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Reality and Preferences in Community Mopane (*Colophospermum Mopane*) Woodland Management in Zimbabwe and Namibia

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***Abstract*—**There is increasing pressure on, and decline of mopane woodlands due to increasing use and competition for mopane resources in Zimbabwe in Namibia. Community management strategies, based largely on local knowledge are evidently unable to cope. Research has generated potentially useful information for mopane woodland management, but this information has not been utilized. The work reported in this paper sought to add value to research work conducted on mopane woodlands by developing effective community-based mopane woodland management regimes that were based on both local and scientific knowledge in Zimbabwe and Namibia. The conditions under which research findings were likely to be adopted for mopane woodland management by communities were investigated. The study was conducted at two sites each in Matobo and Omusati Districts in Zimbabwe and Namibia respectively. The mopane woodland resources in the two study areas were assessed using scientific ecological methods. A range of participatory methods was used to collect information on use of mopane woodland resources by communities, institutional arrangements governing access to and use of these resources and to evaluate scientific knowledge for applicability in local management regimes. Coppicing, thinning and pollarding were the research generated management methods evaluated. Realities such as availability of woodland resources and social roles and responsibilities influenced preferences for woodland management interventions

***Keywords*—**Woodland management, community, coppicing, thinning, pollarding

I. Introduction

MOPANE (*Colophospermum mopane*) woodland products are key resources to rural communities across southern Africa. Mopane trees provide varied products and these include construction and fence poles, wood for tools, carvings and utensils, firewood, rope, gum, tannin, medicines and resin, green manure, livestock browse and edible caterpillars (commonly referred to as mopane worms). Mopane is not used just because it is the dominant species, but because for many of the uses it is a highly preferred resource (De Winter *et al*., 1966; Palmer and Pitman, 1972).

Woodlands and other natural resources in the communal areas of southern Africa are largely managed as common pool resources, with traditional institutions being at the core of managing these resources (Bradley and McNamara, 1993; Nemarundwe and Kozanayi, 2003). Although research has been conducted on many different aspects of mopane in Southern Africa (e.g. Tietema et al., 1988; Smit, 1994; Smit and Rethman, 1998; O'Connor, 1999; Smit, 2001; Macgregor and O'Connor, 2002 and many other studies) the management of mopane woodlands by communities has been hardly influenced by research findings. Some of the findings e.g. on tree thinning, coppicing and tree die back (Tietema *et a*l., 1988; Smit, 1994; Smit, 2001) have potential for use by rural communities to manage mopane woodlands. Coppicing studies on mopane showed that mopane coppices readily and pole production from seedlings took twice as long as from coppices and diameter growth (annual increment) of coppice shoots is linear up to seven years (Tietema *et al*., 1988; Tietema *et al*., 1991; Erkkila and Siiskonen, 1992).Thinning was found to have little impact on tree height, but mainly resulted in redistribution of basal area increment among fewer stems. Although reducing total production per hectare, thinning results in achievement of desired pole sizes faster and increases vegetative growth, flowering and seed bearing by the remaining trees (Coe, 1991; Scholes, 1991; Smit and Swart, 1993; Smit and Rethman, 2000). Pollarding, the cutting back of a tree's branches to the trunk encourages the growth of new shoots and increases the leaf and wood production. The judicious blending of research findings and local knowledge and experimentation has the potential to benefit mopane woodland management. Mopane woodlands in Southern Africa are under pressure from increasing human use. There is also lack of systematic research on social and economic factors of mopane usage. We hypothesize that access to scientific research findings on mopane can be used as a basis for improved management of tmopane woodlands by local people when incorporated with their local technical

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knowledge. The broad objective of this study was to add value to research conducted on mopane woodlands by translating research findings into practical mopane woodland management strategies. The question being addressed is what issues influence the perception of and likely adoption of research findings for mopane woodland management by rural communities?

II. Materials and Methods

The study was conducted in Zimbabwe and Namibia during the period September 2004 to September 2006. In Zimbabwe, the study was conducted at two sites Dzembe and Sigangatsha wards in Matobo District in the south west of the country. In Namibia, the study was conducted in Omusati region, northern Namibia. Three study sites were selected: Okalongo Village in Central Omusati, Okamboola Village in Western Omusati and a game park (protected since 1969) in central Omusati. In Zimbabwe there was no protected site within the vicinity of the study area to act as a control.

Woodland Assessments

Tree measurements were made in 20 x 20 square metre plots. The location of each plot was entered onto a GPS. All the woody plants within the 20 x 20m plot with a basal circumference of 16cm or more were regarded as trees. All woody plants were identified to species level and for those that were unknown; samples were taken for later identification. For the trees the basal circumferences were measured using a tape measure and the tree heights were estimated using ranging poles. Stumps were identified to species level and categorized as dead or alive and the circumference was then measured, using a tape measure. The stumps were recorded to give a measure of tree cutting in the study areas. Canopy cover was determined using the line intercept method (Mueller-Dombois & Ellenberg, 1974). In this method, a 50m line transect was laid. All the trees whose canopies intercepted the line were identified to species level and the total intercept length covered by the trees was recorded. A total of 58 plots were assessed in Namibia, while 36 plots were assessed in Zimbabwe.

Data Analyses

One – way ANOVA was used to test for differences in tree densities and canopy cover among the sites. Before ANOVA tests were done, normality tests were performed on the data. To test for differences in the tree size frequency distributions, a chi square test was used.

Socio-Economic Assessment

The data was collected using Participatory Rural Appraisal (PRA) techniques. The methods used were time series analysis, resource mapping, observation and focus group discussions. In group discussions techniques such as problem analysis, objective analysis and strategic planning were employed to assess mopane woodland problems and map out future priorities. To assess social preferences, the study relied on understanding group processes through ranking and scoring exercises. Bi-polar analysis was used to analyze group perceptions of thinning, coppicing and pollarding innovations. Although ranking obviously introduces a subjective element into the analysis, the technique is usually used to explore variations in perceptions (Campbell and Shackleton, 2002). One of the assumptions made with the PRA tools used was that rural households make rational decisions within their given contexts and that they make appropriate choices which are influenced by their surrounding environment.

III. Results

Vegetation Assessments

The mean tree density in Dzembe and Sigangatsha Wards in Zimbabwe was 971 and 746 ha^{-1} respectively, with no significant differences between the sites ($P>0.05$). In Namibia, there were significant differences in tree densities among the three sites ($F=30.843$, $P< 0.001$). Tree densities were 435 for the protected site, 380 for Western Omusati and 100 in Central Omusati. Overall, tree density was higher in Zimbabwe than in Namibia. Canopy cover in Namibia ranged fron 25% in Central Omusati to 62% in Western Omusati. In Zimbabwe, canopy cover was 15% and 31% in Sigangatsha and Dzembe Wards respecticely. In both countries, there were more trees in the smaller size classes (up to 299 cm^2 basal area) than in the larger size classes (Table I).

TABLE I
Density of Trees in Different Basal Area Size Classes at Four Sites in Zimbabwe and Namibia

Basal area (cm^2)	No of trees ha^{-1}			
	Zimbabwe		Namibia	
	Sigangatsha	Dzembe	Central Omusati	Western Omusati
<100	3200	3975	192	13
100- 199	875	725	130	7
200-299	250	275	68	12
300-399	50	75	47	5
400-499	0	175	26	1
500-599	0	100	15	4
600-699	0	75	12	1
700-799	25	125	7	1
800-899	0	125	8	11
900-999	0	50	3	0
>1000	25	875	17	1

Tree cutting, recorded as number of stumps per hectare, in Zimbabwe, was higher in Sigangatsha Ward (150 stumps ha^{-1}) than in Dzembe Ward (125 stumps ha^{-1}) although the differences between the areas were not significant ($P>0.05$) (Fig. 1). In Sigangatsha most of the stumps encountered were alive, indicating recent tree cutting, whereas up to 60% of the stumps encountered in Dzembe were dead. In Namibia, densities of live stumps differed significantly among sites

(F=13.70, P<0.01) with density being significantly higher in Central than in Western Omusati and the game park (Fig. 2)

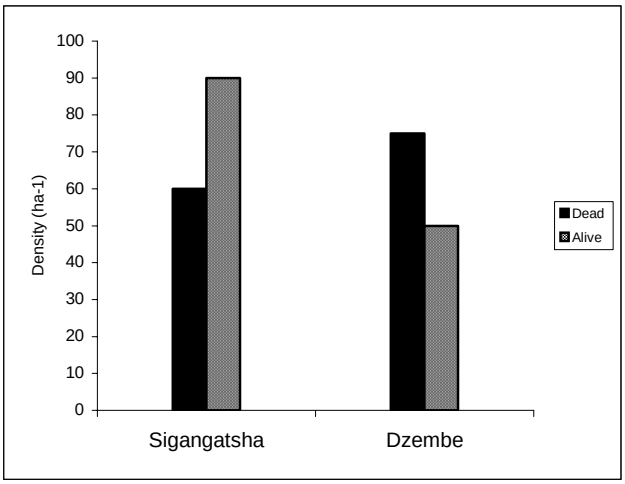

Fig. 1 Densities of dead and live stumps found in mopane woodlands at two sites in Matobo district, Zimbabwe

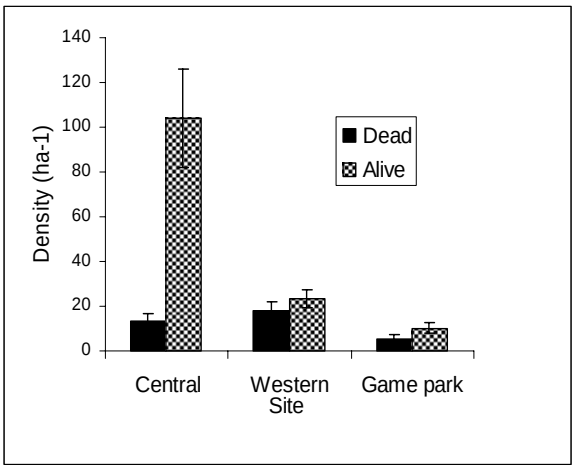

Fig. 2 Differences in the densities of dead and live stumps in mopane woodlands at three sites in Omusati Region, northern Namibia

Socio-Economic Assessment

Mopane woodlands are important to the livelihoods of rural communities in the two countries as extensive use is made of these woodlands.The study communities obtained a variety of products from mopane woodlands (Table II). In addition to saving money through the use of mopane tree products, as most of the products had purchasable substitutes, households also earned money through the sale of products such as mopane worms, firewood, construction poles and tools and implements.

TABLE II
MOPANE TREE USES BY HOUSEHOLDS IN MATOBO AND OMUSATI DISTRICTS IN ZIMBABWE AND NAMIBIA RESPECTIVELY

Household Use	Tree part used	Close purchasable substitutes
Construction poles[1]	Bole and branches	Bricks, concrete
Fence posts	Bole and branches	Metal poles, timber
Carvings	Bole and branches	Commercial items
Furniture[2]	Bole	Commercial items
Tools & implements[3]	Bole and branches	Metal implements
Household utensils[4]	Bole and branches	Metal, plastic & glass
Firewood	Bole and branches	Kerosene, coal
Rope[5]	Bark	Nylon, jute, etc.
Gum	Bark	Commercial medicines
Medicine	Bark	Commercial medicines
	Roots	
	Leaves	
	Leaves	Commercial fertilizer
Leaf litter[6]	Twigs	
Livestock browse	Leaves	
	Leaves	Meat, fish
Edible caterpillars (mopane worms)		

1 House walls, floors and roof beams, granaries, drying racks, livestock coops and pens
2 Tables, chairs, doors, ladders
3 Yokes, hoe and axe handles
4 Pestles, mortars, cooking sticks
5 For tying firewood bundles, thatch on roofs, hut frames, baskets, herding whips
6 For soil amendment home made floor polish

Historical trends analyses showed that communities in both countries observed a decline in mopane woodland densities over the last two decades. The decline was ascribed to demographic, economic, environmental and cultural changes. Human populations in the four study sites have been increasing. In Zimbabwe, for example, the population of the study district increased by 24% between 1992 and 2000 (Matobo Rural District Council, 2001). The economic decline in the country was also sited as one of the main reasons for the increased exploitation of woodlands at the sites in the country.

Men, women and children in the study communities had responsibilities associated with the utilization of mopane woodlands. Women and children were mainly responsible for harvesting mopane worms for family consumption and sale. Women and children also had the task of collecting firewood while men were responsible for construction and marking artifacts and finding the requisite materials from woodlands.

In Namibia, in Central Omusati where tree densities were low, tree cutting high and woodland resources relatively scarce, 40 % of households expressed interest in using thinning and coppicing and pollarding in mopane woodland given the opportunity. These strategies were perceived to be an immediate source of firewood. In Western Omusati on the other hand, only 20% of households preferred thinning and coppicing, with the majority perceiving woodlands as being managed by nature. In Zimbabwe, households in Dzembe

Ward (where tree density was higher and tree cutting lower), attached lower values to the mopane woodland management interventions of thinning, pollarding and coppicing compared to those in Sigangatsha (Table III).

TABLE III
VALUES ATTACHED TO RESEARCH GENERATED MOPANE WOODLAND MANAGEMENT STRATEGIES BY HOUSEHOLD IN MATOBO DISTRICT IN ZIMBABWE

Management intervention	Value Attached										
	0	1	2	3	4	5	6	7	8	9	10
Coppicing						*		▪			
Pollarding							*		▪		
Thinning				*						▪	

* Dzembe Ward ▪ Sigangatsha Ward
Value attached increases from 1 to 10, with 0 denoting not important and 10 denoting very important.

Thinning was valued particularly lowly in Dzembe as the area had experiences of theft of woodland resources by outsiders. The perception was that thinning could be used to disguise theft of trees. Social roles defined along gender lines also influenced the values attached to management interventions. Men ranked thinning higher than women and children, while women and children on the other hand ranked pollarding higher than men. Men, women and children ranked coppicing equally.

IV. DISCUSSION

Mopane woodlands are central to the livelihoods of rural communities in Zimbabwe and Namibia as these woodlands are used to meet a variety of needs. Despite their importance to livelihoods, mopane woodlands in both countries are declining as reported by the communites, the observed intensities of tree cutting and reconstruction of past basal area structures. The mopane woodlands in both countries were dominated by small size trees (<300 cm^2 basal area). This could be an indication that the large trees have been harvested. Stump size distribution, however did not indicate this as most stumps encountered were in the small size category. Different tree densities and levels of cutting were recorded at the different sites and this was affected by population density. Tree cutting as estimated through stump density is, however, likely to be underestimated due to the fact that dead stumps are eventually harvested for firewood. Cunningham (1993) emphasized that patterns of woodland use and depletion vary according to settlement patters, abundance and patchiness of favoured plant species and their sizes. The demand for woodland resources also depends on human population densities and replacement times of construction timber. These issues had a bearing on the vegetation densities observed, but they make it difficult to compare values across the sites in the two countries.

In both Namibia and Zimbabwe, the perceived availability of mopane woodland resources had an influence on whether or not people were interested in actively managing woodlands. Woodland density had an influence on willingness to adopt woodland management interventions. Communities living in well-wooded areas were less interested in managing woodlands than those in areas where woodland resources were less abundant. Preferences for management interventions were also influenced by societal roles. People tended to prefer techniques which were perceived to improve the availailability of products in their direct line of responsibilities. These roles and responsibilities were defined along gender lines.

Men ranked thinning highly as the technique was perceived as having a high likelihood of improving the supply of thick poles. Women and children on the other hand ranked pollarding higher than men as pollarding increases leaf production and this was perceived as potentially leading to increases in the availability of mopane worms (the worms feed on mopane leaves) and livestock browse. Coppicing was ranked equally by all groups as the technique was perceived as potentially increasing the production of wood and leaf, products which all groups were interested in.

V. CONCLUSION

Realities on the ground such as resource abundance, social responsibilites and past experiences influenced preferences for woodland management interventions. To succeed, communal woodland management interventions therefore need to be designed to take into consideration local level issues and concerns.

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