DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

WORKING PAPER

EVALUATION OF MANAGEMENT STRATEGIES FOR FOREST RESERVES IN MALAWI: The Case of Thuma Forest Reserve

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LIST OF ABBREVIATIONS

BO	Baseline option (State Protection with Access to NFPs)
BZ	Buffer Zone
CML	Community-led Management
EP&D	Economic Planning and Development
EU	European Union
FD	Forestry Department
FR(s)	Forest Reserve(s)
FSP	Full State Protection
ICDP(s)	Integrated Conservation Development Project(s)
IIED	International Institute for Environment and Development
MCA	Multi-Criteria Analysis
MG	Malawi Government
NFPs	Non-forest Product(s)
NSO	National Statistical Office
OPC	Office of President and Cabinet
PA(s)	Protected Area(s)
PM	Participatory Management
TFR	Thuma Forest Reserve
VFA	Village Forest Area

Abstract

This paper demonstrates how functions and values of forest reserves can be used to determine appropriate management strategies of forest reserves. The paper also demonstrates how community perceptions and preferences can be incorporated in the decision making process. An investigation is also carried out on the social and economic factors that can determine community self interest and willingness to get involved in forest management activities. A simple framework for analysing forest reserve management strategies has been developed using Multicriteria Analysis.

Results from the analysis suggest that communities surrounding Thuma Forest Reserve (TFR) seem to perceive the benefits from the forest reserve to be less that those from the alternative use of the land (cultivation). It also appears that local leaders are perceived to be weak in enforcing regulations and therefore not to be effective in protecting the forest reserve. The state is perceived to be the best management option for future preservation but not for direct benefits to the community. Participatory management with both the communities and the state involved is, on the other hand, perceived to be the option that can encourage future preservation and increase direct benefits to the neighbouring community. Another finding of the study is that willingness to participate in forest management activities appears to be affected by literacy level, income level and land holding size.

The analysis of the management options has indicated that participatory management can best maintain the water catchment role of TFR, which is very crucial to the residents of Lilongwe City. Further research should consider ways in which those benefiting from it could reward those protecting the catchment in order to ensure continued catchment protection .

1.0 INTRODUCTION

Malawi is one of the most densely populated countries in Africa. This implies that the demand for land and other environmental resources is high. The level of pressure on Malawi's reserves and parks is, therefore, high compared to other countries (MG, 1998). Along with many other countries, Malawi established forest reserves with the theme of shielding forest resources from growing use driven by demographic pressure. In Malawi these forest reserves account for 10% of the land area, which is classified as forested. Mainly, the forest reserves were established for the protection of watersheds and fragile areas. However they also serve as a source of firewood and other forest and non-forest products for the community and Malawi's national as well as regional markets.

1.1. Problem Statement

There are signs that the current centralised sectoral, bureaucratic and regulatory approach to forest conservation is facing serious difficulties. In recent years, reports of illegal activities in forest reserves have been on the increase. These illegal activities have taken the form of game poaching, tree felling, charcoal burning and general removal of forest resources without authority. The forest reserves are under threat of deterioration due to these illegal activities. The Forest Department (FD), with declining resources and increasing pressure, can no longer manage the forest reserves effectively using the old preservationist approach. Having acknowledged these difficulties, the FD has recently revised the Forestry Act. The new Forestry Act of 1997 encourages community involvement in management of forest reserves. Considering this change, the FD is faced with a challenge of devising ways in which the communities can best be involved. Each of the forest reserves in Malawi is unique and the decisions on appropriate management approaches have to be made on a case by case basis. To this end, there is need to develop a system which the forestry department can use in decision making about appropriate management strategies for different forest reserves.

1.2. Study Objectives

The main purpose of this study is to develop a system which could be used by the FD in decision making about appropriate management strategies for forest reserves on case by case basis.

The specific objectives are as follows:

- To demonstrate how functions and values of forest reserves can be used to determine appropriate management strategies for forest reserves.
- To understand the social and economic factors that can determine community self interest and willingness of surrounding communities to get involved in forest management.
- To demonstrate how community perceptions and preferences can be incorporated into the decision making about forest reserve management.

1.3 Forestry Management Alternatives

Several management approaches have been suggested for sustainable management of forests as opposed to the conventional approach where the state plays the role of a forest guard. Michael Wells (1992) termed these approaches Integrated Conservation Development Projects (ICDPs). These are approaches that attempt to ensure the conservation of biological diversity by reconciling the management of protected areas with the social and economic needs of people. The conventional approach is perceived as restricting the ability of the local community to earn a living. Despite this growing interest in ICDPs there has been only limited research in Malawi. Malawi has only a few examples of community based natural resource management in practice. By March 1999, only Chimaliro FR in the central region had been identified as a location for developing co management schemes. On a pilot basis, the government demarcated part of Chimaliro FR with the aim of working in partnership with the communities. This has involved a change in the tasks of foresters,

moving away from their policing role to a more advisory and facilitating role (Mangani, 1999). However, community involvement may not be appropriate in all cases. Where there is a broader stakeholder community, it may be necessary to retain full state control. There is therefore a need to devise a system, which could be used in deciding which management option is appropriate for each forest reserve.

In this study, five management alternatives are considered and described below. The likely access and management arrangement for each option is also described.

1. Full State protection with Access to Non-forest Products

This is the current management regime and it is the baseline option against which all other options will be measured. The government is the main source of support and is responsible for all management and operation activities. The surrounding communities are allowed to freely access non-forest products. Wood products are available to the surrounding communities at a price determined by the Forestry Department.

2. Full State Protection

This option will consider what would happen if management were to revert to very strict control whereby the reserve is a strictly no go area. Even non-forest products would not be extracted from the reserve. In this case, the government would shoulder all management and maintenance responsibilities.

3. Buffer Zone

This option represents a case whereby the reserve is managed in two sections. The buffer zone could be under joint management by the state and the community while the rest of the reserve is still under full state control. The government would remain the main source of support in the core zone which would be a no go area. In the buffer zone, some restricted harvesting by the neighbouring communities would be allowed. The community would be involved in decision making about utilisation and management of the buffer zone.

4. Participatory Management

This is a case whereby the state and the communities manage the whole reserve together. The forest would remain a protected area but it would be managed by the state in conjunction with community institutions. Joint management would entail sharing costs (mostly labour contribution), sharing the benefits and involvement of the communities in decision making about management and utilisation of resources.

5. Community-led management

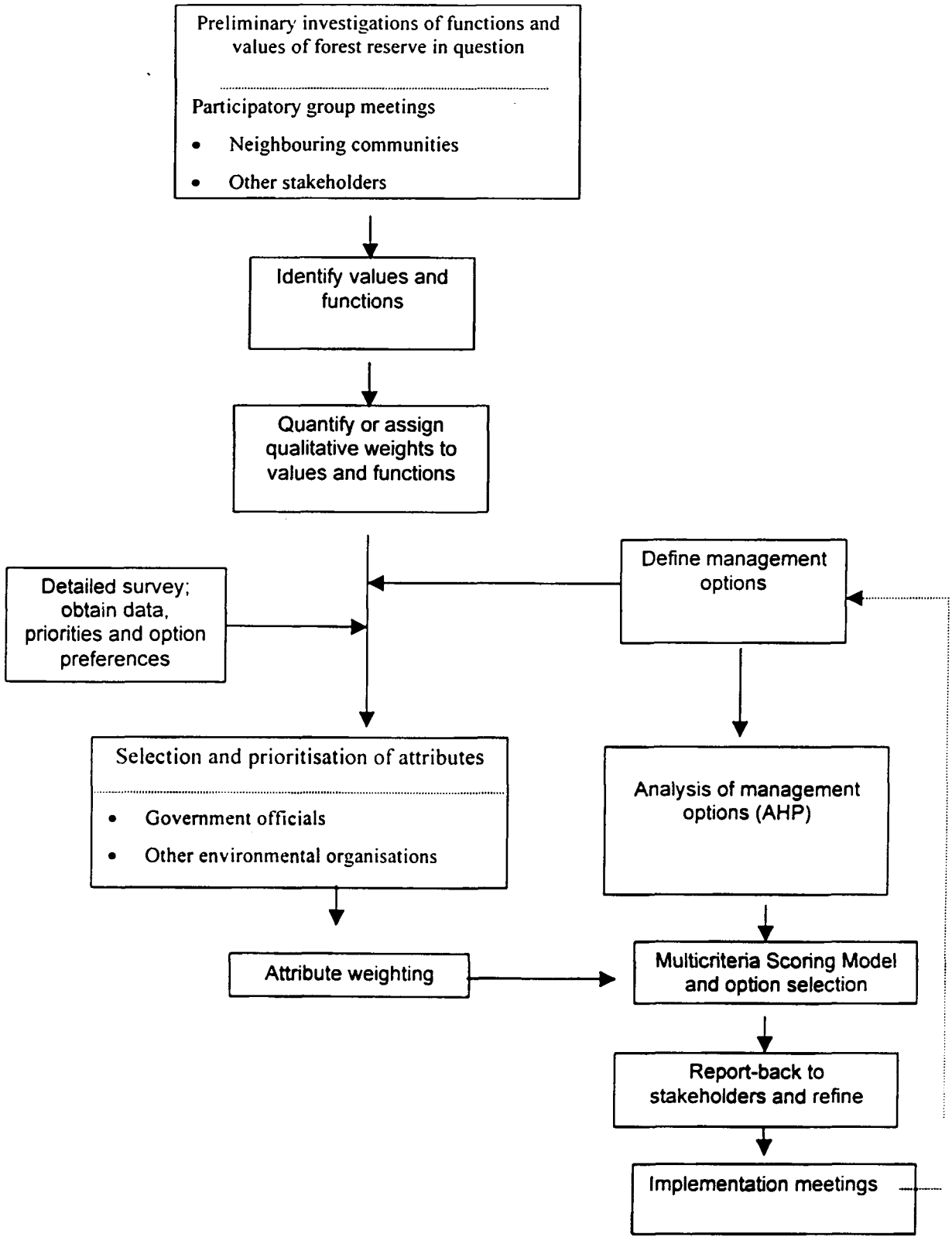
The last option represents a situation whereby the reserve is handed over to the community but is still maintained as a forest reserve. Community organisations will be fully responsible for management and operational activities. The Forestry Department will only provide some technical advice where necessary.

A framework has been developed and a case study has been used to demonstrate how the framework can be used in decision making about which strategy is appropriate for each forest reserve. The framework that has been developed is described below.

1.4 Framework for Forest Reserve Management Strategies

The framework involves identifying and quantifying the costs and benefits of the reserve, identifying and prioritising attributes to be considered and analysing the options based on how each option achieves each particular attribute. Figure 1 below presents a schematic model, which has been developed, for application to any particular forest reserve in Malawi.

Figure 1 Framework for Decision Making for Forest Reserve Management Strategies in Malawi



Ideas and perceptions have to be solicited from neighbouring communities, other affected communities, forestry specialists and other environmental organisations at various stages of the decision making process in order to minimise subjectivity by decision makers and ensure full participation of stakeholders. The following sections present the results of the analysis of perceptions and preferences of communities surrounding TFR and the quantitative estimates of the functions of TFR. Multi-criteria scoring model is then used to compare the alternative management strategies in order to select the best management strategy for TFR.

2.0 SURVEY RESULTS

Thuma, the study site, is one of the few forest reserves, which is currently facing serious problems of illegal practices. The reserve is one of the few that has appreciable large mammal fauna including a resident herd of elephants and buffaloes. The reserve also fulfils a vital catchment role and a natural reserve for a wide range of flora and fauna. Thuma has been historically subjected to levels of illegal activity that could be considered insignificant but in recent years, poaching and illegal cutting of trees have risen to record levels. Bicycle loads of charcoal are also a common sight on the road from Thuma to Lilongwe City. This is posing another threat to the forest reserve and it is important to find ways of controlling the situation. Because of the currently rising rate of illegal activities, this site was found to be suitable for this study which is considering appropriate management strategies for sustainable management of forest reserves.

A survey was conducted in the villages surrounding the forest reserve. Data was also collected on the operating costs incurred by the government in maintaining the reserve as well as the revenue collected. A multi-scoring model was then applied criteria to decide on the appropriate management strategy for Thuma. Participatory rural appraisals and stakeholder meetings could be more useful than a formal survey, which was used in the case study. More comprehensive quantification of the direct and indirect benefits is also a very important component of the framework.

2.1. Analysing the Community Perceptions and Preferences

This section presents the results of the community component of the study. A questionnaire was administered which included questions about which tenure option they preferred and how they perceive the benefits of state management, local leadership and joint management. Frequencies and percentages of the responses on the perception and preference questions were used to analyse the data. In addition, an investigation was made into the factors affecting community's willingness to participate in forest management. Chi-squared tests were used to determine the degree of dependence between willingness to participate and independent variables. The independent variables included literacy level, income level and land holding size.

2.1.1. Characteristics of Communities Surrounding TFR

The study was carried in Traditional Authority Chitekwere, village headman Chinkhowe that is adjacent to TFR. 60 households were interviewed. Data from these households indicates that farming was the main occupation in the area. As shown in Table 2.1 below the majority of the respondents considered farming as their main occupation (94%).

Table 2.1. Main Occupation Of Chinkhowe Village Residents

Occupation	Frequency	Percentage
Farming	94	82
Bamboo Crafts making	8	7
Charcoal/firewood selling	5	4
Non contract labour	4	3
Beer brewing	3	3
Teacher	1	1
Totals	115	100

Other people engaged in bamboo crafts activities, firewood and charcoal selling, non-contract labour and beer brewing. The literacy level of the respondents was very low with only 25% being able to read or write the vernacular language (Table 2.2).

Table 2.2 Literacy Level Of Respondents

	Frequency	Percentage
Can't read/write vernacular language	45	75
Can read/ write vernacular language	15	25

Table 2.3 shows that average land-holding size ranged from 0.5-14 hectares. The average land holding size was 2.35 hectares. All the respondents reported that they allocated part of their land to maize production.

Table2.3. Land use Information

	Responses	Range	Mean	Median
Land holding size	60	0.5 - 14	2.35	2.00
Livestock ownership				
Goats	37 (61)	1 - 17	4.73	4.00
Cattle	3 (5)	2 - 12	7.33	8.00
Chickens	24 (40)	1 - 50	12.71	9.50
Pigs	7 (12)	1 - 6	2.35	2
Crops Grown	Responses	Frequency	%	
Maize	58	58	100	
Groundnuts	58	23	40	
Cassava	58	8	14	
Beans	58	3	5	
Tobacco	58	3	5	
Other	58	11	19	

Note: percentages in parenthesis

Table 2.3 also shows that other crops grown in the area include groundnuts, cassava, beans and tobacco. Some of the farmers kept livestock but it appears that livestock production is a less important activity than farming in the area. Only 5% of the households owned an average of only 7 cattle while 61% and 40 % owned goats and chickens respectively. Income levels were also low among the households. Only about 20% of the households indicated that they earned at least Mk2500 per year. The majority of the households (approximately 65%) indicated that they earned less than MK 1500 per year (Table 2.4).

Table 2.4 Annual Income Per Household

Income Level	Frequency	Valid Percentage	Cummulative Percentage
< 500	9	16.7	16.7
500-900	17	31.5	48.1
1000-1499	9	16.7	64.8
1500-1999	7	13.0	77.8
2000-2499	1	1.9	79.6
≥ 2500	11	20.4	100

One thing that was clear during the survey was that the respondents did not want to be associated with extraction of resources from the reserve. However, some of the respondents revealed that they extracted some resources from the reserve, legally or illegally, for household use or for sale. Table 2.5 presents numbers and percentages of respondents who admitted that they extracted resources from the reserve. All the respondents indicated that they collected firewood from the reserve mostly for household purposes. Other resources extracted include mushrooms, bamboo, wild fruits, poles for construction, caterpillars, honey and thatch grass. Apart from bamboo, which was used for making crafts for selling purposes, the rest of the resources were for household use.

Table 2.5. Resources Extracted from Thuma

Resource	Frequency	Percentage
Firewood	50	50
Mushrooms	24	40
Bamboo	15	25
Wild fruits	15	25
Poles	11	18
Medicine, honey, thatch grass.	11	18

An attempt to get information on how much was extracted but that information was not forth coming from the individuals. Getting such information would require an in depth study involving direct observation of the extraction rates and habits, which was not done in this study. The only resource that could be estimated meaningfully was firewood. Each household collected an average of 91 headloads per year (Table 2.6). It is clear from these results that resource extraction from the forest reserve is one of the sources of livelihood in the study area.

Table 2.6. Forest Resource Use Information

Resource Extracted	Unit	Mean	Median	Range	Average Price Per Unit (If Sold)
Firewood	Head loads	91	78	4 - 312	MK10

2.1.2. Community Perceptions of Benefits from the Reserve

In order to assess how the villagers valued the benefits from the reserve, the respondents were asked a contingent valuation type of question to assess the value, which they attach to the forest reserve as compared to the alternative use (cultivation). The respondents were asked if they would cut forests, if given the chance, in order to increase their cultivated area. It is assumed that willingness to cut forests to increase cultivated area implies that the forest is perceived to provide fewer benefits than the best alternative use (cultivation). As illustrated in table 5.7 below, 92% of the respondents who had plans to increase cultivated area indicated that they would clear the forest if given the chance.

Table 2.7 Perceptions about Benefits from TFR

Would Cut Forests	Respondents	Frequency	Percentage
Yes	50	46	92
No	50	4	8

These sentiments are reinforced by the finding that the majority of the respondents who were willing to participate if forest management were motivated by the anticipation that they would have access to land for cultivation.

As shown in Table 2.8 below, three reasons were given for agreeing to participate in forest management. The main reason given was to have access to land for cultivation. Only 27% would participate in order to help protect the forest. The low percentage in preserving the forest reserve could be an indication that the communities attach low value to the forest reserve and that they perceive the benefits from the forest to be lower than cultivation so they have no incentive to preserve it.

Table 2.8 Reasons for Participating in Management

Reasons For Participating	Respondents	Frequency	Percentage
To have access to more land	37	17	45
To have access to forest products	37	16	43
To help protect the forest	37	10	27

It was also found that illegal practices are highly prevalent at Thuma as was evident from the monthly reports kept by the Lilongwe District Forestry Office. Although actual recorded confiscations were low, there was serious concern about increasing rate of illegal practices, especially charcoal burning, in the reports. Plates 1 and 2 were taken during the survey as part of the evidence of charcoal burning in the reserve. The issue of illegal practices is further discussed in section 6.2.2. The point being made here is that the high rates of illegal practices could be explained by the perception that the forest reserve offers fewer benefits than the alternative use (cultivation).

These results suggest that that the communities surrounding Thuma Forest Reserve perceive the benefits from the reserve to be lower that the best alternative use. Although the respondents

expressed willingness to participate in forest management, their motivation for participating seems not to be for purposes of preserving the forest. If participatory approaches have to be adopted at Thuma, the issue of community benefits has to be looked into lest the reserve will be utilised in a manner contrary to conservation goals.

2.1.3. Perceptions and Preferences of Tenure Options

The respondents were asked questions about their preferences among local leadership, state protection and joint management. The results are itemised in Table 2.9.

Table 2.9. Perceptions And Preferences Of Tenure Options

Perception Statement	Frequency			Percentage
Perception of Local Leadership				
The forest would be better preserved if handed over to the community	17			29
The forest would not be better preserved if handed over to the community	41			71
Totals	58			100
Preference of Management Regimes				
The state is the best manager	19			35
Local leaders are the best managers	14			25
Joint management is the base approach	22			40
Totals	55			100
	High	Moderate	Low	None
The best regime for future Preservation				
State	43 (82)	4 (8)	3 (6)	2 (4)
Local leadership	3 (6)	14 (27)	12 (23)	23 (44)
Joint management	5 (10)	40 (77)	6 (12)	1 (2)
The best regime for indigenous extraction				
State	8 (15)	12 (23)	21 (40)	1 (2)
Local leadership	37 (71)	7 (13)	6 (12)	2 (4)
Indigenous Extraction	12 (23)	31 (60)	8 (15)	1 (2)

Note: Percentages in parenthesis

It is apparent from the results that local leaders are perceived to be unable to protect forests effectively. 71% of the respondents indicated that the reserve would not be preserved if it was handed over to the community and was under local leadership control. The main reason given for the failure of local leaders to effectively protect forests was that local leaders could not effectively enforce the rules and regulations leading to careless utilisation of the forest resources. When asked to indicate their preferences among the three management regimes, most of the respondents were also not in favour of local leadership. Only 25% indicated that local leadership was the best management regime while 40% opted for joint management and 35% opted for state management. The respondents were further asked to compare the management options in terms of future preservation and indigenous extraction. The results (Table 2.9) show that most of the respondents (71%) were aware that under local leadership indigenous extraction would be high. On the other hand, only 6% of the respondents indicated that future preservation would be high under local leadership. This is an indication that the respondents are aware that under local leadership there would be high exploitation but the forest would not be preserved. The state was considered to be the best for future preservation. 82% indicated the state was the best for future

preservation. For both indigenous extraction and future preservation, joint management was rated as moderate by most of the respondents (60% and 77% respectively).

2.1.4. Factors Affecting Willingness to Participate

The degree of dependence between independent variables and willingness to participate was determined using chi squared tests. The results are shown in Table 5.10.

Table 2.10 Factors Affecting Participation

Factor	Participate		χ^2	Df	Assympt. Sig.(2sided)
	Yes	No			
Literacy level					
Cant read/write	25	16			
Can read/write	17	2	5.021	1	0.025
Total	42	18			
Total income					
Less than K1000	14	13			
K1000 – K2500	12	5	5.560	2	0.062
More than 2500	10	1			
Total	36	19			
Land holding size					
Less than 1.5	25	5			
1.5 -2.5	9	10	7.091	2	0.029
More than 2.5	7	4			
Total	41	19			

Among the respondents who could at least read and write the vernacular language, a very high percentage (about 89%) were willing to participate in forest management while only 11% said they could not participate. Willingness to participate is dependent on literacy level (χ^2 = 5.021, df = 1, 2sided sig. = 0.025). Illiteracy is associated with unwillingness to participate, which means that illiteracy is associated with a negative attitude about the reserve and thus the individual may not be able to participate effectively. These results agree with a number of studies on attitudes of protected areas. At Kossi Tappu Wildlife Reserve in Nepal, it was found that respondents with high literacy level had more positive attitudes about the reserve (Fiallo 1995). Fiallo also cites a case of Machalilla National Park in Eucador where similar results were found. Level of literacy is therefore one of the factors that determines participation in forest management.

Another factor that was proved to be one of the determinants of participation is landholding size (χ^2 = 7.091, DF = 2, 2sided sig. 0.029). 61% of the respondents who were willing to participate had less than 1 hectare of land while only 17% were those who had more than 2.5 hectares of land. Willingness to participate was higher among respondents who had less land. This may be because the respondents were hoping that by participating, they might get access to more land. Land holding size is thus associated with of participation in forest management. This may be because the respondents hope that by participating they may either get access to more land or to other increasing opportunities.

Income level also seems to have an effect on willingness to participate (χ^2 = 5.560, DF = 2, 2sided sig. = 0.062). At high-income levels (greater than K2500), a higher percentage (90%) of the respondents was willing to participate in forest management. These results indicate that high-income level is associated with more willingness to participate.

From the above results, it is apparent that a number of factors influence community's willingness to participate in forest management. At Thuma forest reserve, people who were at least literate were more willing to support the forest reserve than those who could not read or write. It was also found that residents who had less land were more willing to participate than those who had more land. Income level also affects the willingness of the respondents to participate in forest management. High income is associated with more willingness to participate. This direct relationship seems to be counter-intuitive with the inverse relationship to land.

These factors have to be taken into consideration when designing participatory management approaches. Among the components of participatory management projects should be environmental education in order to increase the level of understanding of the importance of conservation and income generation initiatives in order to provide an incentive to conserve the forest resources. Income generation from the forest resources could also compensate for the bitterness of the community about being denied access to land for cultivation. It is necessary to provide mechanisms to make forest protection attractive to the local community if it is not to be spontaneously converted to farmland. One way of doing this is by making those who benefit from the reserve pay those who protect the forest. This could be in terms of direct payment to the communities living around TFR in order to give them an incentive to protect the forest.

2.5. Summary

This section looked at the factors affecting willingness of the communities to get involved in forest management communities. It has been shown that people are willing to participate in forest management. However, it appears that the willingness to participate is motivated by anticipation of having access to more land. The study also suggests that the villagers perceive cultivation to be a more beneficial use of land than maintaining it as a forest reserve. This is inferred from the finding that the communities would rather use the land for cultivation than have it maintained as a forest reserve. Thus, participatory management in the case of Thuma can only be successful if the incentive to cultivate is removed. This will require that alternative income generation initiatives should be part of the participatory management programmes. Income generation activities from forest resources could ensure that participation is on the basis of sound motivation and not on the basis of having access to land for cultivation.

High literacy level and high-income level seem to be associated with more willingness to participate. People with less land are also more willing to participate. These factors should therefore be looked into when embarking on participatory management programmes.

On the preferences of management options, it appears that local leadership is considered by the community, as the worst management regime in terms of future preservation. The state is considered to be the best for preservation but the benefits to the community are perceived to be low. Joint management is considered to offer moderate opportunity for indigenous extraction as well as future preservation. It appears that participatory management is perceived to be the best way of preserving the forest while maintaining the direct benefits to the community.

3.0 QUANTITATIVE ESTIMATES AND QUALITATIVE VALUES OF THE COSTS AND BENEFITS

The quantitative values for the costs and benefits were developed for those attributes that could be quantified. For attributes that could not be valued quantitatively, quantitative scales were defined. These estimates were made for the baseline option and formed the basis against which the other options were measured.

The costs reflected government expenditure on operating costs including wages and salaries, policing costs road maintenance costs. The costs of illegal activities were also estimated. In addition, the opportunity cost of the forest reserve to the community was also estimated in order to reflect the benefits forgone by the community by not using the land for agriculture.

The benefits to the government as well as the community were estimated. This included direct benefits like government revenue, estimated tourism potential and sustained forest use by the community. Indirect benefits including the value of maintenance of biological diversity and watershed protection were also incorporated qualitatively.

3.1. The Costs and Benefits

The revenue collected from Thuma forest reserve (K2491) in the financial year 1997/98 was far less than the management and maintenance costs incurred by the government in the same year (K274, 643). These results are shown in table 6.4.below. However, the benefits derived by the community are considerable. Use of firewood alone has a value of K546, 000 that surpasses the government costs.

Table3.1 Summary Of The Quantified Costs And Benefits

Costs	Amount (Kwacha)
Government Costs[a]	274,643
BENEFITS	
Government revenue[a]	2491
Use Benefits	546,000
Total Benefits	548,491
Net Benefits	274,124

Moreover, the non-quantified benefits listed in Table 6.5 below could increase the net benefits to a significant extent. Bamboos provide an important source of income to the community apart from being useful at household level and are thus considered to be more important than the other non-forest products (mushrooms, grass, and wild fruits) which are only used at household level. The community at a considerable extent also uses non-forest products. Together, these non-forest products could have increased the net benefits of the reserve to a great extent if they were quantified. Non use benefits have not been quantified but it is clear that their value is high. Catchment control is considered to be more important because its direct effects are spread over a wide area including a high percentage of the population of the Lilongwe City. It is very likely

[a] estimated based on the records obtained from the forestry department

that if the conservation value was quantified, it could even surpass the opportunity cost[b] to the community, which has been estimated at MK7, 212, 000 (Section 6.4).

Table 3.2 Summary Of The Non-Quantified Benefits

Direct Benefits	
Bamboo	++
Mushrooms [1]	+
Wild fruits [1]	+
Thatch grass [1]	+
Medicinal plants[1]	+
Honey[1]	+
Indirect Benefits	
Biodiversity [2]	++
Catchment control [3]	+++

Note

+ = significant at a low level ++ = moderately significant +++ = highly significant

Thuma is thus very valuable in its role as a Catchment area for two rivers, which are very important in the livelihoods of the people living along these rivers and those living in Lilongwe City. Although these values have not been quantified, their value is immense. Even if we only consider the value derived by the Lilongwe City residents (over 140,000 people) from the water catchment function, the quantity would be very high. The biodiversity conservation function is also very important. Even if we only consider one of the values arising from the biodiversity conservation function, the tourism potential (estimated at MK424, 764 [1]), its value is high enough to surpass the costs incurred by the government.

Maintaining Thuma as a Forest reserve is costly on the part of government in the current property regime and is not justifiable on the basis of amount of revenue generated by the government. However, the water catchment and biodiversity roles although not specifically

[b] It was assumed that the opportunity cost of maintaining the land as a forest is the amount of money which could have been obtained if the land was used for growing maize. An assumption was made that 11% of the land was cultivatable. Using an average yield of 800kg per hectare and a consumer price of MK5 per kg, The opprtunity cost was estimated at MK7,212,000.

[1] Significant at a low level. Considered being less important than bamboos because bamboos are an important source of income apart from being used at household level.
[2] moderately significant Biodiversity is considered to have less significant value than catchment conservation because it only affects the surrounding communities who get the direct benefits.
[3] highly significant value. Considered to be most important because it directly affects a widely spread population including over 140,000 residents of Lilongwe City.
[1] The value was based on an estimate of potential revenue from tourism in three forest reserves namely Thuma, Zomba-Malosa and Mulanje by Orr etal (1998) in the public Lands Utilisation Survey. It was assumed that all the three reserves have similar potential in attracting tourists and the figure for the three reserves (US$33,535) was divided equally among the three forest reserves. Although this is not necessarily the case, it provides a rudimentary estimate of the potential tourism revenue from Thuma Forest Reserve. An exchange rate of 1:36.2 was used to convert the value to the local currency.

quantified are clearly very high. The task is therefore to find ways of reducing the costs of maintenance incurred by the government and the loss through unsustainable harvesting caused by to illegal activity. Self-policing by the local communities could reduce the costs incurred by their government which are mostly borne by policing costs. Mechanisms should be found of making those benefiting from the reserve, like the Lilongwe City residents, pay for some of the management and maintenance costs.

3.2. Summary

This section has developed some estimates of costs and benefits under the current management regime. It appears from the results that government expenditure is extremely high as compared to government revenue. However, Thuma plays a very important role of catchment conservation to two very important rivers namely Lilongwe and Linthipe. Moreover, Thuma is one of the few forest reserves in Malawi, which still has rich biodiversity especially fauna, which renders TFR as one of the forest reserves with high tourism potential. If the conservation and biodiversity values are quantified, it is very likely that the costs will be surpassed. From this analysis, it is reasonable to maintain Thuma as a forest reserve because of its very important water catchment conservation role, which is very critical to the residents of Lilongwe City and people living along Lilongwe and Linthipe rivers.

These estimates form the basis for prioritising the attributes in the multi criteria scoring model in the next section.

4.0 EVALUATION OF THE MANAGEMENT OPTIONS FOR THUMA FOREST RESERVE

A comprehensive literature survey was done on the successes and failures of the management options being considered in this investigation. Ranking of the options on the attributes under consideration was based on the evidence provided by this literature survey on how effective each option has proved to achieve a particular attribute. In addition, evidence collected from the Forestry Department and the community households was used to support the philosophies and evidence in literature. The options being considered are full state protection; state control with access to non-forest products, participatory management in buffer zones, joint management and community led management.

4.1 Attributes selected

These options were compared on the following attributes:

- Water Catchment and Biodiversity conservation by reducing illegal practices (the conservation goal)
- Income generation by the surrounding community through use of forest and non-forest products by the community to foster their support.
- Reducing government expenditure by reducing operation and management costs including policing costs and other activities or by increasing government revenue.

These attributes were selected to reflect the broad objective of increasing the economic and social value of TFR while maintaining the protection role that the reserve plays to water, soil and wildlife.

Each management option was examined on the extent to which it achieves each attribute.

4.2 Criteria for Rank Ordering of the Management options

The evaluation criteria used in this study are derived from the broader concerns for achievement of the above mentioned attributes. The criteria for each attribute are outlined below.

4.2.1. Criteria for the Conservation Goal

I. To what extent does the management option instil a sense of security of tenure in the neighbouring communities by granting them the right of exclusion?

II. How do the communities perceive the benefits from the reserve under the management regime in question?

III. How easy /difficult is it to control access and harvesting levels with each option?

4.2.2. Criteria for the Community Income Generation Goal

I. What are the opportunities that the communities can generate income from the FR with the management option in question?

II. What are the chances that the income generation opportunities will be maintained for a long time?

4.2.3. Criteria for the goal of Reducing Government Costs

I. How much policing is required based on the access rights?

II. Who shoulders the bulk of the policing costs between the State and the communities?

4.3. The Multicriteria Scoring Model

The Multicriteria Scoring Model adopted from Ragsdale 1998 was employed in evaluation of alternatives. Each alternative was scored (or rated) on each criterion. The weighted average score for alternative (j) was calculated as:

$$j = \sum_i w_i s_{ij}$$

Where Sij = score for alternative j

Wi = weight assigned each criterion indicating its relative importance to the decision maker.

The alternative with the largest weighted average score is the one that was selected. The values were based on the extent to which each alternative provides utility on the various criteria. To determine the scores and weights to be used in the model, the Analytic Hierarchy process was used (AHP).

The AHP provides a structured approach for determining the scores and weights for the Multicriteria Scoring Model. The first step in the AHP is to create a pairwise comparison matrix for each alternative on each criterion. Pairwise comparisons as the decision-makers preferences between two alternatives on each criterion based on a ranking scale. Table 3.2 below illustrates an example of a scale for pairwise comparisons in AHP, which was adopted for the comparison of management alternative in this study.

Table 4.1. Scale for Pairwise Comparisons in AHP

Value	Preference
1	Equally preferred
2	Equally to moderately preferred
3	Moderately preferred
4	Moderately to strongly preferred
5	Strongly preferred
6	Strongly to very strongly preferred
7	Very strongly preferred
8	Very strongly to extremely preferred
9	Extremely preferred

Pairwise comparisons of each of the alternatives were performed using the values in the table above and then a pair wise comparison matrices were created.

Where the preference between X and Y (Pxy) already known, the preference between Y and X is the reciprocal of the preference between X and Y. Thus Pji was calculated as:

$$p_{ij} = \frac{1}{p_{ji}}$$

The scores were standardised 0 to 1 to reflect the relative worth of each decision alternative on each criterion. This was done by calculating the sum of each column in the pairwise matrix. Each entry in the matrix was then divided by its column sum. The average of each row in the normalised matrix was then used as the score for each alternative on the criterion under consideration. These scores indicated the relative desirability of the alternatives to the decision-maker with respect to that criterion. These scores reflect the preferences expressed by the decision-maker in the pairwise comparison matrix.

To ensure consistency in the preference rationgs, a consistency measure was obtained by multiplying the preferences given in one of the rows of the original pairwise comparison matrix by the scores obtained from the normalised matrix. The products were summed and then divided by the score of the alternative measure for X. The formula for consistency measure can be expressed as follows:

$$\frac{\Sigma \text{ (Preferences from original pair wise matrix} * \text{normalised scores)}}{\text{. Normalised score for the alternative in question}}$$

If there is consistency in the preferences, each consistency measure will equal the number of alternatives in the problem. However, Ragsdalle indicated that it is difficult to be perfectly consistent in stating preferences between a large amount of pairwise comparisons. However, the scores obtained from the normalised matrix can be considered to be reasonably accurate provided that the amount of inconsistency is not excessive. To determine whether or not the inconsistency is excessive, a consistency ratio can be calculated as follows:

$$CR = \frac{CI}{RI}$$

$$\text{CI (Consistency index)} = \frac{\lambda - n}{n - 1}$$

Where: λ = the average consistency measure for all alternatives

n = the number of alternatives

RI = the appropriate random index.

The values of RI in table 3.4 below give the average value of CI if all the entries in the pairwise matrix were chosen at random, given that all the diagonal entries equal 1 and Pij = 1/Pji. If CR ≤ 0.1, the degree of inconsistency in the pairwise matrix is satisfactory and the AHP results are acceptable. However, if CR > 0.1, serious inconsistencies might exist and AHP might not yield meaningful results.

Table 4.2. Values For RI For Use In AHP

N	RI
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41

Source: Ragsdalle (1998)

Before using the values in the scoring model, weights indicating the relative importance of the decision making attributes were obtained. The pairwise comparison process to generate scores for alternatives on each criterion was also used to generate criterion weights.

4.4. Performance of the Management Options

This section presents the results of the Multicriteria Scoring Model for each attribute. The preferences of the management options on the criteria for each attribute are indicated. The preference statements are based on a synthesis of literature, findings from the community survey and discussions with forestry officials. The final AHP model for each attribute is also presented.

4.4.1. Rationale for preferences on the Conservation Goal

Table 7.1 presents the preference statements and the rationale for the preferences on the conservation goal. These preference statements are based an integration of evidence from literature, findings from the community survey community and discussions with forestry specialists. A ranking scale of 1-9 was used to determine the relative preferences among the management options.

Table 4.3 Preference Statements for the Conservation Goal

Community Benefits Criterion	
Preference Statement	**Rationale**
BZ is moderately preferred to strongly preferred to FSP (4)	At least the communities can derive some benefit from the buffer zone (although restricted), unlike FSP where they have no access at all.
BO is moderately preferred to BZ (5)	With BO, communities have access to NFPs in the whole forest reserve while with BZ, the restriction is twofold - restricted to buffer zone and also the types and levels of extraction.
BO is strongly preferred to FSP (5)	Since BO is strongly preferred to BZ and BZ is moderately to strongly prefer to FSP, then BO is very strongly preferred to FSP.
PM is strongly preferred to BO (5)	Communities are involved in decision making of utilisation of the forest reserve so they have say on extraction levels and types of resources to be extracted. Moreover, they can access the whole forest reserve thus the benefits are likely to be higher.
PM is very strongly preferred BZ (7)	Same argument as above but more strongly preferred in this case because BZ is on a lower preference level than BZ.
PM is very strongly to extremely preferred to FSP (8)	Lower preference level that BO hence PM is more preferred to FSP than to BZ.
CLM is strongly preferred to PM (5)	Communities have full access rights to the forest reserve and are responsible for the benefits that they want to extract from the reserve. PM compares better to CLM than BO, BZ and FSP because in PM, communities have a say on utilisation levels. They are involved in decision making.
CLM is extremely preferred to FSP(9)	Since PM is very strongly to extremely preferred to FSP and CLM is strongly preferred to PM, then CLM is extremely preferred to FSP
CLM is very strongly preferred to BZ(8)	Since PM is very strongly preferred to BZ and CLM is very strongly preferred to PM then CLM is very strongly preferred to BZ
CLM is very strongly preferred to BO (7)	Since PM is strongly preferred to BO and CLM is very strongly preferred to PM then CLM is extremely preferred to PM
Access Control Criterion	
BZ is moderately preferred to CLM(3)	Under the present circumstances of mistrust of local leadership, the likelihood that the communities will abuse their free access to the forest reserve is high. BZ protects the core zone from destruction if access control to the core zone is effective. However, due to inadequate inadequacy of policing at the moment, the preference is only moderate.

BO is strongly preferred to CLM (5)	Although communities are allowed to collect NFPs. The reserve is still under full state protection. Through heavy policing, illegal activities can be reduced to some extent.
BO is moderately to strongly preferred to BZ(4)	BZ restricts access to the buffer zone only in addition to controlling types of resources extracted. Due to dissatisfaction, access control to the core zone is likely to be difficult.
PM is strongly preferred to BO(5)	Self-policing induced by PM can make the task of access control easier and more effective than cases where the state is in full control.
PM is very strongly preferred to BZ(7)	Since BO is moderately preferred to BZ
PM is very strongly preferred to CLM (7)	CLM is effective where local communities trust local leaders and the local authorities are powerful. This is not the case in the study area. Thus CLM is on a lower preference level than BZ and BO where the state is in control.
PM is extremely preferred to FSP(9)	Inadequacy of policing renders FSP ineffective
BZ is moderately preferred to FSP (3)	Unlike FSP where communities do not derive any direct benefits at all, BZ provides some benefits from the buffer zone thus reducing pressure on the core zone.
BO is strongly preferred to FSP (5)	BO is more preferred to BZ and BZ is preferred to FSP this Bo is more strongly preferred to FSP.
FSP is equally to moderately preferred to CLM (1)	If policing is not adequate, FSP results in open access. If community leadership is weak, CLM also leads to open access. Both conditions prevail in the study area. FSP and CLM are therefore rated almost equally.
Security of Tenure Criterion	
BO, BZ, and FSP are all equally preferred (1)	the state maintains full ownership of the reserve in all the three scenarios
PM is very strongly preferred to BO, BZ and FSP(7)	The state and the communities are in partnership. Communities are involved in decision making about management and utilisation of the reserve. Thus the communities have some security of tenure.
CLM is extremely preferred to BO, BZ and FSP (9)	Communities have more sense of ownership to the reserve.
CLM is moderately preferred to PM (3)	While in PM the communities are in partnership with the state, in CLM, the communities are in full control and have more sense of ownership.

Note: Rank in parenthesis

CLM is the most preferred option on the community benefits criterion while PM is the second most preferred option and BZ is the least preferred. On the access control criterion, PM is the

most preferred while CLM is the worst. CLM is the most preferred on security of tenure while BO, BZ and FSP are all equally rated and are the worst on this criterion.

4.4.1.1. Performance on the Conservation Goal

Table 7.1 below presents the final results of the Multicriteria Scoring Model for the conservation goal.

Table 4.4. AHP Model for the Conservation Goal (pairwise comparisons in appendix 3)

	BO	FSP	BZ	PM	CLM	CRITERION WEIGHTS (Derived in appendix 3.4)
Sense of ownership	0.051	0.051	0.051	0.306	0.540	0.232
Access control	0.229	0.041	0.108	0.561	0.061	0.679
Community Benefits	0.107	0.031	0.066	0.254	0.543	0.072
Weighted Average Score	0.175	0.042	0.090	0.470	0.206	

The access control criterion was most highly weighted while the community benefits criterion was the least weighted. PM attained the highest average weighted score and is therefore the best alternative for the conservation goal.

4.4.2. Rationale for Preferences on the Community Income Generation Goal

The preference statements and the rationale for the preferences are presented in Table 7.3. Again these statements are based on the same ranking scale of 1-9 is used.

Table 4.5.Preference Statements for the community income generation goal

Income Generation Opportunities Criterion	
PREFERENCE STATEMENT	RATIONALE
BZ is moderately preferred to FSP (3)	With BZ, communities can generate income from resources in the buffer zone while with FSP there is no opportunity for the community to generate income from the forest reserve since it is a no go area.
BO is strongly preferred to BZ(5)	BZ restricts access to the buffer zone only thus restricts income generation opportunities to a small area.
BO is very strongly preferred to FSP(7)	Since BO is strongly preferred to BZ and BZ is moderately preferred to FSP< the BO is very strongly preferred to FSP.
PM is strongly preferred to BO(5)	Bo restricts income generation to NFPs only while with PM, even forest products can be used at controlled levels.
PM is very strongly preferred to BZ (7)	Since PM is strongly preferred to BO and BO is strongly preferred to BZ, then PM is very strongly preferred to BZ.
PM is very strongly to extremely preferred to FSP (8).	FSP is on a lower preference than BZ.

CLM is moderately preferred to PM (3)	Communities are in full control of the level of extraction. With PM the government and local communities are in partnerships so revenue is also shared.
CLM is strongly preferred to BO (5)	Since CLM is moderately preferred to PM and PM is strongly preferred BO, then PM CLM is v strongly preferred to BO.
CLM is very strongly preferred to BZ (7)	Since BO is strongly preferred to BZ and CLM is strongly preferred to BO, then CLM is more strongly preferred to BZ.
CLM is extremely preferred to FSP (8)	Because FSP is on a lower preference level than BZ
Income Generation Duration Criterion	
BZ is very strongly preferred to FSP (7)	There is no income generation with FSP
BZ is strongly preferred to CLM (5)	Because local leadership is weak in enforcing regulations, it is very likely that resources will be destructed within a short period, thus income generation opportunities will be short term.
BO is moderately preferred to BZ (3)	Harvesting is concentrated in the buffer zone only, people are embittered and they indulge in unsustainable harvesting practices.
PM is strongly preferred to BO (5)	Sense of ownership resulting in self-interest in protecting forest and thus controlling harmful harvesting practices. Income generation becomes long term.
PM is very strongly preferred to BZ (7)	Because BZ is on a lower preference level than BO
PM is extremely preferred to CLM and FSP (9)	CLM and FSP are on lower preference levels than BZ
BO is strongly preferred to CLM (5)	Due to weakness of local leadership in enforcing regulation
CLM is moderately preferred to FSP (3)	Although short term, at least there is an opportunity of income generation

Note: Ranks in parenthesis

CLM is the most highly preferred alternative on the income generation opportunity criterion seconded by PM. On income generation duration PM is the most highly preferred alternative.

4.4.2.1. Performance on the community Income Generation Goal

The final results of the AHP model for the income generation attribute are presented in Table 7.4 below.

Table 4.6AHP Model for the Income Generation attribute

	BO	FSP	BZ	PM	CLM	Criterion weights (Derived in appendix 4.3)
Opportunities	0.148	0.031	0.057	0.296	0.468	0.750
Duration	0.209	0.032	0.147	0.556	0.056	0.250
Weighted Average Score	0.163	0.031	0.080	0.361	0.365	

CLM attained a weighted score of 0.365. The second best alternative on community income generation is participatory management with a weighted score of 0.361. CLM and PM are thus almost equally rated on the income generation attribute.

4.4.3. Rationale for preferences on Reducing Government Costs

Table 4.7 summarises rationale for the relative preferences of the management options on the government costs criterion.

CLM is the most preferred option on the policing requirements criterion while BZ is the least preferred. PM is strongly preferred to BZ, BO and FSP, which are all equally preferred on the cost-sharing criterion. CLM is again the most preferred on this criterion.

Table 4.7. Rationale for Preferences on Government Costs Criterion

Policing Requirements Criterion	
Preference Statement	Rationale
CLM is moderately preferred to PM (3)	Communities have full sense of ownership and are likely to utilise the resources in a responsible manner
PM is strongly preferred to FSP(5)	Due to lack of sense of ownership and deprivation of benefits, communities might revert to harmful practices hence need for policing
PM is very strongly preferred to BO (7)	Since FSP is moderately preferred to BO and PM is strongly preferred to FSP, then PM is more strongly preferred to BO and FSP
PM is very strongly to extremely preferred to BZ (8)	BZ is on a lower preference than BO and PM is very strongly preferred to BO. Thus PM is very strongly to extremely preferred to BZ.
FSP is moderately preferred to BO(3)	Communities have no sense of ownership and yet they are allowed to enter the reserve. There is a possibility of them abusing their access rights hence need for more policing than FSP.
BO is moderately preferred to BZ (3)	Benefits are more limited than in BO and as such communities might be more embittered and might revert to harmful practices. From the survey, respondents also indicated that controlling access to the core zone might be difficult.
FSP is moderately to strongly preferred to BZ (4)	BZ With BZ it is more difficult to control access to the core zone because people might take advantage of their rightful access to the buffer zone.
CLM is very strongly preferred to FSP (7)	Since CLM is moderately preferred to PM and PM is strongly preferred to FSP, then CLM is very strongly preferred to FSP
CLM is extremely preferred to BZ (9)	Since CLM is moderately preferred to PM and PM is strongly to extremely preferred to BZ preferred
CLM is very strongly to extremely preferred to BO (8)	BZ is on a lower preference than BO and PM is very strongly preferred to BO, thus PM is very strongly to extremely preferred to BZ
Cost Sharing Criterion	
Preference Statement	Rationale
BZ = BO = FSP (1)	The state shoulders all the costs
PM is strongly preferred to BO, BZ, FSP(5)	Reserve managed by the state and community together. Communities take part in policing and other maintenance activities.
CLM is very strongly preferred to FSP, BZ, and BO (7).	Since CLM is moderately preferred to PM and PM is strongly preferred to BO, BZ and FSP.
CLM is moderately preferred to PM (3)	Community is the main source of support. The community shoulders most of the costs. The state may only offer technical support.

Note: Rank in parenthesis

4.4.3.1. Performance on the Goal of Reducing Government Costs

The final results of the final AHP model for the government costs attribute are shown in Table 4.8.

Table 4.8.AHP Model for the Government Cost (PAirwise Comparisons appendix 5)

	BO	FSP	BZ	PM	CLM	Criterion weights Derived in appendix 5.3)
Requirements	0.060	0.103	0.034	0.294	0.509	0.875
Cost sharing	0.065	0.065	0.065	0.281	0.568	0.250
Weighted average score	**0.069**	**0.106**	**0.046**	**0.327**	**0.587**	

According to these results, CLM is the best management option for reducing government costs followed by PM.

4.4. Weighting of the attributes

Weighting of the attributes was derived from the priority order of the attributes. It has been shown in Section 6.1.1 that the water catchment role of Thuma Forest Reserve directly affects the livelihood of a wide population living along Lilongwe and Linthipe rivers. In addition, the residents of Lilongwe City depend on Lilongwe River for water supply. Biodiversity has also proved to be an important function of Thuma considering the broad spectrum of biodiversity especially large mammal fauna. The tourism potential resulting from this biodiversity is also high. Together, maintenance of these functions is a very important goal, which has to be given high priority in decision making about management of Thuma Forest Reserve. As shown in Table 7.4 below, water catchment and biodiversity conservation is thus considered to be the most highly prioritised attribute. Income generation by the community is considered to be the second priority attribute. The reasoning behind this judgement is that increasing income generation from the reserve would remove the incentive to utilise the forest illegally (IIED 1994), thus enhancing the water catchment and biodiversity conservation goal. Although government costs have been found to be extremely high as compared to revenue, reducing these costs is the last priority attribute in the case of Thuma because it is not directly related to the water catchment and biodiversity role.

Table4.9. Weighting of the Attributes

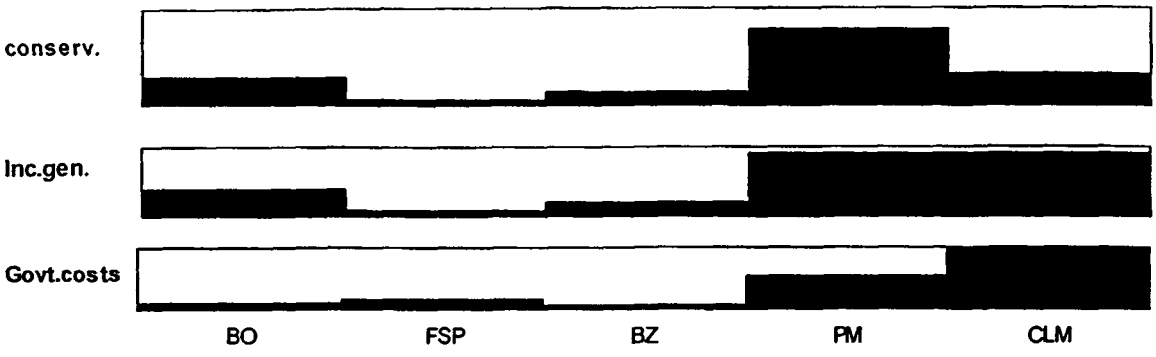
Attribute	Priority Order
Water catchment and biodiversity conservation	1
Income generation by the communities	2
Reducing government expenditure	3

A management alternative, which is best for the highly prioritised attributes, is preferred to one that is best for an attribute, which is not highly prioritised.

4.5. Graphical Presentation of Attribute Performance

A graphical presentation of the results of the AHP analysis is presented in figure 7.1.This graphic presentation can be used to rank the alternatives according to the priority order of the attributes. Each attribute is standardised between zero (the worst alternative) and 1 (the best alternative). The highest bar represents the best alternative.

Figure 4.1. Graphical Presentation Attribute Performance



It is visually evident from the graph that PM is the best option for the most highly prioritised attribute (the conservation goal). On the second highly prioritised attribute (community income generation), PM and CLM are almost equally rated. CLM is also the best option for the third attribute (reducing government costs). However, PM is a better option relative to CLM because CLM attains a low rank on the most important attribute, the conservation goal. According to this analysis therefore, PM is the best management option for TFR.

5.0. CONCLUSIONS

6.0.

One of the purposes of this paper was to demonstrate how functions and values of forest reserves could be used to determine appropriate management strategies for the forest reserves. The other aim was to demonstrate how community perceptions and preferences could be incorporated in the decision making about forest reserve management strategies.

The functions and values, which were discussed in section 4, have been used as the basis for prioritisation of the attributes used in the analysis. The conservation goal, which is the most important role of TFR, according to the discussion in section 4, has been given the highest weight. The other attributes have been weighted based on how closely related they are to the conservation goal.

Community perceptions and preferences have also been taken into consideration in the pairwise comparisons. Throughout the analysis, the finding that local leadership is perceived not to be the best option if the forest has to be preserved has been taken into consideration. Community perceptions of benefit have also been included in the pairwise comparisons.

The study provides a framework which the FD can use in its decision making process about forest reserve management strategies. More detailed quantification of the values and functions is possible and could make the prioritisation process easier and more transparent.

With the findings and assumptions presented in this investigation of TFR, PM has attained the highest weighted average score. It is the best option for the conservation goal, which is the most highly weighted attribute, second best for the second attribute (community income generation), and second best for the least prioritised attribute (reducing government costs). PM is therefore the best management option for TFR according to this investigation. However, this is a preliminary investigation and there is need for a more rigorous study to specifically quantify the values and functions of TFR. It would be useful to take these findings and in particular the assumptions and weightings back to the stakeholders: the forest service, Lilongwe City residents

and water suppliers and the local community. Participatory discussions and appraisals would refine the assumptions and provide more substantial data and information.

As currently presented, this study finds that participatory management offers a greater hope of preserving Thuma forest reserve and thus maintaining the water catchment protection role. There is growing evidence that the rate of harmful practices drops if communities actively participate in forest management.

On increasing income generation to the community, the second attribute, joint management has also attained the highest score. PM instils access security among communities living close to forest reserves. It will provide them with a legal mechanism for excluding outsiders from accessing reserves resources. Moreover, PM is better than BZ, BO and CLM in controlling access and harvesting levels. With BZ and BO, there is a high possibility of abuse of partial access rights while with PM, this can be checked by self-policing. Moreover, communities surrounding TFR perceived PM as a way of balancing future preservation and direct use. On increasing income generation PM offers more long-term opportunities for community income generation.

On the third attribute, Reducing government expenditure, it is evident that communities can share the costs of management and maintenance with participatory approaches to management. Government costs are in such cases reduced. Moreover, illegal practices tend to decline with participatory management approaches thus policing costs are also reduced. The communities surrounding Thuma also have the same perception that joint management could preserve the forest while maintaining the benefits to the community. This provides some assurance that PM can receive the support of the local community at Thuma. PM has therefore been selected as a promising option for sustainable management of Thuma Forest Reserve under the present circumstances of inadequate policing and inability of local authorities to effectively enforce regulations.

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