flavoring for porridge</td>
<td>• Wallplate</td>
</tr>
<tr>
<td>• Leaves and twigs used as fodder especially for goats</td>
<td></td>
</tr>
<tr>
<td>• Porridge from tubers/roots</td>
<td></td>
</tr>
<tr>
<td>• Ripe fruits squeezed to produce juice</td>
<td></td>
</tr>
<tr>
<td>• Sour leaves for appetizing</td>
<td></td>
</tr>
<tr>
<td>• Sweet “water” (soda) from flowers</td>
<td></td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td></td>
</tr>
<tr>
<td>• Building poles/posts</td>
<td>• Potential for sculptors</td>
</tr>
<tr>
<td>• Building structures (<em>cheda</em>) for drying/storing firewood and grains</td>
<td>• Pounding sticks</td>
</tr>
<tr>
<td>• Fencing posts</td>
<td>• Ropes for tying</td>
</tr>
<tr>
<td>• Cross poles (<em>fito</em>)</td>
<td>• Sap support feathers that maintain trajectory for arrows</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td></td>
</tr>
<tr>
<td>• Bar soaps or leaves for daily cleaning</td>
<td>• Sap from bark and/or fruits used as adhesive</td>
</tr>
<tr>
<td>• Bows and arrows</td>
<td>• Soft materials (<em>sufi</em>) from roots for pillows</td>
</tr>
<tr>
<td>• Cooking sticks</td>
<td>• Temporary beds for herdsmen in the bushland</td>
</tr>
<tr>
<td>• Dyes for decorating woven bags</td>
<td>• Three-pronged stirrers (<em>piricho</em>) for cooking</td>
</tr>
<tr>
<td>• Fiber for making woven bags</td>
<td>• Tool handles e.g., for machetes and long chisels</td>
</tr>
<tr>
<td>• Hollowed out trunks for making pounding pots (<em>vidu</em>)</td>
<td>• Toothbrushes and local lipstick</td>
</tr>
<tr>
<td>• Household brooms</td>
<td>• Traditional beehives</td>
</tr>
<tr>
<td>• Household furniture e.g., doors, beds, windows, traditional stools, etc.</td>
<td>• Walking sticks</td>
</tr>
<tr>
<td>• Local carts Making fire</td>
<td>• Wheelbarrow tires and frames</td>
</tr>
<tr>
<td>• Hoe handles</td>
<td>• Yokes for oxen</td>
</tr>
<tr>
<td>• Musical instruments like guitar and <em>kayamba</em></td>
<td></td>
</tr>
<tr>
<td>• Playing toys for children</td>
<td></td>
</tr>
</tbody>
</table>
Table 5 (continued).

<table>
<thead>
<tr>
<th>Remedy</th>
<th>Leaves, roots and/or bark either (un)boiled, squeezed, crushed or soaked either individually or with other medicinal plants to cure and/or prevent human and livestock diseases, and to protect grains against weevils</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Human Diseases</strong></td>
<td><strong>Intestinal problems</strong> (<em>mzito</em>)</td>
</tr>
<tr>
<td>Anti-anemia (‘addition’ of blood)</td>
<td>Malaria</td>
</tr>
<tr>
<td>Asthma</td>
<td>Menstrual problems</td>
</tr>
<tr>
<td>Bilharzia</td>
<td>Muscle spasms</td>
</tr>
<tr>
<td>Bleeding</td>
<td>Muscular pains</td>
</tr>
<tr>
<td>Bodily swellings</td>
<td>Paralysis</td>
</tr>
<tr>
<td>Boils</td>
<td>Potential AIDS concoction</td>
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<tr>
<td>Cerebral malaria</td>
<td>Reversing barrenness</td>
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<tr>
<td>Chest pains</td>
<td>Running nose</td>
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<td>Coughing</td>
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<td>Disinfectants against sores and wounds</td>
<td>Soar throat</td>
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<tr>
<td>Ear sores</td>
<td>Spleen-related problems</td>
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<tr>
<td>Enhancement of male reproductive vitality</td>
<td>STDs like gonorrhea</td>
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<tr>
<td>Epilepsy</td>
<td>Stomach pains</td>
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<tr>
<td>Eye irritations</td>
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<td>Headaches</td>
<td>Swollen muscles</td>
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<td>Hypertension</td>
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<td><strong>B. Livestock Diseases</strong></td>
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<td>Body sores on cattle</td>
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<td>Foot and mouth disease</td>
<td>Improvement of dog appetite</td>
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<td><strong>Ecosystem Services</strong></td>
<td>Internal worms (<em>vunyu</em>) in cattle and goats</td>
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<tr>
<td>Charcoal</td>
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<td>Alleviation of thirst</td>
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<td>‘Chasing away’ evil spirits</td>
<td>Protection of building poles from termites</td>
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<tr>
<td>Edible honey-like substance (<em>kimanga cha mbuche</em>)</td>
<td>Protection of poultry from predators and excessive sun</td>
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<td>Milk fermentation and flavoring</td>
<td>Removing of splinters from the body</td>
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<tr>
<td>Flowers beautify homes</td>
<td>Shade for traditional beehives</td>
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<tr>
<td>Fragrance/aroma in houses</td>
<td>Soothing children</td>
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<tr>
<td>Hanging of traditional beehives</td>
<td>Symbol of peace and reconciliation</td>
</tr>
<tr>
<td>Indication of rainy season/attraction of rain</td>
<td>Water purification</td>
</tr>
<tr>
<td>Improvement of soil fertility</td>
<td><strong>Instructional aids for math</strong></td>
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<td>Live fences</td>
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<tr>
<td><strong>Instructional aids for math</strong></td>
<td><strong>Water purification</strong></td>
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plants recorded in both villages (Makwasinyi = 39, 95.1%, Jora = 30, 90.9% (Table 5). Of these, more than 90% were woody plants (Makwasinyi = 37, Jora = 31), and the rest (Makwasinyi = 4, Jora = 3) were herbaceous. A total of 39 human and five livestock diseases were said to be cured and/or prevented using leaves, roots and/or bark of some plants reported. Herbalists said that remedy plant parts were either used individually or combined with others to form a concoction. The fuel category included trees used for firewood (24, 61.5% in Makwasinyi, 28, 68.5% in Jora), those identified for charcoal (2, 5.1% in Makwasinyi and 1, 2.4% in Jora), and those used for both (13, 33.3% in Makwasinyi and 12, 29.3% in Jora).

All the plants identified by research participants were actually used or were potentially available for some uses (Table 4). None of the plants was said to be potentially useful for food, and only one plant, *Abrus precatorius* (Mwangaluche), was identified as a potential remedy; one herbalist may concoct a remedy to alleviate the health effects associated with AIDS. Residents of Makwasinyi reported more potentially available species for fuel (5) than in Jora (3), while there were more potential technology species mentioned in Jora (5) than in Makwasinyi (3) (Table 4). Most of the potential technology species were targeted for carving, and this, according to Jora respondents, was due to the presence of foreign visitors who would be potential customers as they come to study Mt. Kasigau or offer services as teachers at the high school in Rukanga. An expert in Jora who makes traditional chairs singled out *Thevetia peruviana* (Msoda) as a non-native species with a high potential for furniture because it grows very fast and does not ‘burst’ when nailed together.

Some plant uses require expertise to avoid any possible health-related side effects. For example, the tubers of *Maerua triphylla* (Mtunguru) must be carefully boiled before making a porridge taken during food scarcity or the food is poisonous. Similarly, most of the
herbal concoctions from the remedy plants require preparation by a skilled herbalist. Another observation is that some plant uses, especially in the remedy category, did not necessarily represent the views of the entire village, but reflected individual experts’ views.

Although most of the plants provided useful services such as the provision of nectar for bees, shade around the homes, or soil improvements, participants also mentioned some plants that had negative effects. For example, *Acacia bussei* (Mngololi), *Albizia anthelmintica* (Mporozì), *Grewia bicolor* (Mdomoko Mtini), *Melia volkensii* (Mkurumbutu), *Schlerocarya birrea* (Mnyeshavua), *Terminalia spinosa* (Msaghano), and *Zanthoxyllum chalyboum* (Genjeka) were thought to harm cultivated plants because crops that grew under them were said to be stunted. In Makwasinyi, *Albizia anthelmintica* was reported to have additional side effects of soil compaction. Despite these negative effects, most residents said they rarely cut down these plants in the farms because of their other important uses, and perhaps because they would be potentially useful. One respondent in Makwasinyi emphasized: “You [principal investigator] have walked down in our farms (shambas). What have you seen? You have seen that there are many trees we have not cut down. Some of them are not very good but we do not cut them; we just prune them. Who knows, they may be more helpful in the future.”

**Recognition of Use Value: Construction, Technology, and Fuel**

- **Construction**

  In both villages, residents reported several trees that were used for home construction and other buildings. The use of a species on a house structure depended on its function because participants said that different functions require different attributes/qualities. *Fito* is a Swahili word denoting the long slender twigs that are tied (often, among the Kasigau Taita, using the fiber from *Sterculia africana*-Mweja) against the posts from
the inside and outside (Fig. 11). They run parallel to the ground and the wallplate, forming a mesh-like structure where mud/adobe is put to “cement” the house.

Struts are short, strong vertical poles often nailed on the rafters to reinforce them and minimize directional movement especially when nailing the rafters on the wallplate to form the roof (Fig. 11). Posts and wallplates need to be strong and durable because they support the weight of the house, while cross poles need to be flexible so that they can be easily wound and tied against the poles for subsequent ‘plastering’ of the house with mud.

For example, among 254 posts recorded on four houses in Makwasinyi, 100 were *Terminalia prunioides* (Mshoghoreka), and in Jora, 110 out of 209 posts recorded on four houses were *Terminalia prunioides* as well (Tables 6 & 7). This species was heavily used as a post, rafter, and wallplate because residents said it was resistant to pests and rotting, grows straight, and can be easily split into desired sizes. Similarly, *Pittosporum viridiflorum* (Mshaughi) was used as a post because it was hard and resistant, and in Jora, residents said *Terminalia spinosa* (Msaghano) also served as a post for similar reasons and was said to be relatively abundant. *Acacia bussei* (Mngololi) was valued but its use as a post was minimal because residents said the tree was locally rare (mostly because it has been selected for charcoal), and mostly found deeper in the bushland where wild animals pose greater danger. *Combretum* spp. (Ndashi) and *Grewia bicolor* (Mdomoko Mtini) or *G. mollis* (Mdomoko Mbaa) species were heavily used as cross poles, accounting for 61% and 99% of all the crosspoles on the measured houses in Makwasinyi and Jora, respectively. These species were selected because they were said to be flexible, and *Combretum* spp. were also desired because they are light and grow in groups allowing for easy collection with minimal labor. An additional advantage for *Grewia mollis* (Mdomoko Mbaa), according to village residents, was that bigger ones could be split into smaller cross poles.
Fig. 11: A typical home for the Kasigau Taita, showing different functions that construction trees serve as posts (A) that are firmly anchored in the ground by earth, crosspole (jitó) (B), wallplate (C), strut (D), and rafter (E). The photo taken in Jora shows a home that is almost ready for mud and thatch.
Table 6: Plants used for home construction recorded from four houses in Makwasinyi. None of the houses was complete and ready for muddying.

<table>
<thead>
<tr>
<th>Hse #</th>
<th>Species Used</th>
<th>Functions</th>
<th>Totals</th>
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<td></td>
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<td>Terminalia spinosa (Muango)</td>
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<td>Dalbergia vaccinifolia (Seneka)</td>
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Table 7: Plants used for home construction recorded from four houses in Jora. House 2 was almost complete and ready for muddying.

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<th>Totals</th>
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Melia volkensii (Mkurumbutu) was used as a strut on two of the four houses surveyed in Makwasinyi, accounting for the highest number of the struts recorded (45, 70.3%). It was probably used for this function more than any other species because, according to the respondents and especially the experts, it was durable and resistant to pests. Additionally, struts could be made from the many leftover branches of the species after it would be cut for other purposes, especially timber and technology. Melia volkensii and Commiphora baluensis (Mwaghare) were particularly recognized by carpenters as important sources of sawn timber, which would be sometimes used as rafters, doors, and window frames on houses. Melia volkensii was especially preferred because it was said to produce a smell that repelled pests, becomes useable after 10-15 years when the bark turns from light to dark, and does not shrink or bend unless persistently exposed to direct sunshine or damp conditions. In Jora, participants said that pruning of Melia volkensii right from the young stage ensures that the tree would grow straight with less branches (knots), an attribute that is desired especially for sawn timber and making technology products. Commiphora baluensis is also considered a good timber because participants said it was resistant to pests, could be split to smaller pieces, and was attractive, but was said to crack easily when nailed and hence required the additional work of drilling before nailing.

Technology

Many technological products such as furniture, pounding sticks, pounding pots, bows, arrows, beehives, and local combs among others are made by experts in both villages (Fig. 12). Consequently, the experts described some of the good qualities that a plant had to have in order for it to be suitable for making a certain craft. Desired attributes varied with the craft made, but commonly cited ones included durability, resistance to pests, ease of
Fig. 12: Some technology uses of forest resources in Makwasinyi and Jora. The technology products are used locally in the homes and/or are sold to village residents or to foreign visitors.
An expert and his student making a pounding pot from *Acacia tortilis*. The long handle for the chisel is made of *Dalbergia vacciniifolia* (Mseneka, Makwasinyi).

Locally made handles for a wheelbarrow (Jora).

A local guitar whose arm is made of *Melia volkensii* (Mkurumbutu, Jora).

A local carpenter making a door using wood from *Melia volkensii* (Jora).

Fig. 12 (continued).
workability with local implements, and resistance to cracking. For example, in Makwasinyi, an expert who makes pounding sticks said he preferred *Balanites aegyptica* (Muaghani) for making pounding sticks because it was straight and heavy. Pounding sticks made of heavy trees are preferred because of the weight they exert on the grains thereby speeding up the dehusking process. In Jora, some experts said that large stems of *Dobera glabra* (Muivu), *Lannea schweinfurthii* (Mshiga), and *Melia volkensii* (Mkurumbutu) could be hollowed out to make pounding pots, while straight branches could make pounding sticks. They observed that the ease of working with each of the species differed, and preferred Mkurumbutu mainly because it was easier to work with. For example, comparing the three species, one expert said: “If three of us [with the same knowledge] were given Mkurumbutu, Mshigha and Muivu to compete in making pounding sticks, I assure you that the one with Mkurumbutu will finish fast, and the product will be the best, followed by that of Mshigha and then Muivu. Mkurumbutu is easier to work with.”

Similarly, carpenters preferred Mkurumbutu for making furniture (doors and doorframes, windows and window frames, tables, and cupboards) because its timber is straight, strong, decay-resistant, easier to plane, and the furniture is attractive. An expert in Jora said that timber from Mkurumbutu rarely shrinks or warps unless exposed to prolonged sunshine and/or moisture. In one home in Jora, a boy had a fully functioning guitar whose arm was made of *Melia volkensii*, tuning pegs from *Combretum exalatum*, and resonator from used plastic containers (Fig. 12). *Commiphora baluensis* (Mwaghare) was also preferred for household furniture because it is durable, big stems can be split to desired sizes, and the furniture is attractive. In Jora, carpenters interviewed said *Diospyros mespiliformis* (Mkulu) can make good doorframes because it is very durable and pest-resistant, but they observed that it is not widely used because it is too hard for local implements. Some experts also made bows
and arrows. The attributes desired for making bows differed from those for arrows and consequently the plant species differed as well. In Jora, for example, *Dombeya kirkii* (Waru) and *Sacleuxia newii* (Ingole) were used for making arrows because they were strong and flexible thus ensuring that the arrows do not easily break, and for Waru, the arrows could last long. In Makwasinyi, experts interviewed also said that *Blepharisposmem zanguebaricum* (Mbulutu) makes durable arrows because it is a strong species. In both Makwasinyi and Jora, experts said Waru was good for making bows because it was strong and flexible. In Jora, the experts added that the species could be found growing in groups thereby saving time and labor in collecting it. However, in both villages, making bows and arrows was not widespread because most of the desirable species were found higher on the mountain. Finally, in Jora, *Dalbergia melanoxylon* (Mwingo) was preferred for making local combs because it was resistant to cracking.

Furthermore, a number of women participants, especially the elderly ones in Jora, had knowledge of weaving bags (*viondo*), winnowing baskets, and sleeping mats using fibers from local trees. Two main fiber species used are *Ficus thonningii* (Mvumu) and *Lannea schweinfurthii* (Mshigha). Of the woven products, *viondo* were the most popular because they were sold both locally and to tourists. The women experts said they preferred fibers from *Ficus thonningii* for making *viondo* because they could be easily chewed to a soft and suitable fiber called *murunguwa*, which is easy to weave, and was gentle on the hands. The main disadvantage was that only the fibers from mature trees could be used because women said they were more durable than those from young trees. Conversely, fibers from *Lannea schweinfurthii* were used because they could be stored for long time and *viondo* were durable. Additionally, the women said that they preferred the plant because they could obtain a brown color from the same plant to decorate their product. According to the women, the
main disadvantage of *Lannea schweinfurthii*’s fiber was that it was wasteful because only the fiber in the middle of bark was suitable for weaving. However, presently, almost all *tiodo* are made of sisal (*Agave sisalana*; Fig. 12).

- **Fuel**

  In both villages, I accompanied women to the main firewood collection sites and carried out a transect across these sites to document the diversity of firewood species. In Makwasinyi, the transect was done near *Tombolo*, and in Jora, one transect was at a rocky site called *Magagarenyi* close to their homes at *Mwakuri*, and the other was on black cotton soil (*Mlawasi*) between their farms and the *Itoronyi* bushland. Conversations with the women on these transects and when visiting their homes to document firewood species stored in the compounds revealed that women preferred certain firewood species due to the desirable qualities they had (Tables 8 & 9). Generally, women in both villages preferred a species that could produce a strong flame, store fire, produce less smoke and flying fireballs (*sisia*), ignite even when wet, and split easily using their local implements (Tables 8 & 9). All the women especially favored *Acacia mellifera* (Iti ya Ngunge) because they said it possessed most of the desirable qualities.

  The firewood species chosen depended on which meal was being cooked, time, and whether the person cooking was an adult or a child. For example, women who could afford breakfast said that they cooked for their school-going children using fast igniting species like *Acalypha fruticosa* (Jija) and *Grewia bicolor* (Mndomoko Mtini). Conversely, they said that *pure* (maize and beans) and *kimanga* (cassava, beans, etc.), both slow-cooking foods, are cooked using species that provided a strong fire like *Acacia bussei* (Mngololi), *Acacia mellifera* (Iti ya Ngunge), *Diospyros consolatae* (Mzuzi), *Terminalia prunioides* (Mshoghereka), and *Terminalia*
Table 8: Distinctive attributes for some important firewood species recorded with women participants in Makwasinyi. The trees and their attributes were compiled during a transect across a firewood site near Tombolo, and during conversations with the women in their homes when I surveyed the types of firewood they stored in their compounds.

<table>
<thead>
<tr>
<th>Species</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acacia etbaica</em> (<strong>Shighire</strong>)</td>
<td>givess strong heat; does not produce smelly or eye-irritating smoke; splits easily; and does not have thorns. However, the wood turns to ash very fast, and stored wood is susceptible to attacks by ants.</td>
</tr>
<tr>
<td><em>Acacia mellifera</em> (<strong>Iti ya Ngunge</strong>)</td>
<td>gives very strong fire; stores/glows overnight; produces less smoke; burns even when wet; is resistant to pests and hence can be stored for long periods; splits relatively easily using local implements; and does not produce flying fireballs (<strong>sisia</strong>) and smelly smoke. However, its strong heat must be regulated to protect pots and the small thorns are potentially dangerous.</td>
</tr>
<tr>
<td><em>Acacia nilotica</em> (<strong>Mchemeri</strong>)</td>
<td>has strong heat; does not produce eye-irritating smoke; and splits easily. However, the tree has small thorns and is difficult to burn when wet.</td>
</tr>
<tr>
<td><em>Cassia abbreviata</em> (<strong>Mkigondo</strong>)</td>
<td>burns longer and has strong heat. However, the wood burns with sparks (<strong>sisia</strong>) and does not split easily.</td>
</tr>
<tr>
<td><em>Combretum hereroense</em> (<strong>Ndashi ya Ng'ombe</strong>)</td>
<td>catches fire easily; has a strong fire; does not produce eye-irritating smoke; and is easy to collect because the tree grows in groups. However, the wood does not store fire for a long time.</td>
</tr>
<tr>
<td><em>Combretum exalatum</em> (<strong>Ndashi ya Mburi</strong>)</td>
<td>also catches fire easily; has strong fire; and is abundant. However, the wood produces a lot of smoke and does not store fire for a long time.</td>
</tr>
<tr>
<td><em>Diospyros consolatae</em> (<strong>Mzuzi</strong>)</td>
<td>produces very strong heat; burns for long and stores fire overnight; reddish pink firewood (pith is black) are aesthetically pleasing when kept in the compound; and produces less smoke. However, the tree is rare and the wood is hard to split.</td>
</tr>
<tr>
<td><em>Manilkara mochisia</em> (<strong>Mnao</strong>)</td>
<td>produces strong heat, but is infested with caterpillars that are very irritating to skin.</td>
</tr>
<tr>
<td><em>Psydrax schimperiana</em> (<strong>Mzereghembe</strong>)</td>
<td>produces strong heat; has beautiful firewood; and splits easily. However, the wood produces a lot of smoke that turns cooking pots black.</td>
</tr>
<tr>
<td><em>Teclea simplicifolia</em> (<strong>Mwambololi</strong>)</td>
<td>has a strong fire that can glow for a long time; produces less smoke; is pest resistant; does not produce fireballs; and does not have thorns.</td>
</tr>
<tr>
<td><em>Terminalia prunioides</em> (<strong>Mshoghoreka</strong>)</td>
<td>produces a strong fire; stores fire overnight; splits easily because it is straight; split firewood are easy to tie and carry; firewood are attractive in the homestead because they are neatly tied together; pest resistant so it can be stored for a long time; does not produce <strong>sisia</strong>; and does not have spikes. However, the split wood has very sharp edges that are potentially dangerous.</td>
</tr>
</tbody>
</table>
Table 9: Distinctive attributes for important firewood recorded with women participants in Jora. The species and their attributes were collected during transect walks with women across two firewood sites, one at Magagarenyi near the homes in Mwakuri, and the other in the Itoronyi bushland close to the farms, and during visits in the homes to identify stored firewood.

Acacia ancistroclada (Kidenya): splits easily; does not produce eye-irritating smoke; does not burn with flying fireballs (sisia); it is lighter when carried; it splits easily; and is easy to tie. However, the tree has thorns so more time is spent in collecting the firewood.

Acacia bussei (Mngololi): stores fire for a long time; produces a strong heat; does not produce eye-irritating smoke; produces very little ash; splits easily; and does not produce fireballs. However, the tree is rare and the wood is heavy.

Acacia mellifera (Iti ya Ngunge): splits easily; has a very strong heat; it is relatively abundant; does not produce fireballs or smelly smoke; produces very little ash; catches fire even when wet; stores fire for a long time; and is pest-resistant so the wood can be stored for future use. However, the wood is heavy and has thorns (spiky), thus collecting the wood can be time consuming.

Acacia nilotica (Mchemeri): is relatively abundant and can grow in groups; it does not produce eye-irritating smoke or fireballs; is easy to split especially when dry; easy to arrange and carry; and the bark can be peeled off the firewood to make tea. However, the tree has thorns, thereby requiring more time and patience to collect; small logs cannot store fire for a long time; it is hard to catch fire when wet especially, with bark; and the wood is susceptible to pests hence cannot be stored for a long time.

Diospyros consolatae (Mzuzi): produces a strong heat; keeps fire for a long time; produces very little ash and eye-irritating smoke; its pink color is attractive; does not produce fireballs; does not have sharp edges when split; and can grow in groups. However, the wood is heavy; does not split easily because it is hard and bent; is difficult to tie into bundles; and is hard to catch fire when wet.

Terminalia prunioides (Mshoghereka): is easy to split and tie because it grows straight; catches fire easily due to its sharp edges; ignites even when wet; has a very strong heat and the fire can stay overnight; and does not produce eye-irritating smoke or fireballs. However, the wood is heavy and must be handled carefully after splitting due to its very sharp edges.

Terminalia spinosa (Msaghano): splits easily; has a very strong heat and stores fire for a long time; does not produce fireball; the tree does not have thorns so it is easier to collect the wood; and does not produce eye-irritating smoke. However, its sharp edges are dangerous.
*spinosa* (Msaghano). These species, except *Terminalia prunioides*, are often slow to catch fire so they need small igniting twigs like *Acalypha fruticosa*. Women further said that because of their slow-burning and heat-storing capabilities, they are suitable for cooking long meals that are important during labor-intensive periods such as weeding and harvesting, and during gatherings that require the preparation of a lot of food (e.g., the mappingsessions). These species were also economical, as was justified by one woman in Jora: “By using them [heat-storing species], we save time to do other things, and do not frequently buy a matchbox. Neither do we bother our neighbors for fire.” However, species with potential health effects were avoided. For example, women in Jora said that although *Zanthoxylum chalybeum* (Genjeka) was good firewood, its smoke was observed to cause skin rashes to babies if used by breastfeeding women. It was also avoided because it produces fireballs (*sisia*) that restrict its use to adults. Furthermore, women in both villages said they disliked *Diospyros mespiliformis* (Mkulu) and *Senna siamea* (Msaji) because of their bad smell. Finally, women said they could use fast igniting firewood such as those used for breakfast (*Acalypha fruticosa* and *Grewia* spp.) to cook for a visitor who could be in a hurry.

Firewood species such as *Acacia mellifera*, *Terminalia prunioides*, and *Terminalia spinosa*, among others were heavy yet they were among the most extensively used firewood. This suggests that women do not consider the weight of a firewood species to be a major factor influencing their decisions to collect the wood. In fact one woman in Makwasinyi said she would rather spend more time collecting, for example, *Acacia mellifera*, than spending less time on less desirable species. Others said they were assisted by their daughters to collect the firewood, and in Jora, women from well-off families occasionally used ox-drawn carts (or hired people with carts) to collect desirable species from the bushland, especially *Acacia*
*mellifera.* Perhaps women make such decisions of spending more time on these species because using them eventually saves them time as these species store fire for a long time.

Men and women participants in both villages said charcoal burning was limited because suitable species were far into the bushland where wild animal threats are high, and the provincial administration backed by the local forest guard and forest vigilating individuals banned the activity within the homesteads and farms. Consequently, there were relatively few species identified for charcoal (Makwasinyi = 2 species, 5.1%, Jora = 1 species, 2.4%) as compared to those for firewood (see Table 4). Most of the charcoal species were also used as firewood, with *Acacia bussei* (Mngololi) cited as providing the best charcoal. Others were *Acacia ethbaica* (Shighire), *Terminalia prunioides* (Mshoghoreka), and in Jora, *Terminalia spinosa* (Msaghano) chosen mainly because their charcoal gives strong heat, and can glow for a long time.

**A Landscape View of Resource Value**

In both villages, I asked the participants to list some important trees they had mentioned over the course of the study period with the purpose of determining their level of consensus regarding how the species were used. Participants in Makwasinyi mentioned 24 species and those in Jora 26 species (Tables 10 & 11). I then ranked these species by the number of uses and consensus among uses (i.e., total values for the six use categories). Based on the participants’ votes on whether or not these species were used for particular purposes, I identify three main ranking categories: species with a high consensus among participants in several uses; species with high consensus but used in fewer categories; and species with many uses but low consensus among participants.
Table 10: Important species compiled through voting by residents of Makwasinyi, show those species with higher ranks based on the high consensus among participants and many uses, those having high consensus but fewer uses, and the species many uses but lower consensus among participants.

<table>
<thead>
<tr>
<th>Plant Used</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Food/Fodder</td>
</tr>
<tr>
<td>Terminalia prunioides (Mshoghoreka)</td>
<td>4</td>
</tr>
<tr>
<td>Melia volkensii (Mkurumbutu)</td>
<td>20</td>
</tr>
<tr>
<td>Acacia mellifera (Iti ya Ngunge)</td>
<td>22</td>
</tr>
<tr>
<td>Pittosporum viridiflorum (Mshaughi)</td>
<td>18</td>
</tr>
<tr>
<td>Zanthoxylum chalybeum (Genjeka)</td>
<td>20</td>
</tr>
<tr>
<td>Acacia nilotica (Mchemeri)</td>
<td>22</td>
</tr>
<tr>
<td>Cassia abbreviata (Mkigondo)</td>
<td>0</td>
</tr>
<tr>
<td>Manilkara mochista (Mnao)</td>
<td>17</td>
</tr>
<tr>
<td>Diospyros consolatae (Mzuzi)</td>
<td>13</td>
</tr>
<tr>
<td>Combretum hereroense (Ndashi ya Ng’ombe)</td>
<td>10</td>
</tr>
<tr>
<td>Azadirachta indica (Mkilifi)</td>
<td>9</td>
</tr>
<tr>
<td>Grewia similis (Muododo)</td>
<td>18</td>
</tr>
<tr>
<td>Acacia etbaica (Shighire)</td>
<td>14</td>
</tr>
<tr>
<td>Dalbergia melanoxylon (Mwingo)</td>
<td>0</td>
</tr>
<tr>
<td>Teclea simplicifolia (Mwambololi)</td>
<td>10</td>
</tr>
<tr>
<td>Albizia anthelmintica (Mporozi)</td>
<td>5</td>
</tr>
<tr>
<td>Tamarindus indica (Mkwachu)</td>
<td>22</td>
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<tr>
<td>Combretum exalatum (Ndashi ya Mburi)</td>
<td>7</td>
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<tr>
<td>Balanites aegyptica (Mwaghani)</td>
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<tr>
<td>Sterculia africana (Mweja)</td>
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<td>Acacia tortilis (Mwaghuba)</td>
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<td>Commiphora edulis (Mtandara)</td>
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<tr>
<td>Commiphora baluensis (Mwaghare)</td>
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</tr>
<tr>
<td>Lannea schweinfurthii (Mshigha)</td>
<td>7</td>
</tr>
</tbody>
</table>
Table 11: Important species compiled through voting by residents of Jora, show those species with higher ranks based on the high consensus among participants and many uses, those having high consensus but fewer uses, and the species many uses but lower consensus among participants.

<table>
<thead>
<tr>
<th>Plant Used</th>
<th>Uses</th>
<th>Food/ Fodder</th>
<th>Cons.</th>
<th>Tech.</th>
<th>Remedy</th>
<th>Fuel</th>
<th>Eco. services</th>
<th>Score</th>
<th>Rank</th>
</tr>
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<tbody>
<tr>
<td>Terminalia prunioides (Mshoghoreka)</td>
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<td>20</td>
<td>24</td>
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<td>20</td>
<td>19</td>
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<td>Melia volkensii (Mkurumbutu)</td>
<td></td>
<td>20</td>
<td>24</td>
<td>25</td>
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<td>Terminalia spinosa (Msaghano)</td>
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<td>Pittosporum viridiflorum (Mshaughi)</td>
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<td>15</td>
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<td>Zanthoxylum chalybeum (Genjeka)</td>
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</tr>
<tr>
<td>Acacia senegal (Iti ya Wasi)</td>
<td></td>
<td>2</td>
<td>11</td>
<td>3</td>
<td>0</td>
<td>12</td>
<td>11</td>
<td>39</td>
<td>25</td>
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<tr>
<td>Commiphora baluensis (Mwagharec)</td>
<td></td>
<td>0</td>
<td>18</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>38</td>
<td>26</td>
</tr>
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</table>
Species with high consensus among participants for most of the material use categories have the highest rank. In Makwasinyi, these include *Terminalia prunioides* (Mshoghoreka), *Melia volkensii* (Mkurumbutu), and *Acacia mellifera* (Iti ya Ngunge) although they, respectively, have low consensus in food/fodder, fuel, and technology use categories, and virtually no consensus for remedy (Table 10). In Jora, species with the highest rank have a high consensus for all the material resources except remedy, and an equally high consensus for ecosystem services (Table 11). These species include *Terminalia prunioides* (Mshoghoreka), *Melia volkensii* (Mkurumbutu), and *Terminalia spinosa* (Msaghano). The low and high consensus among participants in Makwasinyi and Jora, respectively, regarding the ecosystem services constitutes a major difference between the two villages. Participants in Jora, for example, were more inclined to value ecosystem services provided by the ranked species, including shade, aesthetics, and nectar for bees.

Furthermore, in both villages, there are species that have a high consensus among participants but the high consensus was only for a few use categories. Species in this category are comparatively few, and include *Dalbergia melanoxylon* (Mwingo) and *Commiphora baluensis* (Mwaghare) in Makwasinyi, and *Acacia ancistroclada* (Kidenya) and *C. baluensis* (Mwaghare) in Jora. Participants in both villages show a high consensus for *C. baluensis* only for construction and technology. A number of other species in the two villages have many uses but there was less consensus among participants regarding these uses. In Makwasinyi, for example, *Commiphora edulis* (Mtandara) has five of the six uses but its consensus was very low for most of these uses with the exception of the construction category (Table 10).

Similarly, in Jora, *Grewia mollis* (Mdomoko Mbaa) was used in all the categories, but four of the six categories had low consensus among participants (Table 11). Trees used for some
remedies were only noted by a few individuals suggesting the importance of specialized knowledge.

These rankings, based on the votes recorded to show consensus among participants, agree generally with the use data I gathered over the course of study concerning the species local people continually saw as important. For example, the votes show that *Terminalia prunioides* and *Melia volkensii* have the highest rank and a high consensus for most of the use categories, and this is a general reflection among the residents of Makwasinyi and Jora as they regard these species highly.

- **Distribution of Species Across Habitats**

  The useful woody plants identified by the Kasigau Taita are distributed across different habitats that include the evergreen forest on the mountain, a semi-evergreen to deciduous woodland at mid elevations, homes, farms, and the bushland. In both villages, the homes and farms were cleared from bushland or lower woodland to create an environment in which both indigenous and domesticated plants, including crops, are utilized. Some valuable trees recognized in Makwasinyi and Jora occur only in specific habitats. For example, *Tricho cladus ellipticus* (Mazido), a potentially important species for construction, is found in the semi-evergreen forest on the mountain, while *Euclea racemosa* (Mlalaku), an important firewood species, occurs mainly in the black cotton area (*ilenyi*) of the farms and bushland. Other valuable trees are found in the bushland. One such species is *Acacia bussei* (Mngololi), a highly valuable tree that is found deep in the bushland because residents have utilized most of it in the upper bushland for charcoal and firewood.

  Most of the useful species are found within a transitional area that includes the upper bushland, the farms, the homes, and the deciduous woodland below 700 m. Species found in this habitat include *Acacia senegal* (Iti ya Wasi), Ndashi (*Combretum* spp.), *Terminalia prunioides*
(Mshoghoreka), and *Terminalia spinosa* (Msaghano). Others have a somewhat more restricted distribution. For example, *Commiphora baluensis* (Mwaghare) can be found in the upper bushland, but is more abundant in the woodland close to the semi-deciduous transition where it is utilized for timber, while *Teckea simplicifolia* (Mwambolo) is mainly in the semi-deciduous woodland and forms an important secondary firewood site. *Acacia aneistroclada* (Kidenya), *A. ethaica* (Shighire) and *A. mellifera* (Iti ya Ngunge) are found mostly in the bushland where they form important firewood sites utilized especially when there are fewer threats posed by wild animals. *Adansonia digitata* (Mlamba) is found close to homes, especially in Jora, and in the farms where residents do not clear them because their leaves are believed to enrich the soil. *Acacia robusta* (Mghunga) and *Acalypha fruticosa* (Jija) are also plenty within the transitional habitats, but are plentiful along [seasonal] streams and, for Jija, along fencerows as well. The transitional area not only has indigenous trees but also non-native ones that are planted in the farms and homes, including *Azadirachta indica* (Mkilifi), and *Tamarindus indica* (Mkwachu). The distribution of *Melia volkensii* (Mkurumbutu) is unclear (Beentje 1994) and may indeed be naturalized in the transitional zone.
Chapter Seven

DISCUSSION

Landscape Patterns of Resource Diversity at Mt. Kasigau

The mapping sessions with men and women in Makwasinyi and Jora demonstrate a local understanding of the landscape and the changes that have taken place over time. Their maps show a diverse and dynamic landscape that has undergone major shifts in resource utilization practices. The shift in human settlements and farms from the mountain in the past to the lower elevation areas at present must have been occasioned by some factors, including increase in population. Additionally, I argue that the shift played a part in enabling the establishment of the forest on the mountain to its present condition. Since there was virtually no settlement in the lowland as shown on the past maps, it can be assumed that people obtained all forest material resources including plants for technology, medicine, and building materials from the mountain. The reverse is now true for the present as the maps show that people obtain material resources both on the mountain and the bushland. Furthermore, present human settlements in Makwasinyi and Jora are located close to the farms and are connected to the main road by small footpaths, suggesting that proximity to resources and transport routes is important. My findings support similar participatory studies, which have shown that during mapping sessions, participants tend to locate human settlements close to major resources such as rivers, irrigation dikes, and forest (e.g., see Neefjes 1993 for Guinea-Bissau; Nemarundwe & Richards 2002 for Zimbabwe).

The participatory maps for the villages of Makwasinyi and Jora also reveal a sense of place for the village residents. Lockwood (1999: 368) defines place as “a setting or landscape of profound meaning and connection to an individual by virtue of personal, direct
experiences.” Sense of place would imply that an individual or community has an attachment or belonging to a particular place, thereby developing identity with the place (cf. Butz & Eyles 1997). The presence of different resources in different habitats, unique natural and human-made features, farms as well as homes within the territories mapped by men and women indicates that village residents can identify themselves with the place they live and work. Butz and Eyles (1997) lay down a theoretical framework for understanding sense of place and use two examples (a rural and an urban setting) to show that sense of place is both collective and individual, and may be different for men and women. My study partly concurs with their findings in that men and women in Makwasinyi and Jora identify different forest resources, especially firewood trees for women and building trees for men, from the same landscapes they map.

Another dimension of sense of place learned from the residents is the resolution and area included in the village maps. In all the maps, there is a high amount of detail, showing natural and human-made features, different land-cover types, and different areas for resources on a very small space. It seems like when mapping their territory, people compress their landscapes to include resources that are far away, and this is evident in the Makwasinyi resource maps where both men and women included far-away sites that had building and firewood trees. Further, the area devoted to the sites for different resources appears small on the maps, but is actually large in reality. This is similar to a resource map compiled by residents of a rural village in Zimbabwe (Nemarundwe & Richards 2002) in which relatively large resources such as hills, mountains, woodland, and rivers were mapped as small sites to fit with the other locally recognized resources. Two interpretations can be made from the scale of the village resource maps. First, including far-away resources in the village maps shows that village territories are not static; they are dynamic and will expand with the
‘discovery’ of new resource sites. This is especially true for the villages of Makwasinyi and Jora as their surroundings are uninhabited and are by definition open access lands. Secondly, including far-away resources may be an indication of the availability of important resources within the vicinity of a village. Since research participants expressed concern that some tree species were declining, it can be argued that one of their responses to the shortage is to extend their territory so as to include these resources. An understanding of the changes in the landscape, as is shown in Makwasinyi and Jora, is thus important in management of local resources especially in agrarian communities where there is a high human modification of the landscape (Ernoult et al. 2003).

The study also underscores the importance of recognizing local knowledge about local resource diversity. Many studies (e.g., Kokwaro 1995; Kvist et al 2001; Mandondo 2001; Liu et al. 2002) show that local ethnobotanical knowledge greatly contributes to the survival of many communities and also helps in maintaining biodiversity. In my study, research participants demonstrated an understanding of woody plant resources, as exemplified by the 105 useful woody plants recorded for the provision of material resources and ecosystem services. Together with additional plants recorded by Medley (2004), the combined list of useful plants in Makwasinyi and Jora is currently 198, an incredibly high diversity that attests to the rich local knowledge exhibited by the research participants. There is potential for even greater knowledge among the village residents on the use of plant resources if another study is done to document uses of all plants—herbs, grasses, shrubs, and trees— in all habitats. Hazanaki et al. (2000), for example, recorded 227 useful plants in two communities in Brazil that represented woody and non-woody plants, showing the high diversity and rich ethnobotanical knowledge in this region. However, I emphasize that the
ethnobotanical knowledge recorded in this study represents the views of the participants and cannot account for the diversity that would exist in the whole village.

Study findings show that research participants in Makwasinyi and Jora identify with a number of material goods and ecosystem services, especially those that directly benefit their livelihoods. They use different plant parts for different purposes, including tubers, fruits, stems, bark, leaves, and/or twigs as food for themselves and fodder their livestock, poles and/or fiber for construction, technology, fuel, and remedy. Because of such direct benefits, I argue that ethnobotanical research mainly documents those uses local people derive from the environment, evident in the many uses recorded for the material use categories (see Table 5). Locally recognized material resources and ecosystem services will, therefore, vary from place to place depending on the cultural fabric and livelihood strategies of the community investigated. This contrasts with conventional materials and services, which are benefits offered by different biomes and which have important but indirect benefits to humans (Costanza et al. 1997; Daily 2000).

This study also shows the importance of comparative studies as forming stronger basis for resource management decisions. Studying two or more locations provides greater potential for learning and exchange of information pertinent to management of similar resources as there is availability of information that can be compared, unlike in single-site studies where comparisons are minimal. Oyewole and Carsky (2001), for example, compared uses of fruit trees in eight villages in two states in Northern Nigeria and found that farmers were motivated by economic factors in planting and maintaining trees on their farms. They thus recommended that agroforestry practices in the region needed to focus on multiple use trees. My study integrates the similarities in land-cover types and plant uses in Makwasinyi and Jora to recommend forest management at Mt. Kasigau that aims at preserving trees
species that have similar uses. Similarly, as men and women have very different views on resource availability, accessibility, and use (Molnar 1990; Rocheleau & Edmunds 1997; Styger et al. 1999; Goebel et al. 2000), management decisions at Mt. Kasigau should focus on meeting gender specific needs, thus ensuring adequate availability of species for firewood for women and building and construction for men. Certainly, these management decisions are not static but are subject to change depending on the evolving use and perception of forest resources.

- *A Transect of Forest Resources in Makwasinyi and Jora*

Among the Kasigau Taita, the plants that provide the material goods and ecosystem services are distributed within different habitats along an altitudinal gradient that extends from the bushland, farms, homes, montane woodland, and the evergreen forest. Of these, a transitional area, comprising the upper bushland, the farms, homes, and lower woodland, is the most important in terms of recognized resource diversity and bulk of resource use (Fig. 13). Residents in both villages cannot fully utilize the resources higher on the mountain because of the steep slopes and the restrictions imposed by the local administration. The bushland occurs in an important wildlife corridor between Tsavo East and West National Parks. Wild animals pose a danger to village residents and sometimes restrict utilization of forest resources to the upper bushland. The transitional area is the most important region where residents obtain forest resources throughout the year. This highly modified landscape should be prioritized for the conservation of plant resources for local residents (cf. Redford & Richter 1999). Transitional areas, also called forest/crop mosaics, are recognized as important in the livelihoods of many communities in Africa and can be sustainably
Fig. 13: An idealized distribution of habitats with useful forest resources along an altitudinal transect across Mt. Kasigau

**Evergreen forest** that is recognized mainly for services as a water catchment

**Lower montane woodland**, that changes from semi deciduous to evergreen with increasing altitude, includes a high diversity of valued and potentially available timber and non-timber resources

**Transitional area**, comprised of homes and farms, is the most vital source of forest resources for the two villages

**Bushland** has plenty of forest resources but more dangerous due to wild animals; a major grazing site
managed to provide timber and non-timber forest products, fodder crops, fuelwood, shelter for crops, and as habitat for wildlife (WRI 2000).

**Adaptive Collaborative Management of Forest Resources at Mt. Kasigau**

My study concurs with other ethnobotanical research that shows how rural communities depend on forest resources (e.g., Hazanaki et al. 2000 and Ladio & Lozada 2001 for South America; Harris & Mohammed 2003 and Kristensen & Balslev 2003 for Africa; and Ramnath 1997 and Hongmao et al. 2002 for Asia). Two studies done in Africa (Goebel et al. 2000, Zimbabwe and Lykke 2000, Senegal) exemplify the high value that local communities place on useful woody plants. The overall species rankings I did for my study show varying levels of participant consensus with regard to different plant use categories. The fact that participants recorded potential and actual uses of plant resources shows that management efforts should target all useful plants, and/or the landscapes in which these plants occur, irrespective of whether they had high or low consensus among participants. Further, indigenous woody plants, the focus of the study, provided the bulk of material goods and ecosystem services, showing their importance to local communities, as found by Backes (2001) in Western Kenya. Efforts should thus be made to manage most of the indigenous trees, especially those cited to be declining, while also promoting local efforts to establish native but equally important trees, such as *Azadirachta indica* (Mkilifi).

The ethnobotanical data gathered with research participants can be interpreted as local information reflecting their views and perception of forest resources and which can be shared amongst different stakeholders interested in the conservation of the Eastern Arc forests (Fig. 14). Collection of reliable information and sharing it among different stakeholders is emphasized in adaptive collaborative management (Wilhere 2002). Because
Fig. 14: A framework for sharing information among stakeholders interested in the conservation of local resources. Research with local communities is needed to yield information on resources, and the information is shared among all stakeholders. Reliability of information for adaptive collaborative management plans is achieved through continual monitoring and evaluation.
different stakeholders have different motivations and interests in a resource (McNeely 2001), there is a dichotomous view of resources, and hence a potential for conflicts of interests. The international significance of Mt. Kasigau as a biological hotspot as well as its local importance in the provision of material resources and ecosystem services to surrounding communities places it at the center of a potential clash of interests. Uniquely, adaptive collaborative management becomes a platform upon which disagreements concerning use could be amicably solved (Fig. 14). Consequently, negotiations among stakeholders, including the government (through the Forest Department), the East African Wild Life Society (EAWLS), the East African Crossborder Biodiversity Project, the Taita Discovery Center, and the local communities will help define roles for each stakeholder. For example, the local people may become responsible for the performance of activities and the Government can assume a supervisory and regulatory role and safeguard and protect the rights of the people to have access to the forest resources, and the conservation groups may offer financial and technical assistance, leading to co-management of the local forest resources (Notzke, 1995; Ndibi & Kay 1999; Senaratna 1999). Certainly, collaboration needs to be done in such a way that the goals of managing a biodiversity hotspot do not compromise the ability of the local people to benefit from the forest resources.

I also argue that successful management and protection of forest resources at Mt. Kasigau will entail protection of village residents from the dangers associated with wild animals. During interview sessions, participants alluded to the threats they faced while in the bushland, especially from elephants, and this can be attributed to the fact that Kasigau lies in a wildlife migration corridor between the Tsavo East and Tsavo West National Parks. Consequently, the Kenya Wildlife Service, which is responsible for the protection of all wildlife in Kenya (Mugabe et al. 1998), should become a strategic partner with other
stakeholders interested in the management of Mt. Kasigau. While each stakeholder has specific management objectives that may not necessarily reflect the interests of others, consultations can enable measures taken to reverse the potential adverse effects posed by elephants. Results show that the bushland together with the transitional area are the most diverse in terms of plant resources. An environment with less wild animal threat will enable residents to use most of the bushland tree resources and this can have a positive effect on the forest on the mountain especially areas earmarked as secondary firewood sites and the Mazido site (in Jora) where there are potential building trees.

Further, adaptive management of forest resources at Mt. Kasigau should be viewed from a broader context of economic prosperity of the local people. Incentives that promote and encourage local economic ventures have been known to have positive impacts on natural resource management (e.g., Tisdell 1995; Horowitz 1998). Consequently, incentives to the Kasigau Taita residents based on their priorities would be an important step in managing the forest. Over the study period, residents expressed desire to receive funding of local projects. In Makwasinyi, for example, a women’s group needed support for a tree nursery, and also wished to start a project with more realistic gains such as vegetable garden. In Jora, a self-help group had rental houses and a conference hall that needed to be completed, and both men and women agreed that water scarcity remained a major problem that needed to be addressed. Further, in Jora, women who wove baskets wished to have a ready market for their products. Consequently, encouraging and financially supporting such micro-projects could be seen as a means to support local livelihoods and may be an incentive for forest conservation at Mt. Kasigau, otherwise management options that conflict with, or do not promote, economic objectives are unlikely to be locally considered and supported (c.f. Wilhere 2002).
Finally, stakeholders interested in the conservation of Mt. Kasigau should be open and willing to experiment with options that can possibly benefit the local people. After all, a central feature of adaptive management is for resource managers to undertake management as experiments, and be willing to learn from lessons that accrue in order to make ‘better’ decisions in the future (Wilhere 2002; Armitage 2003). Relating to this study, there is evidence that *Acacia* trees are not only useful for firewood and forage but can also become important producers of tannins and gums for industrial purposes (Fagg & Stewart 1994; see Barrow 1996 for a discussion on *Acacias* in different parts of Africa). A *Commiphora-Acacia* woodland dominates the drier areas of southeastern Kenya, including Mt. Kasigau (c.f. Morgan 1973; Beentje 1994; Medley 2004). Organizations that are traditionally interested in the development of rural areas of developing countries (such as the USAID) in conjunction with the current stakeholders at Mt. Kasigau can provide funds enabling a pilot project to investigate the viability of gum production from *Acacia senegal*. Farmers in the Sudan have extracted gum from *A. senegal* while the Samburu of Kenya have extracted oil from the seeds of *Balanites aegyptica* for sale (Barrow 1996), so it would be interesting to investigate if the same could apply to the Kasigau Taita. By encouraging such experimentations, resource managers will be exploring the opportunities for local development as well as protection of forest resources, and this could likely stimulate even more interest especially on the part of the Kasigau Taita in the sustainable use of forest resources. While such pilot projects are long-term, have very uncertain outcomes, and need substantial financial commitments, they can still provide managers with lessons that can be improved upon to adapt to the local situation at Mt. Kasigau. Ultimately, the goal is to create an ecosystem that is more resilient, provides people with material goods and services for their livelihoods, promotes diversity of species, and offers opportunities for economic development (cf. Folke et al. 2002).
Participatory Methods as Tools for Forest Conservation

Participatory methods are effective at “creating space for bringing different stakeholder groups together to first appreciate local resource realities, and from this, identify management options” (Brown & Hutchison 2000: 1). Participatory methods, by definition, aim at obtaining and sharing of biophysical and socio-economic information that is needed for implementing local community development projects (Jackson et al. 1994; Tuxill & Nabhan 2001). I used participatory mapping, participant observations, and interviews to gather information on the use of woody plants among the village residents of Makwasinyi and Jora. The rich ethnobotanical information I gathered using PRA methods supports them as important tools to generate local information, which can form the basis for initiation and implementation of local projects (Aversa et al. 1999). Participatory mapping, for example, is easily accepted among participants and is not threatening as residents themselves supply information, thereby showing essential information on resources that can be targeted for management (Jackson et al. 1994). The different resource sites mapped by men and women, including different trees that provide different uses could, for example, be important sites for management interventions. Essentially, the information provided on plant uses could contribute to an accumulation of baseline information that could be used in part for monitoring and evaluating changes in plant use patterns.

My experiences in Makwasinyi and Jora show how participatory methods can facilitate reviving stalled projects or initiating new ones. In Makwasinyi, for example, I held mapping sessions at a tree nursery run by women. The piped water system that provided the nursery with water had blocked and the seedlings were slowly drying out. However, on the first day of mapping, the Sub-chief, who also participated in the mapping session, authorized the pipe to be repaired, and by the end of the day, water was available at the nursery. This
stimulated discussion among participants on how they would maintain the pipe and plan a roster for watering the seedlings. In Jora, the end of the study saw the creation of a new self-help project called KANDUJO, abbreviated from Kanduyi, the home area of the principal investigator, and Jora. Although KANDUJO did not have immediate long-range objectives, participants promised to set up a communal garden where they would grow vegetables, and also proposed initiating a poultry project. The mapping sessions in the two villages saw participants ask how they could be supported to do local projects such as implementing a better water supply, or finishing the women’s rental houses and conference hall. These experiences show how participatory methods can unite community members into initiation of micro-projects that could be funded to diversify local income sources and support the livelihoods of the members (cf. Barrow 1996). Armitage (2003) demonstrates using an example from Central Sulawesi, Indonesia, that local institutions can play an important role in the management of local resources.

An important component of participatory research concerns who participates (Webber & Ison 1995; Barrow 1996). By encouraging men and women to participate in the research, I gained information on the woody plants used for different purposes, desirable attributes for trees in different use categories, and the habitats where these trees were found. Although my study does not provide a detailed account of the differences among men and women with regard to plant uses, the few that were recorded especially for firewood and building trees show that indeed carefully planned and executed participatory studies can tease out gender similarities and differences regarding local resources, especially accessibility, ownership, and use. All these are essential considerations in designing resource management plans. It is, however, important to emphasize that the information acquired in this study should not be automatically considered as representative of community views in the villages.
of Makwasinyi and Jora. There is a misconception that communities consist of members who are “similarly endowed (in terms of assets and income), ---- [and are] relatively homogenous households who possess common characteristics in relation to ethnicity, religion, caste, or language” (Agrawal & Gibson 1999: 634). In reality, a single community is made of different subgroups each with individuals who have “varying preferences for resource use and distribution” (Ibid. 637). The ethnobotanical data recorded is, therefore, a reflection of individuals who participated in the research, but can still provide a framework for understanding the general use of plant resources at Mt. Kasigau.

Inspite of the strengths and potential contributions of participatory research, a number of drawbacks are associated with it, thereby drawing criticisms from some authors (eg., Martin & Sherington 1997). From my experience in Makwasinyi and Jora, implementing participatory methods can be time consuming, as there needs to be a way to assemble different segments of the community, including men and women of class and age difference. Adequate planning and outreach is required. Furthermore, there may be possibilities of disagreements among the participants especially when some participants want to dominate others (Barrow 1996), thereby leading to a waste of time on one exercise. Although I did not experience the problem of cultural barriers, some studies that have adopted participatory techniques have reported barriers that completely inhibit women from participating in research (e.g., Hellier et al. 1999) so that results coming from such studies are a representation of views of one gender.

Barrow (1996) also warns of the loss of interest among research participants thereby forcing researchers to contend with smaller numbers of people. By staying with the residents and working with local field assistants, I managed to sustain the community’s interest over the research period. I maintain, from my experience in the field, that sustaining participants
in a participatory research largely depends on the relationship between the investigator and the participants: immersing oneself into the people’s activities, attempting to speak their language, and compensating their participation by, for example, having meals together will maintain their interest. Another important point that Martin and Sherington (1997) emphasize is the fact that results from participatory research are qualitative and hence inapplicable to quantitative analysis, subjective, and cannot be easily applied to wider contexts. However, by using a combination of methods (triangulation), researchers using participatory methods can minimize subjectivity and ensure validity of information (Pretty 1995; Aversa et al. 1999). For example, I verified the use of many plants mentioned over the course of the study period by talking to women and men as a group, observing them in their daily activities, and also holding in-depth interviews with experts.
Chapter Eight

SUMMARY AND CONCLUSION

This study reveals the capacity that lies in the local people to visually represent their landscape, both past and present, and pinpoint sites with important resources. The historical changes that have taken place in Makwasinyi and Jora, especially the shift of human settlements from the mountain to the lowland, may have indirectly contributed to the maintenance of the forest on the mountain as seen today. Most importantly, the study shows the importance of woody plant resources to the livelihoods of the village residents of Makwasinyi and Jora. These resources provide food, fodder, construction materials, handicrafts, remedy, and numerous services, and many more have potential for future use. The comparative ethnobotanical studies of the two villages allowed for cross-examination of the uses of different woody plants between the two populations, thereby noting similarities and differences that exist. Such location-specific differences can be incorporated in the formulation of forest management plans that are sensitive to the local context, as demonstrated by Macharia (2002: 77) whose comparative study of two wetland sites in Kenya urges researchers to “understand the dynamics within communities and how resources are viewed by people at different locations.” Finally, this research demonstrates that participatory methods are effective tools that can engage local people and researchers in documenting views on natural resources, thereby providing information that can be included in adaptive management plans of these resources.

I conclude that the different habitats, including the mountain, the bushland, and especially the transitional area (an area that includes the farms, homes, the lower montane forest, and the upper bushland) are all important in providing residents of Makwasinyi and
Jora with forest resources. Consequently, the ethnobotanical data presented in this study can be seen as a contribution of local data that can give local people a voice in participating with other stakeholders in the formulation of adaptive management plans for the forest. While efforts should target protecting the evergreen forest on the mountain due to its role as a water catchment, specific attention should be towards enhancing the productivity of the transitional area because this is the actual zone where the Kasigau Taita live and work on a daily basis. Enhancing the productivity of this habitat will have direct benefits on the conservation of the evergreen forest on the mountain, and will probably minimize times when people go to the bushland for forest resources, thereby reducing potential incidences of attacks by wild animals. As Mbuthia (2003) recommended forest restoration efforts in the Taita Hills based on species’ ecological attributes and ethnobotanical uses, I similarly recommend that conservation measures at Mt. Kasigau especially target locally important tree species. The conservation measures should specifically target the following species because of their importance to the residents of Makwasinyi and Jora:

- Firewood species such as *Acacia bussei* (Mngololi), *A. etbaica* (Shighire), *A. mellifera* (Iiti ya Ngunge), *A. nilotica* (Mchemeri), *A. Senegal* (Iiti ya Wasi), and *Diospyros consolatae* (Mzuzi).
- Food and fodder species such as *Acacia tortilis* (Mwaghuba), *Adansonia digitata* (Mlamba), and *Tamarindus indica* (Mkwachu).
- Building and construction species (including timber trees) especially *Commiphora baluensis* (Mwaghare), *Melia volkensii* (Mkurumbutu), *Pittosporum viridiflorum* (Mshaughi), *Terminalia prunioides* (Mshoghoreka), and *T. spinosa* (Msaghano).
- Technology species, including *Ficus thonningii* (Mvumo), *Lannea schweinfurthii* (Mshigha), and *Melia volkensii* (Mkurumbutu).
Medicinal species especially *Strychnos benningsii* (Bachia), *Zanthoxylum chalybeum* (Genjeka), as well as exotic ones such as *Azadirachta indica* (Mkilifi).

Since most of these species have multiple uses, their conservation will also assure village residents of their other material resources and ecosystem services. Locally rare species such as *Acacia bussei* (Mngololi) and *Diospyros consolatae* (Mzuzi), among others, as well as species that local people expressed concern over their declining rates due to local demands (such as *M. volkensii* and *T. prunioidei*) should especially be targeted for conservation and restoration programs. Village residents also indicated willingness to plant important trees especially *M. volkensii* on their farms, indicating that individual on-farm conservation practices can be adopted in the two villages (cf. Mbuthia 2003). However, on-farm management presents an especially formidable challenge, as there is no water, especially in Jora, that can be used for irrigating the seedlings. Perhaps this also shows that successful forest management at Mt. Kasigau will not only target the conservation of useful woody species; it may also imply that there should be efforts to increase the current capacity of the piped water supply from the mountain so that residents can have adequate drinking water. Finally, to understand the full diversity of useful plants present in the villages at Mt. Kasigau, I recommend a study that includes all plants found in the region- a project that will most certainly maintain collaboration between researchers and village residents for a long time to come.
References


Macharia, A. N. (2002) Community participation in wetland research at Lake Naivasha and the Tana River Delta. A thesis submitted to the Faculty of Miami University for the partial fulfillment of the requirements of the Degree of Master of Arts, Department of Geography.


Appendices

Appendix I

The research protocol for the thesis that was approved in 2002 by the Human Subjects Committee at Miami University prior to the actual field research.

Research Description

A Participatory Assessment of Forest Resource Use at Mt. Kasigau, Kenya

1. Project Personnel

*Principal Investigator (PI):* Humphrey A. W. Kalibo, MA Student, Department of Geography, Miami University.

*Advisor:* Kimberly E. Medley, Associate Professor of Geography, Miami University.

*Botanical Field Assistant:* One botanist will be hired from the National Museums of Kenya to help in the identification of tree species useful to the local people.

*Local Field Assistant:* One field assistant will be hired to help in the translations from Kiswahili, Kenya’s national language, to Kitaita, the local language. He/she will also help with introductions to the community and identification of key informants.

2. Purpose:

I propose a study to investigate the way two villages at the base of Mount Kasigau utilize their natural resources with an emphasis on use of forest resources. The study will document patterns of resource use and contribute cultural-ecological information that will form an important yardstick in the formulation of community-based management plans. To reach this goal, the study will address two research questions:

(i) How do the residents of Makwasinyi and Jora view their surrounding landscape and the distribution of different land-cover types?

(ii) What kinds of forest resources do the residents of the two villages derive from their mapped landscape and the respective land-cover types?

3. Subject Population:

The people occupying the area of study are called Wataita, an ethnic group practicing small scale agriculture on the slopes of Taita Hills. Their farms at the base of these hills are surrounded by private cattle ranches in the adjacent plains. Participants will include men and women 18 years and above.

4. Recruitment and Selection of Subjects:

I will interview the local residents to establish the uses they derive from the forest and other resources found in their villages. The local administration (The Chief) will be notified of my research. I will work in conjunction
with a field assistant (hereafter called the assistant) who will introduce me to the village residents. Participation will be voluntary. I will focus my interviews on established groups such as women and youth groups. People with specialized knowledge such as elders will be consulted. Again, the assistant will play an important role in linking me to such groups. Participants will be compensated for their time with small quantities of commodities such as flour and cooking oil. However, no cash will be given out. My intention is to get first-hand information on the subject under investigation. I will not be discriminative or coercive during the research process.

5. **Informed Consent**: The assistant will be the only person involved directly in the research. He/she will make introductions during each study session, after which PI will go over the Consent Form. The assistant will translate it to Kitaita. Those in agreement with the form will then participate in the research process. Any participant will be at liberty to terminate an interview session without special permission from the PI. Interviews will carried out during times compatible with participants’ time schedules.

6. **Research Procedures**:

- **Nature of Activities in which Participants will be engaged**: I will investigate the spatial distribution of forest and other land resources as perceived by the local residents. To achieve this, the PI will ask the participants to construct their village maps and indicate locations of different resources. They will then be engaged in informal interviews to determine how they use these resources they have mapped out. They will be asked to symbolically represent the importance of each use on large sheets of paper. Emphasis will be on a two-way dialogue to enhance optimal information exchange between the PI and the participants.

- **Research Location**: The PI will carry out the study in two villages called Jora and Makwasinyi at the base of Mt. Kasigau, found in southeastern Kenya.

- **Data Gathering Instruments**: The PI will use participant observation and semi-structured interviews to obtain information. Photographs will be taken, and transcription will be by hand in a field notebook, and if permitted by respondents, by a tape recorder. This recorder will be in full view of the participants. To guide the interview process, the PI will frame leading questions such as “Tell me about the uses you get from this forest-----”, “can you locate a resource considered useful (such as a forest stand) on your village map?”

- **Frequency of Activity and Overall time of Participation**: The research will use the above data collection methods for a reasonable length of time to ensure adequate information is collected. I anticipate that each interview session will last no more than an hour. Transect walks are projected to take no more than three hours. I anticipate holding a total of five interview sessions and three transect walks in each village. These will be spread over the entire time of data collection. However, they will not be used in such a way as to be time consuming and hence interfere with participants’ daily schedules.
- **Training of Persons Administering Data Collection:** The PI and his assistant will be the main people collecting data. A botanist, possibly from the National Museums of Kenya in Nairobi, will be with the PI for a brief period to help identify tree species of use to the community. The PI will give a brief orientation to the assistant on how to carry out participatory mapping sessions and transcription of field data. However, the PI will be responsible for compilation of all information.

- **Potential Risks and Discomforts:** This study does not anticipate any potential physical, psychological, social and/or legal risks. Participants will be at will to terminate their involvement at any time should they feel the research poses a risk to them.

- **Anonymity and Confidentiality of Information:** To protect confidentiality, respondents will not be identified by names or locations in their village. No respondent will mention his/her name even during sessions they will be recorded by tape.

The following is an introductory and informed consent form

**INFORMED CONSENT FORM**

**TO WHOM IT MAY CONCERN**

My names are Humphrey Wafula Kalibo, a graduate student in the Department of Geography at Miami University in Oxford, Ohio, USA. The purpose of my study is to gain a local understanding on the way residents at Mount Kasigau value and use their forest. Your participation in the research process will facilitate documentation of patterns of use of your resources and generate information that may be useful in the future management of the forest.

To achieve this goal, I will administer a number of interview sessions with willing community members at least 18 years of age. I will ask you talk about how see and use the resources you will have identified in your village. I will take notes of your responses and in some circumstances, tape record our conversations as a way of taking full track of the responses. I will also take photographs of different settings in your village. Your participation, nevertheless, is voluntary, hence you can terminate an interview session at your will, or avoid answering some questions. Your identities, both names and locations, will remain confidential.

Later, I will avail to you a copy of my study findings as well as photographs of your resources. You will be at liberty to suggest areas you wish to be modified.

I thank you in advance for your time, and hope that we are going to work collaboratively.

Sincerely,

Humphrey W. Kalibo
To: Chair, Committee on the Use of Human Subjects Research, Miami University

From: Humphrey W. Kalibo, Graduate Student, Department of Geography

Date: April 17, 2002

RE: APPLICATION FOR CERTIFICATION OF EXEMPT STATUS

This letter kindly draws your attention to my impending research in Kenya for my Masters Thesis in Geography.

I am a Kenyan national anticipating to undertake research from June to August 2002. To collect data for this research, I will need to observe and interview residents at the area of study. My questions will not have adverse impacts on persons participating in the study. I will treat the information given with utmost confidentiality, since no respondent will be named, nor their locations disclosed. The data obtained will be purely for research purposes and not constitute a basis for legal or economic appraisal as a result of the respondents’ activities. Further, the respondents will provide information at their volition, and will have the right to terminate participation at any time.

I hereby, therefore, apply for Certification of Exemption for my research. Attached herein are the relevant documents for your kind consideration.

Thank you in advance.

Yours sincerely,

Humphrey W. Kalibo
Appendix II

Research Permit obtained from the Government of Kenya prior to the research

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

HUMPHREY WAFULA KALIBO
MIAMI UNIVERSITY, DEPT. OF GEOGRAPHY
OXFORD, OHIO 45056
U.S.A.

Dear Sir,

RE: RESEARCH AUTHORIZATION

Following your application for authority to conduct research on Participatory Assessment of Forest Resource use at Mount Kasigan, Kenya, I am pleased to inform you that you have been authorized to conduct research in Taita Taveta District for a period ending 30th August 2002.

You are advised to report to the District Commissioner and the District Education Officer, Taita Taveta District before embarking on your research project.

You are further expected to deposit two copies of your research findings to this office upon completion of your research project.

Yours faithfully,

[Signature]

A. C. KAARLA
FOR: PERMANENT SECRETARY/EDUCATION

CC.

THE DISTRICT COMMISSIONER
TAITA TAVETA DISTRICT

THE DISTRICT EDUCATION OFFICER
TAITA TAVETA DISTRICT.
Appendix III

Plant identifications from the East African Herbarium at the National Museums of Kenya of some of the useful plants collected from the villages of Makwasinyi and Jora. Identification of the Latin names was made by Mr. Paul Kirika with assistance from Mrs. Emily Wabuye. These plants are now at the East African Herbarium in Nairobi.

<table>
<thead>
<tr>
<th>Species No.</th>
<th>Local Name</th>
<th>Scientific Name</th>
<th>Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAK 1</td>
<td>Mbulileri</td>
<td><em>Melhania velutina</em> Forssk.</td>
<td>Sterculiaceae</td>
</tr>
<tr>
<td>HAK 2</td>
<td>Mswaki</td>
<td><em>Salvadora persica</em> L.</td>
<td>Salvadoraceae</td>
</tr>
<tr>
<td>HAK 4</td>
<td>Mkungo</td>
<td><em>Terminalia kilimandscharica</em> Engl.</td>
<td>Combretaceae</td>
</tr>
<tr>
<td>HAK 5</td>
<td>Mkangazighe</td>
<td><em>Maerua decumbens</em> (Brongn.) De Wolf</td>
<td>Capparaceae</td>
</tr>
<tr>
<td>HAK 6</td>
<td>Mwamati</td>
<td><em>Rhoicissus revolii</em> Planch.</td>
<td>Vitaceae</td>
</tr>
<tr>
<td>HAK 8</td>
<td>Msimakwari</td>
<td><em>Maerua triphylla</em> A. Rich var johannis</td>
<td>Capparaceae</td>
</tr>
<tr>
<td>HAK 9</td>
<td>Mrikamundu</td>
<td><em>Tarenna graveolens</em> (S. Moore) Brem.</td>
<td>Rubiaceae</td>
</tr>
<tr>
<td>HAK10</td>
<td>Mudonga-Mwamubolo</td>
<td><em>Grewia forbesii</em> Mast.</td>
<td>Tiliaceae</td>
</tr>
<tr>
<td>HAK 13</td>
<td>Kitarika</td>
<td><em>Rhus natalensis</em> Krauss</td>
<td>Anacardiaceae</td>
</tr>
<tr>
<td>HAK 17</td>
<td>Mchemeremier</td>
<td><em>Acacia nilotica</em> (L.) Del. ssp. subulata (Vatke) Brenan</td>
<td>Mimosaceae</td>
</tr>
<tr>
<td>HAK 18</td>
<td>Mlundi</td>
<td><em>Hymenodictyon parvifolium</em> Oliv.</td>
<td>Rubiaceae</td>
</tr>
<tr>
<td>HAK 19</td>
<td>Mzuzi</td>
<td><em>Diospyros consolatae</em> Chiov.</td>
<td>Ebenaceae</td>
</tr>
<tr>
<td>HAK 20</td>
<td>Kishoe</td>
<td><em>Vicus ingens</em> (Miq.) Miq.</td>
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</tr>
<tr>
<td>HAK 21</td>
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<td><em>Diospyros cornii</em> Chiov.</td>
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</tr>
<tr>
<td>HAK 24</td>
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<td><em>Ricinus communis</em> L.</td>
<td>Euphorbiaceae</td>
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<tr>
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<td>Iti ya Wasi</td>
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<td>HAK 28</td>
<td>Bachia</td>
<td><em>Strychnos benningsii</em> Gilg</td>
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<tr>
<td>HAK 32</td>
<td>Ngidi</td>
<td><em>Ochna bolstii</em> Engl.</td>
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<td>HAK 35</td>
<td>Mumerumeru</td>
<td><em>Ancylodobryx pertosiana</em> (KL) Pierre</td>
<td>Apocynaceae</td>
</tr>
<tr>
<td>HAK 36</td>
<td>Mvyumu</td>
<td><em>Ficus sp.</em></td>
<td>Moraceae</td>
</tr>
<tr>
<td>HAK 37</td>
<td>Iti ya Kizungu</td>
<td><em>Pithecellobium dulce</em> (Roxb.) Benth.</td>
<td>Mimosaceae</td>
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<tr>
<td>HAK 39</td>
<td>Msaghano</td>
<td><em>Terminalia spinosa</em> Engl.</td>
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<td>HAK 40</td>
<td>Mglingili</td>
<td><em>Dichrostachys cinerea</em> (L.) Wight &amp; Arns.</td>
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<tr>
<td>HAK 42</td>
<td>Mlalaku</td>
<td><em>Euclea divinorum</em> Hiern</td>
<td>Ebenaceae</td>
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<tr>
<td>HAK 43</td>
<td>Iti ya Ngunge</td>
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<td><em>Uvaria acuminata</em> Oliv.</td>
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<td>HAK 46</td>
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<td><em>Ximenia americana</em> L. var. caffra (Sond.) Engl.</td>
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<td><em>Albizia harveyi</em> Fourn</td>
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<tr>
<td>HAK 49</td>
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</tr>
<tr>
<td>HAK 50</td>
<td>Mshoshoti</td>
<td><em>Grewia villosa</em> Willd.</td>
<td>Tiliaceae</td>
</tr>
<tr>
<td>HAK 52</td>
<td>Msafu/Msoko</td>
<td><em>Senna occidentalis</em> (L.) Link</td>
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<tr>
<td>HAK 53</td>
<td>Muododo</td>
<td><em>Grewia sp.</em></td>
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### Appendix III (continued)

<table>
<thead>
<tr>
<th>HAK 55</th>
<th>Mkitawa</th>
<th><em>Bourreria teitensis</em> (Gurke) Thulin</th>
<th>Boraginaceae</th>
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<tr>
<td>HAK 60</td>
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<td><em>Dichrostachys cinerea</em> (L.) Wight &amp; Arn.</td>
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<td>Mnyangandende</td>
<td><em>Meyna tetraphylla</em> (Hiern) Robyns ssp. <em>comorensis</em></td>
<td>Mimosaceae</td>
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<tr>
<td>HAK 63</td>
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<td><em>Manilkara sulcata</em> (Engl.) Dubard</td>
<td>Sapotaceae</td>
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<tr>
<td>HAK 64</td>
<td>Mngololi</td>
<td><em>Acacia bussei</em> Sjtedt</td>
<td>Mimosaceae</td>
</tr>
<tr>
<td>HAK 71</td>
<td>Muaghani</td>
<td><em>Balanites aegyptia</em> (L.) Del.</td>
<td>Balanitaceae</td>
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<td>HAK 72</td>
<td>Kidenya</td>
<td><em>Lonchoarpus eriocalyx</em> Harms</td>
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<td>HAK 73</td>
<td>Shighire</td>
<td><em>Acacia reficiens</em> Wawra ssp. <em>misera</em></td>
<td>Mimosaceae</td>
</tr>
</tbody>
</table>
Appendix IV

Kasigau Taita names and uses for woody plants compiled from residents in the villages of Makwasinyi (m) and Jora (j). Plant habits include trees (t), shrubs (sh), and woody vines (wv). Plant uses are categorized as food/fodder, construction, technology, remedy, fuel, and other (see Table 3). Prance et al. (1987) categorize “other” uses as ecosystem services. K. Medley and F.N. Gachathi confirmed Latin and Taita names through a collaborative research project. All plants are indigenous except those noted as planted and/or non-native.

Anacardiaceae

*Anacardium occidentale* (*Mkorosho*), t, non-native, planted. Food: fleshy fruits and seeds are edible; fuel: potential for firewood but its fire is not strong (m, j); others provides good shade when planted around homes and farms.

*Anonucea alata* (*Mngariso*), sh or t. Food/fodder: fruits are edible (m), leaves are eaten by livestock, especially goats (m); construction: poles, but they rot fast (m); technology: hoe handles (m).

*Anonucea rivae* (*Mkorobo*), sh or t. Food: small tubers (*korobo*) are like sweet potatoes (j); technology: bark used as a dye for woven bags (*viondo*), fiber for baskets and tying, hoe handles (m); fuel: potential use as firewood, but fire is not strong (j); other: shade around homes (j).

*Anonucea schweinfurthii* (*Mshigha*), t. Food/fodder: fruits for people and livestock (j); technology: brown dye from bark decorates woven bags (*viondo*) (m, j), large trunks are used to make pounding pots (m, j), soft materials (*sufi*) from roots used as pillows (j); remedy: liquid from bark cures coughs (m); fuel: firewood (j).

*Rhus natalensis* (*Kitarika*), sh or t. Food: edible fruits (m); remedy: liquid from boiled roots can cure bilharzia (m); fuel: firewood (m).

*Sclerocarya birrea* (*Mnyeshavua*), t. Food/fodder: fruits and leaves for goats (m, j), after seeds are eaten by goats and passed out, they are cracked and eaten by children (j), ripe fruits can be squeezed to produce juice (j); technology: brown dye from boiled bark decorates woven bags (*viondo*) (j), large trunks are used to make pounding basins (m, j); remedy: liquid from boiled roots relieves toothaches (m); fuel: firewood but wood is poor (j); other: nectar from flowers (j), flowering shows rainy season is near (j); kills crops growing under it (m, j).

Annonaceae

*Uvaria acuminata* (*Mganganyi*), wv. Food: fruits are edible (m, j); remedy: boiled roots cure spleen and stomach upsets (m); other: burnt twigs ferment and improve milk flavor (m, j), vapor from boiling leaves is believed to chase away evil spirits that manifest themselves through stomach upsets (m).

*Uvaria scheffleri* (*Mumerumeru, Merumeru*), wv. Food: edible fruits (m, j).
Apocynaceae

Thevetia peruviana (Msoda, tree that provides soda, also called Muua [m]), t, non-native, planted. Food: popular among children who drink sweet ‘water’ from the flowers (m, j); construction: strong hard poles (j); technology: hoe handles (m), sap from fruits can be used as glue (m); fuel: potential as firewood (m); other: flowers add beauty to homesteads (m, j). Planted in homes.

Asclepiadaceae

Sacleuxia newii (Ingole), sh. Technology: provides strong flexible sticks for arrows (j).

Balanitaceae

Balanites aegyptica (Mwaghani), t. Food/fodder: fruits for people, leaves for goats (m, j); construction: very durable poles (m); technology: makes “the best pounding sticks” (m, j); remedy: foam from boiled roots cures skin irritations (j); fuel: used for firewood (j).

Bombacaceae

Adansonia digitata (Mlamba), t. Food/fodder: fruits (vilamba) edible and used as a flavoring in porridge, leaves for goats (m, j); remedy: leaves believed to cure epilepsy (kugwa nyonyi) (m), liquid from boiled bark cures body swellings (j); other: symbolizes peace near the home (j), attracts rain (m), leaves used as manure in farms (m), giant diameter allows animal skins to be pegged on it for drying (j), use tree base as one wall in small enclosures for baths (j).

Boraginaceae

Bourreria teitensis (Mkitawa), sh or t. Fodder: leaves are eaten by goats (m); construction: poles for building (j); remedy: inner bark speeds up blood clotting (m); fuel: firewood but has a lot of ash (m, j).

Burseraceae

Boswellia neglecta (Mkitungu), t. Food: fruits chewed as gum (j); construction: poles for cattle enclosures (m); remedy: cures several ailments (m); other: burnt twigs give fragrance in houses (m).

Commiphora africana (Kisundi, Kisundi cha chokwa, slash with white), t. Technology: rounded boles are used to make tires for wheelbarrows and toys (m, j), bark provides a brown dye for woven bags (viondo) (m); other: roots alleviate thirst (m), planted as a live fence (j).

Commiphora baluesnsis (Muaghare), t. Construction: poles and cut boards for building (m, j); technology: large dead trunks for beehives (m, j); remedy: roots boiled with those of lemon to cure body swellings (j); planted as a live fence (m).

Commiphora campestris (Mbambara, turns yellow), t. Construction: cattle sheds from its mostly crooked stems (m); technology: bark is boiled to produce a dye for woven bags (viondo) (m), household furniture, wheelbarrow frames (j), big dead trunks are hollowed out to make beehives (j), sticky sap is used as an adhesive (m); other: burn for a sweet aroma in homes (j), smoke believed to ‘chase away’ spirits in the homes (j).
Commiphora edulis ssp. boiviniana (Mtandara), t. Fodder: leaves are eaten by goats (m); construction: poles for building (m); technology: cooking sticks that are light but strong (m); remedy: chewed leaves cure sore throats (m); other: planted as a live fence (m).

Caesalpiniaceae

Bauhinia sp. (Iti ya Kizungu), t, non-native, planted. Food/fodder: fruits edible, leaves are eaten by goats and cattle (j); construction: poles for fencing (j). Planted in homes.

Cassia abbreviata (Mkigondo; also called Msoko in Makwasinyi), t. Technology: excellent pounding sticks (m, j); remedy: boiled liquid from roots (with Acacia etbaica) cures chest pain, muscular pain, and fever (m), mixed with other plants to relieve ulcers (j); fuel: potential for charcoal (m); other: flowering indicates onset of rainy season (m).

Delonix regia (Mkrismas), t., non-native, planted other: provides shade around homes (j); flowers add beauty to homestead (m, j), fruits when dry produce a rattle that can be used to soothe children (j). Planted in the homes.

Senna siamea (Msaji), t, non-native, planted. Construction: posts for fences (m, j) and building (j); remedy: roots are put in cold water and the water is drank to relieve chest pains (j), helps in blood clotting (m, j); fuel: potential for firewood but cannot keep fire and has a bad smell (m); other: beautifies home (m, j), shade (j), planted as a live fence (m, j). Planted in the homes.

Tamarindus indica (Mkwachu), t, non-native, planted. Food/fodder: edible fruits (m, j), fruit aril used to flavor porridge (j); leaves are eaten by goats (m); technology: yokes for oxen, beds (m), hoe handles (j), walking sticks (j); remedy: chewed leaves cure fever and malaria by inducing vomiting (kichefuchefu) and preventing the possibility of vomiting again (m, j); other: provides shade around homes and farms (j). Planted in the homes.

Capparaceae

Boscia coriacea (Kikorio), t. Fodder: leaves are eaten by goats (m); construction: poles for building (m, j); remedy: leaves are crushed and boiled and liquid given to cattle or goats to cure internal worms (m); fuel: sometimes as firewood (j); other: closely packed leaves provide very good shade in farms (m) that provide a temporary cooking and storage place (j), burned twigs ferment and flavor milk (m, j).

Cadaba farinosa (Kisimakwari mtini, always green with small leaves), sh (scandent). Technology: traditional stools because it can easily bend (m); remedy: roots are burned and the powder neutralizes venom from snakebites (j); other: beautifies home, planted as a live fence (m); its bushy nature protects chicken, especially chicks, from predators and also shields them from excessive sun (m).

Maerua angolensis (Kirughana), t. Fuel: firewood (m, j).

Maerua decumbens (Mkangazighe [m], Igandiki [j]), sh (scandent). Food/fodder: edible fruits (m), roots carefully prepared as porridge during times of food scarcity (j), leaves are fodder for goats (m); other: roots precipitate solid particles in water (m).
**Maerua triphylla (Mtunguru)**, t. Food: roots are carefully prepared as porridge during times of food scarcity (m, j), fruits are edible (m); fuel: potential for firewood but it does not have a strong fire (m); other: observed to increase soil fertility in farms (m).

**Combretaceae**

*Combretum aculeatum* (Msonga), sh. Food: edible fruits (j).

*Combretum exalatum* (*Ndashi Mtini/Ndashi ya Mburi, small and weak*), sh or t. Construction: stems are used as small poles (*fito*) in buildings and fences (m, j); technology: three-pronged stirrers (*piricho*) for cooking porridge (m); fuel: good firewood (m, j).

*Combretum hereroense* (*Ndashi Mbaa/Ndashi ya Ng’ombe, large and strong*), sh or t. Food/fodder: leaves are eaten by goats and even cattle (m, j); construction: strong, slender poles are heavily used as cross poles (*fito*) and rafters on houses and other structures such as granaries and chicken pens (m, j); technology: arrows, three-pronged stirrers (*piricho*) for cooking (m), temporary beds for herdsmen in the bushland (j); remedy: liquid from boiled roots and leaves relieves stomach pains (m); fuel: good firewood (m, j); other: leaves can be collected and used as manure in farms (m).

*Terminalia brownii* (*Mkungo*), t. Construction: large stems are split and used for building (m, j); technology: large dead trunks are hollowed out to make beehives and pounding basins (m), boiled leaves and bark give a yellow-brown dye for decorating woven bags (*viondo*) (m, j); remedy: liquid from boiled bark cures eye problems (j); fuel: firewood and charcoal (m).

*Terminalia prunioides* (*Mshoghoreka*), t. Fodder: leaves and twigs are eaten by goats (j); construction: single stems or large stems are split to provide poles (m, j); technology: hoe handles (m), yokes for oxen, and carts (j); fuel: excellent firewood and charcoal (m, j); other: shade (j).

*Terminalia spinosa* (*Muango* [m], *Msaghano* [j]), t. Fodder: leaves are eaten by goats (j); construction: straight, durable poles and fence posts (j); technology: yokes and pounding sticks (j); fuel: firewood (j); other: flowers provide nectar for bees, shade close to farms or homes (j).

**Compositae**

*Aspilia mossambicensis* (*Msisina*), sh. Technology: flowers produce a yellow dye for decorating woven bags (*viondo*) and baskets (j).

*Blepharisposmem zanguebaricum* (*Mbulutu*), sh (scandent). Technology: good arrows that do not easily break (m).

*Brachylaena huillensis* (*Iribongo, one; Maribongo, many*), t. Construction: poles for buildings and fencing (m, j); technology: has potential for making sculptures and carved products (m); fuel: potential for firewood and charcoal (m, j).
**Ebenaceae**

*Diospyros consolatae* (Mzuzi), t. Food: fruits (zuzi) are edible (m, j); construction: strong and durable posts (m, j); technology: pounding sticks, tool handles (j); fuel: excellent firewood and charcoal (m, j).

*Diospyros mespiliformis* (Mkulu), t. Food: fruits (zuzi) are eaten by goats (j); construction: strong and durable posts (j); technology: door frames (j); fuel: firewood and charcoal (j); other: decayed leaves can be collected and used as manure for crops (j).

*Euclia racemosa* (Mlalaku), t. Food: edible fruits (j); construction: small poles (fito) for building (j); technology: roots can be used as a toothbrush and a red lipstick (j); fuel: hard firewood (m, j); other: flowers provide good nectar for honey (j).

**Euphorbiaceae**

*Acalypha fruticosa* (Jija), sh. Food: leaves are heavily eaten by goats (m); technology: twigs are tied together to make household brooms (m); remedy: water bath with crushed leaves relieves fever in children (m); leaves and those of mrumbawasi (*Ocimum suave*) plus fermented milk relieves intestinal problems locally called mzalo (j), boiled roots are believed to cure cerebral malaria (j), water with crushed leaves washed over the head alleviates headaches (j); fuel: firewood for light meals like tea and porridge (m, j); other: straight twigs help teach basic math to children (m).

*Bridelia micrantha* (Munyamanyama) t. Food: edible fruits (m, j); technology: leaves produce a blue/black dye for decorating woven bags (viondo) (m), straight tender twigs are used as tooth brushes (m); fuel: firewood but cannot keep fire (m, j).

*Croton pseudopulchellus* (Ngombiyani), sh. Remedy: boiled roots relieve muscle spasms; fuel: firewood (m).

*Euphorbia candelabrum* (Izori), t. Construction: rot-resistant poles for building (m); technology: the sap, though very poisonous, is put on arrows to support feathers that help in maintaining the trajectory (m).

*Euphorbia tirucalli* (Mpuse), t. Technology: whitish sticky sap is used as a light glue (m, j); sap; remedy: the sap helps to relieve pain and prevent further infection when applied to sores (m, j), the sap prevents excessive bleeding (m); fuel: lights very fast (m).

*Jatropha curcas* (Mbonikoma), t, non-native, planted. Food: fruits are sweet but make one feel “drunk” (j); remedy: the sap is dangerous to the eyes, but dried leaves are crushed and applied to bodily sores on cattle to prevent flies and further infections (m, j), the sap helps in blood clotting (m); other: planted around homes for shade and decoration (m, j).

*Manihot glaziovii* (Manga, resembles cassava), t, planted. Food: leaves and roots are edible (m).

*Spirostachys africana* (Msaraka), t. Construction: provides poles for building (m); fuel: charcoal (m), sticky sap produces a strong smell so not used for firewood (m).
*Synadenium compactum* (Munyimanyi), t. Remedy: can warm leaves and put on a muscle pull; other: stems prevent termites when planted together with any other useful plant or included as rafters in a grass-thatched house (m).

**Flacourtiaceae**

*Rauwsonia lucida* (*Mngima ghu tinikie, red monkey*?), t. Construction: potential for building poles because of its hardness and durability (m); fuel: potential firewood (m).

**Hamamelidaceae**

*Tricodulas ellipticas* (Mazido), t. Construction: strong hard poles for building (m, j); technology: potential for carvings (j); fuel: potential firewood (m, j).

**Labiateae**

*Hoslundia opposita* (Mvono), sh. Food: yellow fruits are edible (m, j).

**Loganiaceae**

*Strychnos henningii* (Bachia), t. Remedy: stems with bark are crushed and soaked and the resultant liquid drank for chest pains, fever, ulcers, malaria, headache, and general muscular pains (j, m); mixed with a plant called Mghunga (*Acacia robusta ssp. usambarensis*) to relieve stomach pains (m); roots, lemon fruit, roots of paw paw, and soot from saucepans are boiled with water and the liquid is sprayed on a muscle (where a small incision has been made) to cure swollen muscles (j).

**Malvaceae**

*Hibiscus calyphyllus* (Mnyeche), sh. Food: sour leaves are chewed as an appetizer (m); remedy: leaves are chewed to control vomiting (m); roots are boiled with Mshoshote (*Grewia villosa*) to cure vomiting.

**Meliaceae**

*Azadirachta indica* (Mkilifi), t, non-native, planted. Fodder: tender leaves and twigs are eaten by goats (j); construction: good poles for building (m); technology: mixed with calcium carbonate or sodium carbonate and coconut oil to make bar soap for washing clothes (m, j), small stems for toothbrushes; remedy: roots and leaves cure malaria (m, j), hypertension, running nose, stomach upsets and skin irritations (j), powder from crushed leaves prevents weevils from damaging grains in granaries (j); fuel: firewood (j); other: good shade around homes and shambas (m, j).

*Melia volkensii* (Mkurumbutu), t. Fodder: leaves and fruits are heavily eaten by goats (m, j); construction: straight poles for building (m, j), supportive structure (*cheda*) for firewood stacks (j); technology: timber for making household doors and window frames, cupboards, etc. (m, j), large dead trunks can be made into beehives or pounding pots (m), cooking sticks (m, j) and local instruments like guitar (j), relatively small branches that have four or more branches starting near the same point can be cut and used to perch household utensils (j), has potential for carving (j), sticky sap can be used as a glue (j).

*Trichilia emetica* (Mkalamanja), t. Construction: posts for building (j); technology: cooking sticks, hollowed logs for beehives (j); other: provides very good shade around homes (j).
Mimosaceae

*Acacia ancistroclada* (*Kidenya*), t. Fodder: leaves are eaten by goats (j); construction: good poles for building (j); technology: inner bark is peeled to provide rope for tying things (j), sticky sap can be used as glue (j); fuel: firewood or charcoal (j).

*Acacia brevispica* (*Taghasina*), t. Fodder: leaves are eaten by goats (j); construction: small poles (fito) for building (j); remedy: roots and those of sisal (*Agave sisalina*) boiled together and drank is believed to cure men with swollen reproductive organs (j); fuel: firewood (j).

*Acacia bussei* (*Mngololi*), t. Construction: good poles for building (m, j); technology: pounding sticks, hoe handles (j); fuel: firewood and charcoal (m, j).

*Acacia etbaica* (*Shighire*), t. Fodder: leaves are eaten by goats (m, j); construction: straight poles for building (m, j); technology: inner bark is stripped for tying (j); fuel: charcoal and firewood (m, j); other: flowers provide nectar for bees (j).

*Acacia nilotica* (*Mchemeri*), t. Fodder: leaves are eaten by goats (m, j); technology: sticky sap from fruits acts as glue (j); remedy: its roots and those of Mshaughi (*Pittosporum viridiflorum* ssp. *viridiflorum*) and Ndashi ya Ng’ombe (*Combretum hereoense*) are boiled and the liquid taken to cure stomach upsets and problems related with the spleen (m), chewing the leaves alleviates coughing (m), chewing the inner bark helps to alleviate chest pains (m); liquid from its bark and that of Mporozi (*Albizia anthelmintica*) kill internal worms (*vunyu*) in cattle (j), seeds boiled with tea help alleviate stomach ulcers (m); fuel: good firewood and charcoal (m, j); other: its bark can be boiled in water in place of tea leaves (m, j), its spines can be used to remove splinters and other foreign objects (m), flowers provide nectar for bees (j).

*Acacia senegal* (*Iti ya Wasi*), t. Fodder: leaves are eaten by goats (m, j); construction: straight poles are used for building (m, j); technology: bark is boiled to produce a yellow dye for decorating woven bags (viondo) (j); remedy: leaves are chewed to help cure sore throats (m); fuel: excellent firewood and charcoal (m, j); other: flowers provide nectar for bees (m, j), some insects make an edible honey-like substance on or inside the tree (*kimanga cha mbuche*) (j).

*Acacia robusta* ssp *usambarensis* (*Mghunga*), t. Fodder: goats eat the leaves (m, j); construction: poles for building, but it is soft and rots fast (m, j); technology: sticky sap is used as glue (j); remedy: inner bark can be crushed in water or chewed to alleviate coughing, malaria, and common colds (m, j); fuel: potential firewood or charcoal (m, j); other: flowering symbolizes that it is about to rain (m), tree symbolized as a 'rain tree'; flowers provide nectar for bees (m, j).

*Acacia senegal* (*Iti ya Wasi*), t. Fodder: leaves are eaten by goats (m, j); construction: poles for building and fencing but it is susceptible to pests (m, j); fuel: firewood (m, j); other: flowers provide nectar for bees (j).

*Acacia tortilis* (*Mwaghuba*), t. Fodder: fruits and leaves are eaten by goats (m, j); technology: large dead trunks are hollowed out to make beehives (m, j); remedy: inner bark is chewed to alleviate coughing (m); fuel: firewood and charcoal (m, j); other: provides shade around...
homes or in farms, the shade also protects local hives from direct sunlight (m), root parasite (*Hydnora abyssinica*) that grows in association with the tree produces an edible tuber (j).

*Albizia anthelmintica* (**Mporozi**), t. Fodder: leaves are fed to animals, especially goats (m, j); construction: strong straight poles for building (m, j) and fencing (j); technology: hoe handles (m, j), sticky sap is used as glue (j); remedy: when leaves are crushed and the resultant fragrance inhaled/sniffed, it helps to cure a runny nose and general coughs (m), bark is boiled and a teaspoonful of liquid taken to cure stomach upsets (m, j), the same also cures worm problems in dogs and improves their appetite (m, j), boiled roots and bark deworm cattle and goats (j).

*Dichrostachys cinerea* (**Mungiligili**), t. Construction: poles for building (j); fuel: firewood (j).

*Newtonia hildebrandtii* (**Mkame**), t. Construction: building especially when young (mature trees are too hard for local tools) (j); technology: pounding sticks (j); fuel: firewood and charcoal; other: some insects make an edible honey-like substance inside the tree (*kimanga cha mbuche*) (m), planted for shade; used to hang beehives in woodland (j).

**Moraceae**

*Ficus ingens* (**Mgandi** [m]/**Kishoe** [j]), t. Food/fodder: fruits are eaten by people and goats (m); technology: roots provide fiber for making local woven baskets (*viondo*) (m, j); fuel: good charcoal (j).

*Ficus thonningii* (**Mvumo**), t. Food: fruits, though mostly eaten by birds, can also be eaten by people (j); technology: fibers from roots are chewed into a soft substance called *murunguwa* (j) and used for woven bags (*viondo*) (m, j); remedy: chewing the leaves relieves stomach pains and diarrhea (j); other: believed to bring peace and help in reconciliation (m), believed to attract rain (m, j), planted for good shade around the homes (j).

*Ficus sp.* (**Mkuyu, F. sur, F. sycomorus, or F. vallis-choudae**), t. Food/fodder: fruits are eaten by people and goats (j); remedy: sap relieves toothaches (j); technology: sticky sap is used as a glue (j).

**Ochnaceae**

*Ochna ovata* (**Ngidi**), t. Construction: provides small poles (*fito*) for building (m); fuel: used for firewood (m, j).

**Olacaceae**

*Ximenia americana* (**Mdundukua**), t. Food: fruits are edible (m); remedy: leaves or roots are boiled and the liquid gurgled and then spat to relieve toothache (m).

**Oleaceae**

*Olea europea* (**Mwamira**), t. Construction: poles for building (m); fuel: firewood (m).
**Papilioniaceae**

*Abrus precatorius* (Mwangaluche), wv. Technology: beautiful black and white seeds are used to make local percussion instruments such as *kayamba* for Church, wedding ceremonies, etc. and for making children’s toys (m, j); remedy: boiled liquid from its roots and those of male paw paw paw cure sexually transmitted diseases like gonorrhea (m), liquid from boiled roots reduces asthma (m), leaves are crushed, mixed with water, and administered by herbalists to ‘cure’ epilepsy (m), one herbalist speculated that a concoction from it may be concocted to reduce the sufferings associated with AIDS (m).

*Dalbergia melanoxylon* (Mwingo), t. Construction: poles for building (m, j); technology: local combs, knife and machete handles (m), gives a black dye for decorating woven bags (*viondo*) (j), potential for carving (m, j, [choice wood for carvings by the Kamba people]); fuel: firewood (j)

*Dalbergia vacciniifolia* (Mseneka), t. Construction: straight hard poles for building (m, j); technology: strong and durable pounding sticks (m), straight poles are used as handles for long chisels (m); fuel: firewood (m, j), stacks of this wood thought appealing around homes (m); others: used for hanging beehives because of its strength (m).

*Platyclephium voense* (Mkalamu), t. Technology: bark is boiled to produce a pink dye for decorating woven bags (*viondo*), cooking sticks and combs, has potential for carvings; fuel: good firewood, with a resin that ignites quickly; other- when burned it produces a smell believed to chase away snakes, thus providing safety (j).

**Pittosporaceae**

*Pittosporum viridiflorum* ssp. *viridiflorum* (Mshaughi), t. Food/fodder: small yellow and sugary fruits are edible (m, j), leaves are eaten by goats (j); construction: strong straight poles for building, large stems are split for building (m, j); technology: straight stems make excellent and durable pounding sticks (m, j); remedy: eating raw fruits is believed to reduce diarrhea (m); roots are boiled and the liquid taken to relieve ulcers and stomach upsets (m), burnt ash helps to cure foot and mouth disease in cattle (j); other: flowers provide nectar for bees (j).

**Rhamnaceae**

*Berchemia discolor* (Msona), t. Food/fodder: edible fruits (m), leaves are eaten by goats (j); construction: straight poles for building (m, j); technology: sticky sap is used as glue (j); fuel: charcoal (m) and firewood (j).

*Ziziphus mucronata* ssp. *mucronata* (Mwalakule), t. Food/fodder: edible fruits very useful during famine (m), branches and leaves are cut for goats (m, j); construction: straight poles for building (m); fuel: firewood (m).

**Rubiacceae**

*Hymenodictyon parvifolium* ssp. *parvifolium* (Mlundi), wv. Technology: used for making fire (m); remedy: leaves are crushed, mixed with water, and the liquid put in ears to cure and clean sores (m), the liquid also soothes red eyes (m), roots are boiled and the liquid taken to relieve pains associated with ulcers (m), the liquid was also said to aid conception in women (j).
Meyna tetraphylla (*Mnyangandende*), t. Food: brown fruits are edible (m); construction: building, mainly rafters (m); fuel: firewood (m).

_Pydrax schimperiana* (*Mzereghembe*), t. Construction: straight poles for building (m); fuel: firewood (m).

_Tennantia sennii* (*Mumbasa*), t. Food: fruits are edible (m); construction: poles for building (m); fuel: firewood and charcoal (m).

**Rutaceae**

_Teclea simplicifolia* (*Mwambololi*), t. Construction: poles (m, j). Fodder: leaves eaten by goats (m); remedy: roots mixed with those of Genjeka (*Zanthoxylum chalybeum* var *chalybeum*), Mnao (*Manilkara mochisia*) and Mkigondo (*Cassia abbreviata*) to relieve malaria and coughing (m); fuel: firewood (m, j); other: nectar from flowers (j).

_Vespris glomerata* (*Kikondekonde*), sh. Construction: provides poles for building (m).

*Zanthoxylum chalybeum* var. *chalybeum* (*Genjeka*), t. Food/fodder: edible fruits (*zaule*), leaves are eaten by goats (j); construction: straight poles for building (j); technology: three-pronged stirrers (*piricho*) for porridge (j), inner bark provides ropes for tying (j); remedy: roots are boiled and liquid taken to relieve body pains, boils, and malaria (m, j), fruits are directly chewed and the liquid swallowed to cure malaria (m), roots and leaves are boiled and the liquid taken to cure and prevent sore throats (m), its roots and those of Mkigondo (*Cassia abbreviata*) plus lemon juice, leaves of Mndomoko (*Grewia bicolor*) and Shambalaka (*Cissus rotundfolia*) are boiled with water and the mixture (*cheruka*) sprinkled on a patient by a herbalist to alleviate pains from ulcers (j), leaves and flowers flavor tea (m, j), and when the tea is taken, it cures muscular pains (m), inner bark is chewed to alleviate diarrhea (j); fuel: firewood, but it produces a lot of smoke and flying fireballs (*sisia*) that are dangerous (m, j). Kills crops in farms (m).

**Salvadoraceae**

_Salvadora persica* (*Mswaki*), t. Construction: poles for building (j); technology: twigs chewed as a toothbrush (m, j); remedy: roots and bark are boiled and drank to help cure chest pains (m), its bark and that of Mnao (*Manilkara mochisia*) are boiled with the roots of Genjeka (*Zanthoxylum chalybeum*) and Mkigondo (*Cassia abbreviata*) and the liquid (*cheruka*) is sprayed (using Lonyi, *Ocimum kenyense*) by an herbalist on people with ulcers, malaria, fever, and general coughing to aid in their cure (m, j), its roots and those of Muododo (*Grewia similis*) are boiled with sisal bulbs (*Agave sisalana*) and the liquid drank by men to increase their reproductive vitality (j); other: flowers are frequented by bees for nectar (j).

_Dohera glabra* (*Muivu*), t. Food/fodder: edible fruits for people and goats (j); technology: pounding sticks and basins (*vidu*, j), small branches for toothbrushes (j); remedy: boiled liquid from roots is believed to add blood to the body (anti-anemic) (j); fuel: sometimes used as firewood (j).

**Sapindaceae**

_Deinbolla kilmandsharica* (*Msawau*), t. Remedy- leaves are crushed and used as medicine for wounds.
**Sapotaceae**

*Manilkara mochisia (Mnao)*, t. Food/fodder: have very sweet, edible fruits while leaves are eaten by goats (m, j); construction: straight poles are used for building (m, j); technology: pounding sticks and hollowed trunks for beehives (j); remedy: roots are boiled and the liquid drank to cure fever (m); fuel: firewood and charcoal but produces fireballs (m, j); other: planted as a live fence, provide shade in the farms (m), flowers give nectar (j).

**Solanaceae**

*Solanum incanum (Mndongu)*, sh. Remedy: fruits and roots cure stomach upsets (m), liquid from chewed roots cures swollen breasts in women (m), liquid from fruits helps to cure boils (m, j); other: fruits are used by children for playing (m).

**Sterculiaceae**

*Dombeya kirkii (Waru)*, t. Construction: sometimes provides strong poles (nguzo) or cross poles (fito) for building (m, j); technology: preferred for bows because of its durability and flexibility (m, j); fuel: sometimes provides firewood (m, j).

*Sterculia africana (Mweja)*, t. Technology: inner bark is heavily used as fiber for tying (m, j), dry sticks can be rubbed against each other to spark a fire where there is no match stick (m, j), children make toy tires from its rounded trunk for playing (j); remedy: leaves are crushed, boiled and the liquid taken to help cure stomach upsets and diarrhea (m, j); other: dry, burst fruits are burnt and ground into flour to make a substance called ugoro, which adds flavor to food (j).

**Thymelaceae**

*Gnidia latifolia (Njambiriri)*, sh. Technology: provides strong bark for tying (j); remedy: used in the past to cure diarrhea (j); other: burned as a pesticide (j), toxic to cows.

**Tiliaceae**

*Grewia bicolor (Mdomoko Mtini/Mdomoko ya Mburi)*, t. Food: fruits edible, leaves are eaten by goats (m, j); construction: provides small poles (fito) for building (m, j); Technology: flattened as a planting stick (m), can bend easily for furniture (m); remedy: roots are chewed to cure stomach upsets and reduce diarrhea (j), inner bark is tied on a wound to stop bleeding (j); fuel: firewood (m, j); other: flowers provide nectar for bees (j).

*Grewia mollis (Mdomoko Mbaa/Mdomoko ya Ng’ombe)*, t. Food/fodder: fruits edible (m, j), leaves are eaten by goats (j); construction: straight small stems are used in building especially as cross poles (fito) because they are flexible (m, j); technology: small slender stems are used for making piricho (m), hoe handles (j), when squeezed, leaves give out foam that is used for washing utensils where there is no soap (j), small stems are chewed as a toothbrush (j), walking sticks (m, j); remedy: inner bark can be tied to a fresh cut to aid in blood clotting (m), bark is soaked in water and the liquid taken to cure diarrhea (m), liquid from boiled roots is drank by girls/women to reduce excess bleeding during menses (j), leaves were said to prevent paralysis (m); fuel: firewood (m, j); other: leaves were said to be used in traditional ceremonies (m), flowers attract bees for nectar (j).

*Grewia similis (Muododo)*, t. Food/fodder: fruits edible (m, j), leaves eaten by goats (m, j); construction: poles (nguzo) and cross poles (fito) for building (m); technology: three-pronged
stirrers (*piricho*) (m, j), walking sticks (j), twigs can be chewed as a toothbrush (j), leaves and bark produce color for decorating woven bags (*viondo*) (m); fuel: firewood (m, j).

_Grewia villosa_ (*Mshoshoti*), t. Food: edible fruits (*shoshoti*) (m, j); construction: small poles for building (m); technology: slender straight twigs are used for making arrows (j); remedy: liquid from boiled roots cures bodily swellings (j), roots, together with those of mdongu (*Solanum incanum*) and Mweja (*Serculia africana*) are boiled and drank by girls/women to reduce excessive bleeding during menses (j); fuel: firewood and charcoal though its fire is weak, useful in cooking light meals or for starting fires (m, j); other: nectar for bees (m).

**Vitaceae**

*Cissus quadrangularis* (*Mchange*), wv. Remedy: pith is scratched into fine powder and put on wounds to kill pain, speed up the healing process, and offer protection against flies (m).

*Cissus rotundifolia* (*Shambalaka*), wv. Remedy: leaves are chewed to relieve body pains (j), leaves aid in blood clotting when crushed and squeezed against a cut.

*Rhoicissus revoillii* (*Mwamati*), wv. Technology: inner bark provides long and flexible ropes useful for tying (m); remedy: liquid from boiled roots cures malaria (m); other: in dry conditions, the roots can be cut and sucked to alleviate thirst (m), flowers provide nectar for bees (m).

**Zamiaceae**

*Encephalartos kisambo* (*Kisambo*), sh. Technology: leaves are sometimes harvested to make winnowing baskets and mats (j); other: seeds were said to be collected by some people but their use is not known (j).