

*MALAWI ENVIRONMENTAL MONITORING PROGRAM*

*FORESTRY SAMPLE PLOT REPORT*

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## 1.0 INTRODUCTION

*This reports presents the preliminary analysis of a sample plot survey of the woodlands in the MEMP catchment areas. During the months of September to November 1995, the survey was carried out jointly by members of the Forestry Research Institute of Malawi (FRIM) and Forestry Department Headquarters in three of the four MEMP Catchment areas. These were Kamundi (Mangochi), Chulu (Kasungu) and Chilindamaji (Nkhata Bay). Njolomole (Ntcheu) was not included in the survey due to the lack of afforested areas within that catchment.*

*The survey aimed to quantify the woody resource in each catchment area. The resource was quantified in terms of the number and composition of the woodland areas as well as the end-use to which each tree in the plots would be put if used there and then. The results will enable the MEMP project to look at changes in the woody resource over time and, in conjunction with socio-economic surveys, to what extent smallholders growing burley tobacco affect this resource.*

## 2.0 METHODS

*In each catchment, area plots were randomly located in each of the woodland classes stratified by satellite imagery. The random points were computer-generated from the digitized satellite data. More points were selected than were actually needed as some of the points selected had already been cleared by the time the field team reached them.*

*Within each woodland class (strata), for each catchment area three Permanent Sample Plots (PSPs) were laid. These plots ranged in size from 0.01ha to 0.04ha depending upon the density of stocking. Due to the short time allowed for the survey it was only possible to measure 3 PSPs per strata. This gives a low precision and more PSPs are necessary for greater accuracy. The accuracy for each woodland class for each catchment is given in the results.*

*The precision of these PSPs for any particular parameter can be calculated from the following*

Install Equation Editor and double-click here to view equation.

*formula:*

*where  $n$  = number of plots*

*$p$  = the precision*

*CV = Coefficient of Variation of the chosen parameter*

*(  $CV = (s/\bar{0})$  where  $s$  = sample standard deviation and  $\bar{0}$  = sample mean)*

*The precision of the results was found using DBH (Diameter at Breast Height, i.e., 1.3m above ground level). It is not possible to calculate the accuracy for the end-uses due to the qualitative nature of those data.*

*Throughout the results, the precision of the data as sample representatives of each woodland type in each catchment area is quite low. In order to achieve a greater precision, more sample plots are needed. Alternatively larger plots can be used. More numerous, smaller plots are more advantageous in these catchments due to the difficulty of laying out large plots in such densely stocked areas. Also a large number of plots will cover the range of topographic features more evenly.*

### **3.0 RESULTS**

#### **3.1 Some results from the forestry products survey**

*From the socio-economic forest products survey, Table 1 shows those products that were ranked by the villagers as the most important.*

*Table 1. End-Use Ranked by Importance*

<b>Rank</b>	<b>End-use</b>
<i>1</i>	<i>Fuelwood</i>
<i>2</i>	<i>Poles</i>
<i>3</i>	<i>Rope fibre</i>
<i>4</i>	<i>Fruit</i>

*The most preferred species with their associated end-uses are shown in Table 2.*

Table 2. Species Representing &gt;1% of the Total Preferred Species: End-Uses for All Catchments

Rank	% of total species chosen	Species	End-use
1	10.00	<i>Julbernadia paniculata</i>	Fuelwood, poles, hanging racks, medicine
2	9.53	<i>Brachystegia boehmii</i>	Fuelwood, rope fibre
3	5.58	<i>Pseudolachnostylis maprouneifolia</i>	Fuelwood, poles
4	5.02	<i>Uapaca kirkiana</i>	Fruit, fuelwood, poles, medicine
5	4.89	<i>Julbernadia globiflora</i>	Fuelwood, rope fibre
6	3.72	<i>Brachystegia spiciformis</i>	Fuelwood, poles, rope fibre
7	3.49	<i>Azanza garckeana</i>	Fuelwood, rope fibre, fruit
8	3.25	<i>Mangifera indica</i>	Fuelwood, fruit
9=	2.79	<i>Lanea discolor</i>	Fuelwood, hanging racks
9=	2.79	<i>Bauhinia thonningii</i>	Fuelwood, poles
11=	2.33	<i>Dipiorhynchus condylocarpon</i>	Poles, fuelwood
11=	2.33	<i>Brachystegia spp</i>	Fuelwood, rope fibre, poles
13	2.09	<i>Eucalyptus spp</i>	Poles, fuelwood
14=	1.63	<i>Brysocarpus orientalis</i>	Poles
14=	1.63	<i>Brachystegia floribunda</i>	Fuelwood, rope fibre

### 3.2 Kamundi catchment (Mangochi)

Table 3. Description of the Woodland Classes

Class	
3	Open woodland
3(9)	Scrub woodland
3(12)	Regeneration
4	Forest
6	Forest

#### 3.2.1 Precision of the results

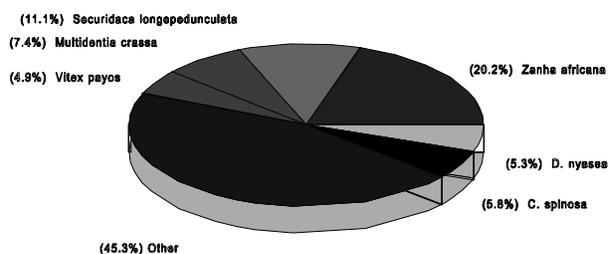
The results presented below for the Kamundi catchment must be viewed with some idea of the precision of the data in mind. Within each of the three Woodland Classes, there was time to lay only three sample plots. The precision of these plots are presented in Table 4.

Table 4. Precision of Plots in Kamundi Catchment by Woodland Class with Regard to DBH

	Precision within Class		
	3	4	6
DBH	35%	45%	51%

### 3.2.2 Species composition

The forest areas within Kamundi catchment were split up into five types of forest according to the digitized data from satellite imagery. These were classified as regeneration, open, scrub woodland, low canopy cover forest, and forest with a denser canopy cover (see Section 3.2.3, Table 5).



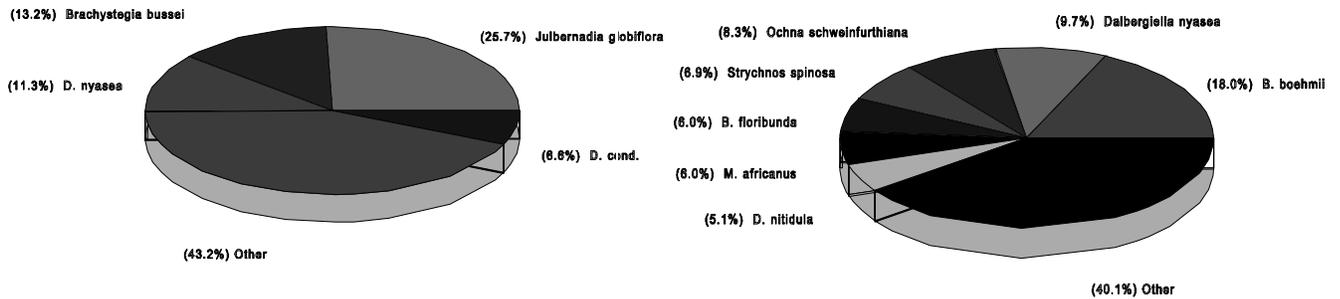
The three groups open, regeneration, and scrub, were originally separated by the satellite imagery. These were all put into one Class after ground truthing the area. This Class is known as Class 3. Class 4 is the low canopy cover woodland and Class 6 is the denser canopy cover woodland.

Class 3 woodland consists of areas that have either been badly degraded/deforested or is agricultural land left fallow. The dominant species can be seen in Figure 1.

The species that comprise >5% of the total number of stems per hectare differ in all three Classes. The only exception to this is Dalbergiella nyasea, which occurs in all three Classes at >5% of the total stems per ha. Full details of the species composition of each Class can be found in Appendix 1. Some of the species found in Classes 4 and 6 have been classed as unknown.

Dalbergiella nyasea is used primarily for poles. It only accounts for 0.47% of the preferred species chosen during the forest products survey, however. In fact, out of all the species representing >5% of the species composition of the three woodlands types, only 2 species in Class 4 and 2 in Class 6 are found in Table 2, the list of species that represent >1% of the preferred species for all the catchment areas. These are Julbernadia globiflora (Ranked 1<sup>st</sup>) and Diplorhynchus condylocarpon (Ranked 11<sup>th</sup>=) in Class 4, and Brachystegia boehmii (Ranked 2<sup>nd</sup>) and Brachystegia floribunda (Ranked 14<sup>th</sup>=) in Class 6.

The other species representing >5% of the species composition of Classes 4 and 6 are illustrated in Figures 2 and 3.



The lack of preferred species raises serious questions about the over-exploitation of these species, and underscores the need to address this issue through proper management of these woodlands. Within Class 3 woodlands the first 'preferred' species from Table 2 is Julbernadia globiflora, ranked seventh, and comprises less than 5% of the woodland.

There is also the need to thin out the areas due to the very high stocking (refer to Table 8). Some management techniques are suggested in Section 4.

### 3.2.3 End-uses of the woody resource

Table 5. End-Uses within the Class 3 Woodland

	class 3	
<USE>		
firewood	1,900	34.2%
small	1,808	32.6%
pole	850	15.3%
racks	417	7.5%
fruits	175	3.2%
medicine	133	2.4%
rafter	133	2.4%
fibre	67	1.2%
other	67	1.2%
SUM	5,550	100%

Table 7. End-Uses within the Class 6 Woodland

	class 6	
<USE>		
small	1,000	49.0%
firewood	617	30.2%
pole	142	6.9%
racks	100	4.9%
medicine	75	3.7%
fibre	58	2.9%
fruits	33	1.6%
rafter	17	0.8%
SUM	2,042	100%

Table 6. End-Uses within the Class 4 Woodland

If the 'small' category is ignored, the overwhelming uses of these woodlands are fuelwood followed by poles.

The third highest end-use differs between woodland categories 3 and 6 (racks), and category 4 (fibre). It is interesting to note that the racks come from both woodlands with a high number of

	class 4	
<USE>		
small	2,775	46.7%
firewood	1,542	25.9%
pole	700	11.8%
fibre	450	7.6%
racks	267	4.5%
medicine	100	1.7%
fruits	67	1.1%
rafter	33	0.6%
other	8	0.1%
SUM	5,942	100%

In order to determine the end uses of the trees currently in the catchment, a local villager accompanied the forestry personnel. He was asked as to what use each tree within the plot would be put to if it was to be used there and then, even if this meant felling the tree. Much of the resource found in Kamundi was too small to be of any practical use. The "small" end-use category was the dominant category in Classes 4 and 6, comprising 46.7% and 49% of the total number of end uses per hectare for Classes 4 and 6 respectively (Tables 6 and 7).

Class 3 had fuelwood as the dominant end-use (Table 5). This is surprising as this is the 'regeneration' class and as such is expected to have the greatest proportion of seedlings. It is possible that grazing is more common on fallow land, and that therefore the seedlings are grazed.

standards and also from regeneration woodlands. Class 4 has a lower canopy cover than Class 6, and fibre is an important product from this woodland.

### 3.2.4 Diameter distribution and stocking of the woody resource

Figure 4 illustrates the diameter distribution of the Kamundi catchment woodlands. Class 3 has the lowest proportion of stems in the <1cm class and Class 6 the highest proportion. This is the opposite of the expected results, i.e., where the regeneration woodland would have the greatest proportion of seedlings. A possible reason is that these woodlands have been cleared, or left fallow, within the recent past and the seedlings have all grown at approximately the same rate into the 1-5cm class. There is little variation in the diameters within this class of woodland. The rest of the graph proceeds as expected, with Class 6 becoming dominant in the higher DBH classes. Class 4 is an intermediate woodland with less small stems and more larger stems than Class 3, and vice versa with respect to Class 6. Table 8 shows the stock density of the woodlands.

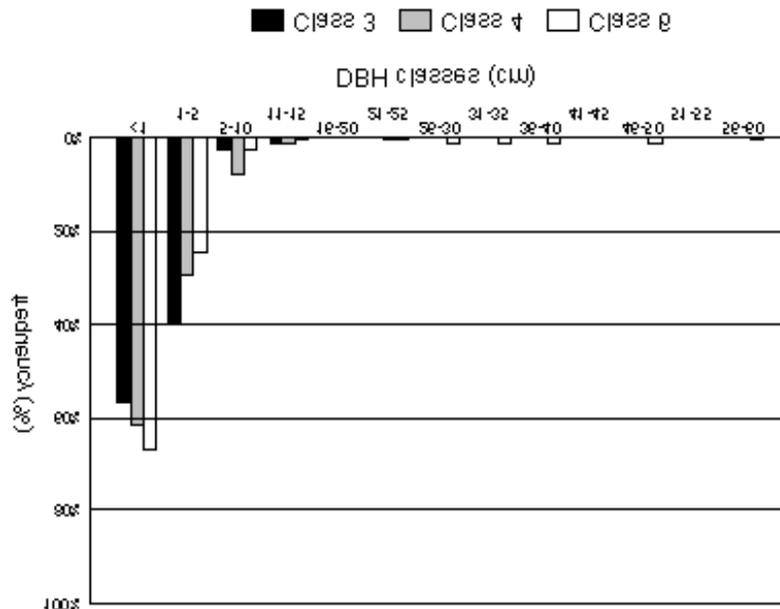


Figure 4. Diameter distribution of Kamundi catchment woodlands.

*Table 8. Stems per Hectare of the Three Woodland Classes*

<i>Woodland Class</i>	<i>Stems per hectare</i>
3	3,600
4	3,671
6	1,808

Classes 3 and 4 are highly stocked and some form of management is necessary for these woodland to reach their potential. Class 6 has a more beneficial level of stocking for a coppice with standards management regime. Classes 3 and 4 need to be thinned out soon in order to stop the stands from going into check and stagnating. The area should be thinned to at least  $\frac{2}{3}$  of the current stocking followed by another thinning within the next 5 years down to  $\frac{1}{3}$  -  $\frac{1}{2}$  of the current stocking. Each area should be thinned for preferred species and products. The type of thinning will depend upon the products - ie. complete coppice or thinning with standards. These management methods will be discussed further in Section 4.

### 3.3 Chulu catchment (Kasungu)

*Table 9. Description of the Woodland Classes*

<i>Class</i>	
11	<i>Scrub/regeneration woodland</i>
22	<i>Forest</i>

#### 3.3.1. Precision of the results

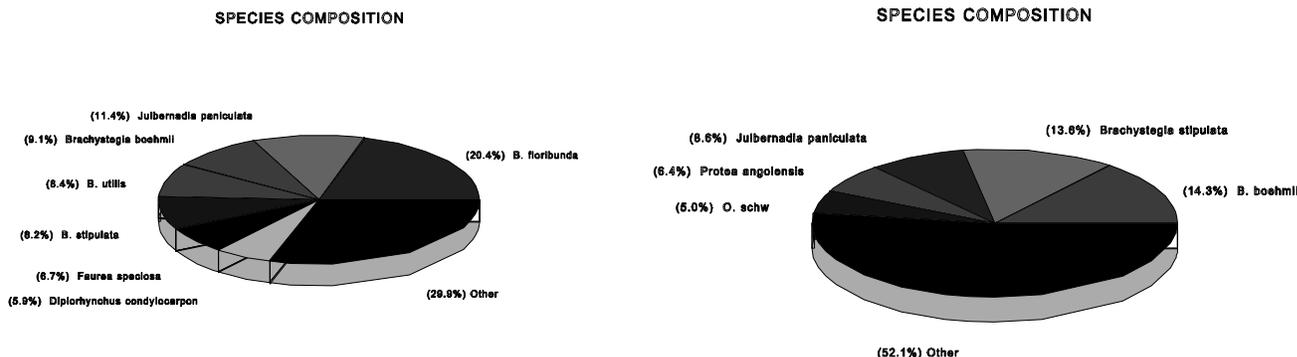
The precision of the plots are presented below :

*Table 10. Precision of Plots in Chulu Catchment by Woodland Class with Regard to DBH*

	<i>Class 11</i>	<i>Class 22</i>
<i>DBH</i>	46.7%	63.1%

#### 3.3.2 Species composition

Figures 5 and 6 show the species composition of Class 11 and 22 woodlands.



Both woodlands have the two most preferred species (*J. paniculata* and *B. boehmii*) representing >5% of the woodland composition. Class 11 also has *D. condylocarpon* (Ranked 11=) and *B. floribunda* (Ranked 14=). The presence of these preferred species may be due to the very large size of the catchment area and the comparatively lower (human) population density compared with Kamundi. *B. floribunda* is especially abundant with over 20% of Class 11 comprised of this species. This is a preferred species for fuelwood and rope fibre.

### 3.3.3 End-uses of the woody resource

As with Kamundi, the fuelwood and poles categories are dominant once the small category is discounted (Tables 11 and 12). Within Class 11, fuelwood and poles are in greater proportions than the small category. Nearly half of Class 22 is designated small. This woodland has far more standards than Class 11, which is dominated by *B. floribunda* (20.4%) used for fibre and fuelwood (Table 2). In order to acquire the fibre, small stems are generally preferred. Small stems are also used for kindling. Even though the Class 11 woodland is smaller in terms of diameter, it has potentially greater use (see Section 3.3.4), and also has a greater variety of end-uses. Both these observations have important implications for the management of the woodlands.

Table 11. End-Uses within the Class 11 Woodlands

Class 11		
Firewood	1,433	22.9%
Poles	1,358	21.7%
Small	1,133	18.1%

Medicine	675	10.8%
Fibre	625	10.0%
Racks	325	5.2%
Charcoal	283	4.5%
Gum	133	2.1%
Fruits	125	2.0%
Caterpillars	117	1.9%
Fishing	17	0.3%
houseware	17	0.3%

<i>Carvings</i>	8	0.1%
<i>Fence</i>	8	0.1%
<i>SUM</i>	6,258	100%

*Table 12. End-Uses within the Class 22 Woodlands*

<i>Class 22</i>		
<i>Small</i>	700	48.0%
<i>Firewood</i>	317	21.7%
<i>Poles</i>	233	16.0%
<i>Fibre</i>	100	6.9%
<i>Medicine</i>	25	1.7%
<i>Latex</i>	25	1.7%
<i>Fruits</i>	17	1.1%
<i>Racks</i>	17	1.1%
<i>Gum</i>	17	1.1%
<i>houseware</i>	8	0.6%
<i>SUM</i>	1,458	100%

**3.3.4 Diameter distribution and stocking of the woody resource**

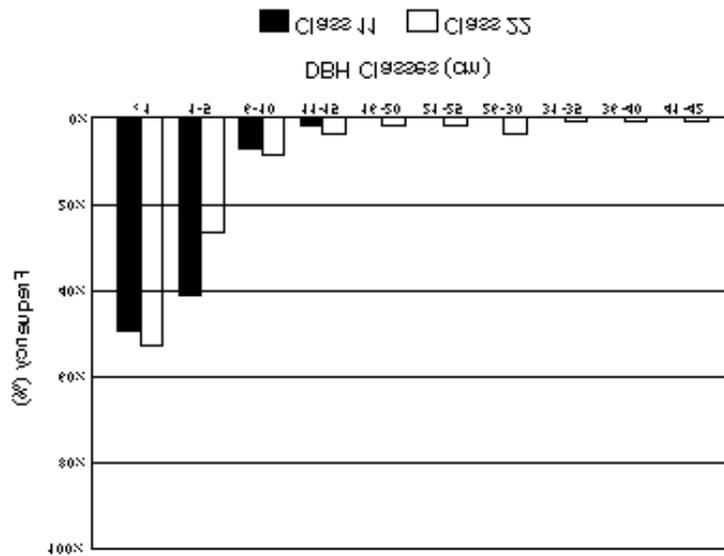


Figure 7. Diameter distribution of the Chulu catchment woodlands.

As with Kamundi the <1cm diameter class is dominated by the forest class rather than the scrub/regeneration woodland. The rest of the Figure 7 follows the expected trend of Class 11 dominating the 1-5cm diameter class and Class 22 dominating the remaining diameter classes.

Table 13. Stems per Hectare of the Two Woodland Classes

Woodland Class	Stems per hectare
11	3,958
22	1,167

Class 11 is too highly stocked and some management will be needed in the near future in order to avoid stagnation of the woodland. Thinning should be carried out in order to release some of the stems.

### 3.4 Chilindamaji catchment (Nkhata Bay)

Table 14. Woodland Class Descriptions

Class	
1	Scrub/regeneration woodland
2	Forest

#### 3.4.1. Precision of the results

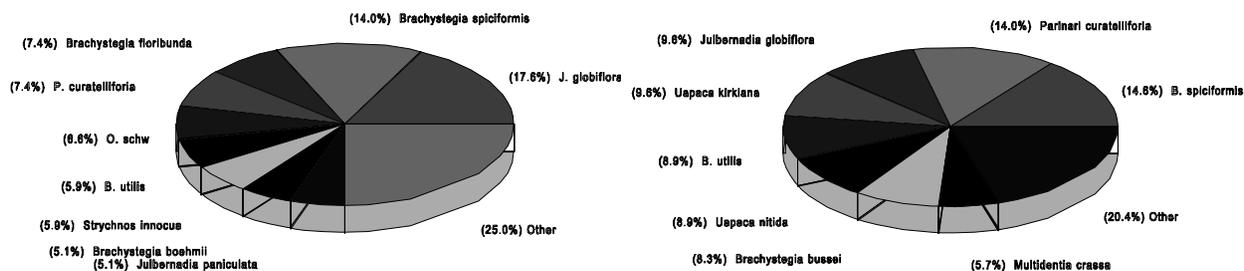
The precision of the plots are presented in Table 15.

Table 15. Precision of Plots in Chilindamaji Catchment by Woodland Class in Regard to DBH

	Class 1	Class 2
DBH	28.3%	42.8%

#### 3.4.2 Species composition

Both woodlands have some of the most preferred species represented at >5% of the total composition of each woodland (Figures 8 and 9). With the correct management, these and other preferred species can be encouraged in order to aid the local people.



Both of the woodlands in this catchment have a lower diversity of species than the other two catchments (Table 16).

Table 16. Species Diversity within Each Woodland Class of Each Catchment

--	--	--

<i>Catchment</i>	<i>Woodland class</i>	<i>Number of Species (not including unknowns)</i>
<i>Kamundi</i>	3	30
	4	38
	6	33
<i>Chulu</i>	11	38
	22	34
<i>Chilindamaji</i>	1	22
	2	23

### 3.4.3 End-uses of the woody resource

Table 17. End-Uses within Class 1 Woodlands

<i>Class 1</i>		
<i>small</i>	2,800	42%
<i>firewood</i>	1,400	21%
<i>pole</i>	1,033	16%
<i>fibre</i>	933	14%
<i>racks</i>	267	4%
<i>fruits</i>	233	4%
<i>SUM</i>	6,667	100%

Table 18. End-Uses within Class 2 Woodlands

<i>Class 2</i>		
<i>firewood</i>	2,333	27%
<i>small</i>	1,900	22%
<i>pole</i>	1,800	21%

<i>fruits</i>	1,167	14%
<i>fibre</i>	867	10%
<i>racks</i>	500	6%
<i>SUM</i>	8,567	100%

The top three end-uses are dominated by the expected 'small,' 'fuelwood,' and 'poles' categories. Class 2 has a lower proportion in the small category than Class 1. This is borne out by the diameter distribution (Section 3.4.4.), which illustrates the proportion of stems in the <1cm diameter class.

Fibre is higher in the scrub/regeneration class than expected due to the preference for small stems for this end-use.

Fruits are more abundant in Class 2, the forest class. Clearly, this is due to the maturer trees in

*that class being able to bear fruit.*

**3.4.4  
Diameter  
distribution  
and stocking  
of the woody  
resource**

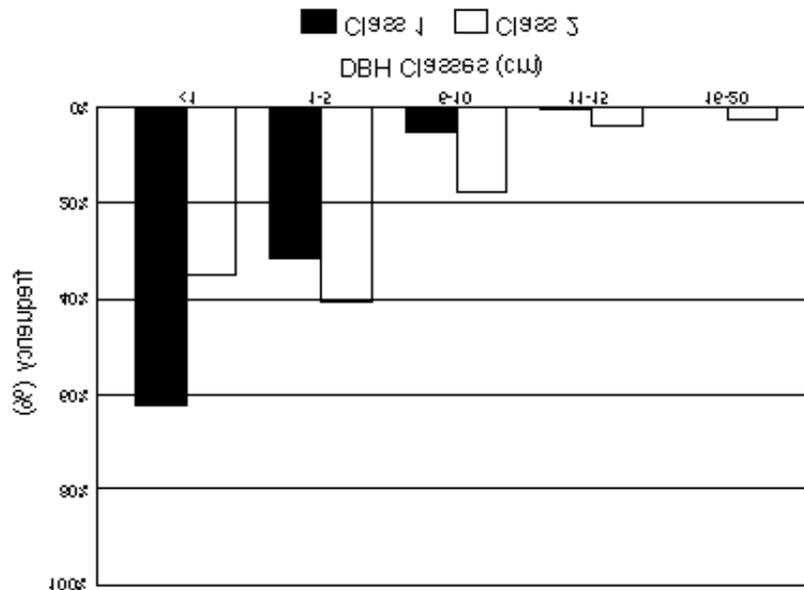


Figure 10. Diameter distribution of the Chilindamaji catchment woodlands.

Both woodlands follow the expected trends. Most of the scrub/regeneration woodland is in the <1cm diameter class, indicating a young woodland with leading stems climbing into the higher diameter classes. There are quite a few seedlings in the forest class. This class in general is still relatively young as none of the stems are greater than 20cm in diameter at breast height.

Table 19. Stems per Hectare of the Two Woodland Classes

Woodland Class	Stems per hectare
1	4,533
2	5,233

Both classes are badly overstocked and are in need of management soon in order to stop the woodlands stagnating and so as to derive the maximum benefit of the woody resource.

## 4.0 DISCUSSION

From the tables showing the stocking of the woodland areas within the catchments, most of the areas are overstocked and in serious need of management. Overstocking can be relieved by careful thinning of selected species and stems depending upon the objectives of the management. Preferred species can be encouraged to grow by thinning out competition from neighbouring trees. Grasses should be managed to avoid destructive late fires. Early burning is a recognised management technique and can be very effective. Grass competition can also be easily managed by grazing or collection of thatch grass for roofs or by a combination of both.

Many miombo species will coppice readily and by careful management miombo woodlands can regenerate quickly yielding relatively high volumes of small sized wood products. Table 20 shows the preferred species and their ability to coppice and root sucker.

Table 20. Coppicability of Preferred Species

Rank	Species	Coppicability / root suckers <sup>i</sup>
1	<i>Julbernardia paniculata</i>	vigorous coppice, poor pollarding
2	<i>Brachystegia boehmii</i>	vigorous coppice and root suckers
3	<i>Pseudolachnostylis maprouneifolia</i>	coppices straight and well
4	<i>Uapaca kirkiana</i>	coppices in young plants only, root suckers vigorously
5	<i>Julbernardia globiflora</i>	--
6	<i>Brachystegia spiciformis</i>	vigorous coppice, pollards when young
7	<i>Azanza garckeana</i>	--
8	<i>Mangifera indica</i>	--
9-	<i>Lanea discolor</i>	truncheons, root suckers, and coppices readily
9=	<i>Bauhinia thonningii</i>	--
11=	<i>Diplorhynchus condylocarpon</i>	coppices readily and root suckers
11=	<i>Brachystegia spp</i>	dependent upon species
13	<i>Eucalyptus spp</i>	dependent upon species
14=	<i>Brysocarpus orientalis</i>	--
14=	<i>Brachystegia floribunda</i>	vigorous coppice and pollard

<sup>i</sup> From Management of Miombo by Local Communities : Proceedings of a Workshop for Technical Forestry Staff (1995) edited by Lowore, J.D., Abbot, P.G. and Khofi, C.F. Forestry Research Institute of Malawi and Aberdeen University.

In order to make the woodlands more productive, it is essential that they be managed properly. Because the land is Common Land, a strong Headperson is needed in order to implement any management strategy.

An important part of management is training. The local populace needs to be educated in the pros

*and cons of management and/or non-management of forest areas. Modalities for the management of each area need to be worked out with the local populace in order to allow the people to air their views. This is important if management of woodlands is to be successful. Also they may be able to suggest the most effective ways of managing the areas themselves.*

*Miombo woodland is generally light-demanding and often responds well to canopy opening. Regeneration comes from coppicing, pollarding, root suckers, seedlings, and suffrutices. A variety of silvicultural systems may be used in order to improve the productivity of the woodlands. Three are presented below.*

*Complete/Simple coppice: All trees over a selected size (i.e., 5cm DBH) are coppiced. Species may be left if it is known that they coppice poorly.*

*The stand is completely opened up. Growth tends to be more vigorous with this system than the others due to the greater amount of light received. Grass competition is greater, however. If properly managed, this grass growth can be used for fodder or thatch as a forest non-wood product. Browsing may be a problem if a large animal population is allowed into the area.*

*Pollarding reduces this as trees are felled at breast height rather than just above ground level.*

*This is not suitable on steep slopes due to the erosion factor.*

*Coppice with Standards: Most trees (i.e., approx. two thirds) are coppiced/pollarded and the rest are left as standards. This gives a greater diversity of sizes and possibly end-uses. Standards can be selected based on a variety of criteria such as species, form, etc. Standards will supply seed for the area in order to aid regeneration.*

*Grass competition is lowered due to the lower level of light reaching the grass layer compared with a complete coppice. Coppice vigour is also slightly reduced.*

*Selective thinning: A selected percentage of the canopy is thinned. Some coppicing will normally result depending upon the species felled. Growth is less vigorous for both grass and coppice shoots. This system is more sustainable on steeper slopes, however.*

*More studies are needed in order to ascertain the best management plan for each area. The three presented above may not be suitable, and an intermediate regime may be best. Also a greater precision of data is needed before any plan is implemented.*

*Miombo woodlands can be productive if they are managed carefully. In many places where the miombo woodland has been cleared and eucalypts planted, the miombo has regenerated and outgrown the planted trees. The range of products available from these woodlands is also very diverse. Both wood and non-wood products can be harvested.*

*The Forestry Research Institute of Malawi (FRIM) is currently carrying out long term studies on the above three management regimes. Three years of data have already been collected, and another three year project is due to carry on the assessments. This will give more accurate indications of the productivity of these systems. Also an inventory of Chimaliro Forest Reserve is planned to give estimates of productivity. A co-management plan is to be drafted with Group Village Boni in Chimaliro in order to promote the sustainable use of the Forest Reserve. Group Village Boni has been used for PRAs for the last three years and village based enumerators are employed to assess the amount of each forest product utilised. This gives valuable information on the needs of the local people and highlights the importance of managing the dwindling resources in the Forest Reserve.*

*FRIM is also conducting studies on Mangweru Hill near Lunzu in the Southern Region in order to create a working Village Forest Committee and to devise a management plan for the Village Forest Area.*

*The MEMP PSPs should be re-assessed on a regular basis in order to monitor the productivity/degradation of the woodlands. The number of PSPs need to be increased and they need to be re-assessed at regular intervals in order to gain growth rates of the woodlands and to assess the impact of burley tobacco farming on these woodlands.*

*The MEMP work has made use of satellite data for mapping the four catchment areas. This mapping technique is extremely useful and should be encouraged where possible. Each of the strata used for this report was mapped separately from the digitized satellite data. The satellite data can be used successively over a number of years to show land use changes over time. Once the ground truthing exercises are completed, effective and economical mapping of Malawi will be feasible.*

## APPENDIX 1

### Species Composition and End-Use Tables for Each Woodland in Each Catchment

*Table 21. Species Composition of Class 3 Woodland in the Kamundi Catchment*

SPECIES COMPOSITION (CLASS 3)										
SPECIES	No/ha	End-Use No./ha								
		small	pole	fibre	F.wood	fruits	racks	medicine	rafter	broom
<i>Zanha africana</i>	817	117	167	0	333	0	150	17	0	0
<i>Securidaca longepedunculata</i>	450	150	67	0	133	0	133	0	17	33
<i>Multidentia crassa</i>	300	250	17	0	33	0	0	17	0	0
<i>Catunaregam spinosa</i>	233	117	0	0	83	0	0	50	0	0
<i>Dalbergiella nyasea</i>	217	50	50	0	67	0	17	0	33	0
<i>Vitex payos</i>	200	33	0	0	133	117	0	0	0	0
<i>Julbernadia globiflora</i>	150	17	17	33	83	0	0	0	0	0
<i>Annona senegalensis</i>	133	33	67	0	100	0	17	0	0	0
<i>Flacourtia indica</i>	133	50	0	0	50	0	0	0	0	0
<i>Strychnos spinosa</i>	133	33	33	0	50	33	0	0	0	0
<i>Brachystegia bussei</i>	117	100	0	0	17	0	0	0	0	0
<i>Dalbergia nitidula</i>	100	67	17	0	33	0	0	0	0	0
<i>Psorospermum febrifugum</i>	83	17	33	0	50	0	0	0	0	0
<i>Brachystegia utilis</i>	67	17	33	0	17	0	0	0	0	0
<i>Strychnos cocculoides</i>	67	33	17	0	17	0	0	0	0	0
<i>Brachystegia floribunda</i>	50	17	0	0	17	0	0	0	0	0
<i>Lanea discolor</i>	50	17	0	0	0	0	0	17	0	0
<i>Acacia galpinii</i>	33	33	0	0	0	0	0	0	0	0
<i>Bridelia cathartica</i>	33	0	17	0	33	0	0	0	0	0
<i>Dichrostachys cinerea</i>	33	0	0	0	33	0	0	0	0	0
<i>Pterocarpus rotundifolius</i>	33	0	0	0	33	0	0	0	0	0
<i>Terminalia sericea</i>	33	0	17	0	17	0	0	0	17	0
<i>Acacia nigrensis</i>	17	0	0	0	17	0	0	17	0	0
<i>Brachystegia longifolia</i>	17	17	0	0	0	0	0	0	0	0
<i>Cussonia arborea</i>	17	0	0	0	17	0	0	0	0	0
<i>Diplorhynchus condylocarpon</i>	17	0	0	0	17	0	0	0	0	0
<i>Ochna schweinfurthiana</i>	17	0	0	0	17	0	0	0	0	0
<i>Pseudolachnostylis maprouneifolia</i>	17	0	0	0	17	0	0	0	0	0
<i>Pterocarpus angolensis</i>	17	0	0	0	17	0	17	0	0	0
<i>Strychnos innocua</i>	17	0	0	0	17	0	0	0	0	0
SUM	3,600	1,167	550	33	1,450	150	333	117	67	33

*Table 22. Species Composition of Class 4 Woodland in the Kamundi Catchment*

SPECIES COMPOSITION (CLASS 4)										
SPECIES	No/ha	End-Use No./ha								
		small	pole	fibre	firewood	fruits	racks	medicine	rafter	other

<i>Julbernadia globiflora</i>	943	600	57	114	200	0	129	0	0	0
<i>Brachystegia bussei</i>	486	171	143	186	229	0	0	0	14	0
<i>Dalbergiella nyasea</i>	414	300	43	0	71	0	0	0	0	0
<i>Diplorhynchus condylocarpon</i>	243	71	71	0	129	0	0	0	43	0
<i>Bridelia cathartica</i>	157	86	43	0	71	0	0	0	0	0
<i>Dichrostachys cinerea</i>	129	71	0	0	57	0	0	0	0	0
<i>Lamea discolor</i>	114	29	0	0	0	0	0	86	0	0
<i>Brachystegia boehmii</i>	100	57	0	0	43	0	0	0	0	0
<i>Pericopsis angolensis</i>	100	43	14	0	43	0	14	0	0	14
<i>Brachystegia utilis</i>	71	43	29	0	0	0	0	0	0	0
<i>Terminalia sericea</i>	71	0	29	0	71	0	43	0	0	0
Unknown	71	29	0	0	29	0	0	0	0	0
<i>Diospyros kirkii</i>	57	14	0	0	43	0	0	0	0	0
<i>Uapaca nitida</i>	57	29	14	0	29	0	0	0	0	0
<i>Vangueria infausta</i>	57	29	14	0	14	14	14	0	0	0
<i>Annona senegalensis</i>	43	29	14	0	14	0	0	0	0	0
<i>Brachystegia spiciformis</i>	43	29	0	14	0	0	0	0	0	0
<i>Cussonia arborea</i>	43	14	0	0	29	0	0	0	0	0
<i>Dalbergia nitidula</i>	43	29	14	0	14	0	0	0	0	0
<i>Multidentia crassa</i>	43	14	14	0	14	14	0	0	0	0
<i>Pseudolachnostylis maprouneifolia</i>	43	14	0	0	29	0	0	0	0	0
<i>Pterocarpus angolensis</i>	43	0	14	0	29	0	0	0	0	0
<i>Terminalia stenostachya</i>	43	29	14	0	14	0	0	0	0	0
<i>Brachystegia floribunda</i>	29	0	0	14	29	0	0	0	0	0
<i>Ochna schweinfurthiana</i>	29	0	0	0	29	0	0	0	0	0
<i>Turraea nilotica</i>	29	29	0	0	0	0	0	0	0	0
<i>Acacia goetzei</i>	14	14	0	0	0	0	0	0	0	0
<i>Bauhinia thonningii</i>	14	0	0	0	0	0	0	0	0	0
<i>Brachystegia longifolia</i>	14	14	0	0	0	0	0	0	0	0
<i>Combretum molle</i>	14	0	14	0	14	0	0	0	0	0
<i>Dalbergia melanoxylon</i>	14	14	0	0	0	0	0	0	0	0
<i>Faurea saligna</i>	14	0	0	0	14	0	0	0	0	0
<i>Julbernadia paniculata</i>	14	14	0	0	0	0	0	0	0	0
<i>Lonchocarpus capassa</i>	14	0	0	0	0	0	0	0	0	0
<i>Monotes africanus</i>	14	0	14	0	14	0	0	0	0	0
<i>Psorospermum febrifugum</i>	14	14	0	0	0	0	0	14	0	0
<i>Stereospermum kunthianum</i>	14	0	0	0	0	0	0	14	0	0
<i>Zanha africana</i>	14	0	0	0	14	0	0	0	0	0
SUM	3,671	1,829	557	329	1,286	29	200	100	57	14

Table 23. Species Composition of Class 6 Woodland in the Kamundi Catchment

SPECIES COMPOSITION (CLASS 6)									
SPECIES	No/ha	End-Use No./ha							
		small	pole	fibre	firewood	fruits	racks	medicine	rafter
<i>Brachystegia boehmii</i>	325	225	25	42	92	0	0	0	0
<i>Dalbergiella nyasea</i>	175	100	17	0	50	0	17	8	0
<i>Ochna schweinfurthiana</i>	150	42	58	0	108	0	0	0	0
<i>Strychnos spinosa</i>	125	117	0	0	8	0	0	0	0
<i>Brachystegia floribunda</i>	108	58	0	0	42	0	33	0	8
<i>Monotes africanus</i>	108	83	0	0	17	0	25	0	0

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<i>Dalbergia nitidula</i>	92	33	8	0	25	0	8	42	8
<i>Pseudolachnostylis maprouneifolia</i>	83	25	25	0	42	0	0	0	0
<i>Brachystegia bussei</i>	75	8	0	0	67	0	0	0	0
<i>Diplorhynchus condylocarpon</i>	75	33	0	8	42	0	0	0	0
<i>Elephantorrhiza goetzei</i>	50	0	0	0	42	0	0	0	0
<i>Parinari curatellifolia</i>	50	17	0	0	8	33	0	0	0
<i>Catunaregam spinosa</i>	33	8	0	0	17	0	0	8	0
<i>Cussonia arborea</i>	33	33	0	0	0	0	0	0	0
<i>Pterocarpus angolensis</i>	33	25	0	0	8	0	0	0	0
<i>Ximenia caffra</i>	33	33	0	0	0	0	0	0	0
<i>Bridelia cathartica</i>	25	17	0	8	8	0	0	0	0
<i>Julbernardia globiflora</i>	25	25	0	0	0	0	0	0	0
<i>Pericopsis angolensis</i>	25	8	0	0	8	0	8	0	0
<i>Burkea africana</i>	17	8	0	0	8	0	8	0	0
<i>Combretum molle</i>	17	17	0	0	0	0	0	0	0
<i>Dichrostachys cinerea</i>	17	8	0	0	8	0	0	0	0
<i>Diospyros kirkii</i>	17	0	8	0	0	0	0	8	0
<i>Flacourtia indica</i>	17	8	0	0	8	0	0	0	0
<i>Lanea discolor</i>	17	8	8	0	8	0	0	0	0
<i>Turraea nilotica</i>	17	17	0	0	0	0	0	0	0
<i>Acacia goetzei</i>	8	8	0	0	0	0	0	0	0
<i>Annona senegalensis</i>	8	8	0	0	0	0	0	0	0
<i>Erythria abyssinica</i>	8	0	0	0	0	0	0	8	0
<i>Pavetta schumanniana</i>	8	8	0	0	0	0	0	0	0
<i>Psorospermum febrifugum</i>	8	0	0	0	8	0	0	0	0
<i>Senna singueana</i>	8	8	0	0	0	0	0	0	0
<i>Uapaca nitida</i>	8	8	0	0	0	0	0	0	0
<i>Unknown</i>	8	0	0	0	0	0	0	0	0
<b>SUM</b>	<b>1,808</b>	<b>1,000</b>	<b>150</b>	<b>58</b>	<b>625</b>	<b>33</b>	<b>100</b>	<b>75</b>	<b>17</b>

Table 24. Species Composition of Class 11 Woodland in the Chulu Catchment

SPECIES COMPOSITION								
Species	Number	No./ha						
		Small	F. wood	Fibre	Poles	Medicine	Gum	Charcoal
<i>Brachystegia floribunda</i>	808	283	250	67	183	42	33	33
<i>Julbernadia paniculata</i>	450	100	158	125	183	117	25	67
<i>Brachystegia boehmii</i>	358	192	92	8	42	50	8	67
<i>Brachystegia utilis</i>	333	50	175	133	133	33	33	0
<i>Brachystegia stipulata</i>	325	83	75	33	133	67	33	33
<i>Faurea speciosa</i>	267	0	200	67	233	33	0	0
<i>Diplorhynchus condylocarpon</i>	233	33	58	42	75	67	0	0
<i>Ochna schweinfurthiana</i>	158	50	42	33	17	33	0	25
<i>Pericopsis angolensis</i>	133	50	50	0	25	42	0	17
<i>Julbernadia globiflora</i>	100	0	33	0	100	67	0	0
<i>Bridelia cathartica</i>	92	42	42	33	42	8	0	0
<i>Flacourtia indica</i>	75	33	33	0	33	8	0	0
<i>Brachystegia spiciformis</i>	75	42	0	33	0	0	0	0
<i>Burkea africana</i>	67	17	8	0	8	42	0	0
<i>Turraea nilotica</i>	42	0	17	0	8	17	0	17
<i>Lannea discolor</i>	33	17	8	8	8	0	0	0
<i>Ximenia caffra</i>	33	0	33	0	33	0	0	0
<i>Dichrostachys cinerea</i>	33	0	17	0	17	17	0	0
<i>Bauhinia thonningii</i>	33	8	8	0	0	0	0	0
<i>Psorospermum febrifugum</i>	33	8	8	8	8	8	0	0
<i>Protea angolensis</i>	25	0	25	0	25	0	0	0
<i>Ochna leotocrada</i>	25	8	8	0	0	0	0	0
<i>Dalbergiella nysea</i>	25	17	0	8	0	0	0	0
<i>Olax obtusifolia</i>	25	8	17	0	0	0	0	17
<i>Acacia amythe</i>	17	0	8	0	8	0	0	0
<i>Senna singueana</i>	17	0	0	0	0	0	0	0
<i>Multidentia crassa</i>	17	8	8	0	0	0	0	0
<i>Combretum molle</i>	17	0	8	0	8	8	0	0
<i>Strychnos innocua</i>	17	17	0	0	0	0	0	0
<i>Rothmannia englerana</i>	17	17	0	0	0	0	0	0
<i>Brachystegia longifolia</i>	8	0	8	0	8	0	0	0
<i>G.</i>	8	0	8	8	8	0	0	0
<i>Monotes africanus</i>	8	0	0	0	0	0	0	0
<i>V. africana</i>	8	0	8	0	0	0	0	8
<i>Strychnos spinosa</i>	8	8	0	0	0	0	0	0
<i>Catunaregam spinosa</i>	8	0	8	8	8	0	0	0
<i>Pseudolachnostylis maprouneifolia</i>	8	0	0	0	0	8	0	0
<i>Dalbergia nitidula</i>	8	8	0	0	0	0	0	0
<i>Parinari curatellifolia</i>	8	8	0	0	0	0	0	0
SUM	3,958	1,108	1,417	617	1,350	667	133	283

Table 24 (cont'd). Species Composition of Class 11 Woodland in the Chulu Catchment

SPECIES COMPOSITION							
SPECIES	No./ha						
	Kacks	Fruits	Carving	Fishing	Fence	Housewa re	Caterpiitars
<i>Brachystegia floribunda</i>	42	67	8	17	0	8	0

<i>Julbernardia paniculata</i>	25	0	0	0	0	0	0	0	0	0	75
<i>Brachystegia boehmii</i>	8	0	0	0	0	0	0	8	0	0	0
<i>Brachystegia utilis</i>	8	8	0	0	0	0	0	0	0	0	0
<i>Brachystegia stipulata</i>	0	0	0	0	0	0	0	0	0	0	33
<i>Faurea speciosa</i>	67	0	0	0	0	0	0	0	0	0	0
<i>Diploporhynchus condylocarpon</i>	42	8	0	0	0	0	0	0	0	0	0
<i>Ochna schweinfurthiana</i>	17	8	0	0	0	0	0	0	0	0	0
<i>Pericopsis angolensis</i>	17	0	0	0	0	0	0	0	0	0	0
<i>Julbernardia globiflora</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Bridelia cathartica</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Flacourtia indica</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Brachystegia spiciformis</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Burkea africana</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Turraea nilotica</i>	0	8	0	0	0	0	0	0	0	0	8
<i>Lannea discolor</i>	8	0	0	0	0	0	0	0	0	0	0
<i>Ximena caffra</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Dichrostachys cinerea</i>	17	17	0	0	0	0	0	0	0	0	0
<i>Bauhinia thonningii</i>	8	0	0	0	0	8	0	0	0	0	0
<i>Psorospermum febrifugum</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Protea angolensis</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Ochna leotocrada</i>	17	0	0	0	0	0	0	0	0	0	0
<i>Dalbergiella nyasea</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Olax obtusifolia</i>	17	0	0	0	0	0	0	0	0	0	0
<i>Acacia amythe</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Senna singueana</i>	17	0	0	0	0	0	0	0	0	0	0
<i>Multidentia crassa</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Combretum molle</i>	0	8	0	0	0	0	0	0	0	0	0
<i>Strychnos innocua</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Rothmannia englerana</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Brachystegia longifolia</i>	0	0	0	0	0	0	0	0	0	0	0
<i>G.</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Monoetes africanus</i>	8	0	0	0	0	0	0	0	0	0	0
<i>V. africana</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Strychnos spinosa</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Catunaregam spinosa</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Pseudolachnostylis maprouneifolia</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Dalbergia nitidula</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Parinari curatellifolia</i>	0	0	0	0	0	0	0	0	0	0	0
<b>SUM</b>	<b>317</b>	<b>125</b>	<b>8</b>	<b>17</b>	<b>8</b>	<b>17</b>	<b>8</b>	<b>17</b>	<b>8</b>	<b>117</b>	

Table 25. Species Composition of Class 22 Woodland in the Chulu Catchment

SPECIES COMPOSITION											
Species	No.	No./ha									
		Sma ll	F. wood	Fibr e	Pole s	Medici ne	Gum	Rac ks	Late x	Fruit s	Hous e ware
<i>Brachystegia boehmii</i>	167	117	42	33	8	0	0	8	0	0	0
<i>Brachystegia stipulata</i>	158	125	25	0	8	0	0	0	0	0	0
<i>Julbernardia paniculata</i>	100	25	50	0	58	8	8	0	8	8	8
<i>Protea angolensis</i>	75	42	17	8	17	0	0	0	0	0	0
<i>Ochna schweinfurthiana</i>	58	25	33	8	25	0	0	8	0	0	0

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<i>Dichrostachys cinerea</i>	50	33	17	0	17	0	0	0	0	0	0
<i>Pseudolachnospstylis maprouneifolia</i>	50	17	25	8	17	0	0	0	0	0	0
<i>Bridelia cathartica</i>	50	33	8	8	8	0	0	0	0	0	0
<i>Diplorhynchus condylocarpon</i>	50	50	0	0	0	0	0	0	0	0	0
<i>Ximenia caffra</i>	42	25	17	0	0	0	0	0	0	0	0
<i>Monotes africanus</i>	33	17	8	0	17	8	8	0	0	0	0
<i>Brachystegia floribunda</i>	33	25	0	0	8	0	0	0	0	0	0
<i>Acacia amythe</i>	33	25	8	8	8	0	0	0	0	0	0
<i>Combretum molle</i>	25	8	17	0	0	0	0	0	0	0	0
<i>Multidentia crassa</i>	25	25	0	0	0	0	0	0	0	0	0
<i>Zanha africana</i>	17	8	0	0	0	0	0	0	8	0	0
<i>Burkea africana</i>	17	8	0	8	0	0	0	0	0	0	0
<i>Pleurostylis africana</i>	17	0	8	8	8	0	0	0	8	0	0
<i>Flacourtia indica</i>	17	17	0	0	0	0	0	0	0	0	0
<i>Faurea speciosa</i>	17	8	8	0	0	0	0	0	0	0	0
<i>Rothmannia englerana</i>	17	0	0	8	17	0	0	0	0	0	0
<i>Turraea nilotica</i>	17	8	0	0	0	8	0	0	0	0	0
<i>Combretum zeyheri</i>	8	8	0	0	0	0	0	0	0	0	0
<i>Swartzia madagascariensis</i>	8	8	0	0	0	0	0	0	0	0	0
<i>Zizyphus mucronata</i>	8	0	8	0	0	0	0	0	0	0	0
<i>Brachystegia spiciformis</i>	8	0	8	0	8	0	0	0	0	0	0
<i>Terminalia stenostachya</i>	8	0	8	0	0	0	0	0	0	0	0
<i>Lannea discolor</i>	8	8	0	0	0	0	0	0	0	0	0
<i>Senna singueana</i>	8	0	0	0	0	0	0	0	0	8	0
<i>Pericopsis angolensis</i>	8	0	8	0	8	0	0	0	0	0	0
<i>Diospyros kirkii</i>	8	8	0	0	0	0	0	0	0	0	0
<i>Uapaca nitida</i>	8	8	0	0	0	0	0	0	0	0	0
<i>Brachystegia utilis</i>	8	8	0	0	0	0	0	0	0	0	0
<i>Dalbergia nitidula</i>	8	8	0	0	0	0	0	0	0	0	0
<b>SUM</b>	<b>1,167</b>	<b>700</b>	<b>317</b>	<b>100</b>	<b>233</b>	<b>25</b>	<b>17</b>	<b>17</b>	<b>25</b>	<b>17</b>	<b>8</b>

Table 26. Species Composition of Class 1 Woodland in the Chilindamaji Catchment

SPECIES COMPOSITION									
Species	Number	No./ha							
		small	pole	fibre	F.wood	fruits	racks	medicine	rafter
<i>Julbernadia globiflora</i>	800	467	267	267	300	0	67	0	0
<i>Brachystegia spiciformis</i>	633	300	267	333	333	0	67	0	0
<i>Brachystegia floribunda</i>	333	267	33	33	33	0	0	0	0
<i>Parinari curatellifolia</i>	333	133	200	0	200	167	0	0	0
<i>Ochna schweinfurthiana</i>	300	300	0	0	0	0	0	0	0
<i>Brachystegia utilis</i>	267	167	33	33	67	0	33	0	0
<i>Strychnos innocua</i>	267	167	0	0	67	0	67	0	0
<i>Brachystegia boehmii</i>	233	33	33	167	133	0	0	0	0
<i>Julbernadia paniculata</i>	233	200	33	33	33	0	0	0	0
<i>Diplorhynchus condylocarpon</i>	200	167	33	0	33	0	0	0	0
<i>Multidentia crassa</i>	167	133	0	0	0	0	33	0	0
<i>Brachystegia longifolia</i>	133	33	67	33	33	0	0	0	0
<i>Vitex payos</i>	133	67	0	0	67	33	0	0	0
<i>Combretum molle</i>	100	100	0	0	0	0	0	0	0
<i>Dalbergia nitidula</i>	100	67	33	0	33	0	0	0	0
<i>Bridelia micrantha</i>	67	67	0	0	0	0	0	0	0
<i>Pericopsis angolensis</i>	67	33	0	33	33	0	0	0	0
<i>Dalbergiella nyasea</i>	33	33	0	0	0	0	0	0	0
<i>Rothmannia englerana</i>	33	33	0	0	0	0	0	0	0
<i>Stereospermum kunthianum</i>	33	0	33	0	0	0	0	0	0
<i>Syzygium guineense</i>	33	0	0	0	33	33	0	0	0
<i>Uapaca nitida</i>	33	33	0	0	0	0	0	0	0
SUM	4,533	2,800	1,033	933	1,400	233	267	0	0

Table 27. Species Composition of Class 2 Woodland in the Chilindamaji Catchment

SPECIES COMPOSITION									
Species	Number	No./ha							
		small	pole	fibre	F.wood	fruits	racks	medicine	rafter
<i>Brachystegia spiciformis</i>	767	367	333	367	333	0	33	0	0
<i>Parinari curatellifolia</i>	733	33	200	0	500	600	67	0	0
<i>Julbernardia globiflora</i>	500	300	100	133	67	0	67	0	0
<i>Uapaca kirkiana</i>	500	100	333	0	367	333	0	0	0
<i>Brachystegia utilis</i>	467	100	233	267	267	0	67	0	0
<i>Uapaca nitida</i>	467	300	100	0	33	0	33	0	0
<i>Brachystegia bussei</i>	433	267	67	33	33	0	67	0	0
<i>Multidentia crassa</i>	300	133	33	0	100	167	0	0	0
<i>Olax obtusifolia</i>	133	0	100	0	133	0	33	0	0
<i>Pericopsis angolensis</i>	133	33	33	0	33	0	33	0	0
<i>Rothmannia englerana</i>	133	100	0	0	33	0	0	0	0
<i>Vitex payos</i>	133	0	67	0	100	0	0	0	0
Unknown	100	33	0	0	33	0	0	0	0
<i>Brachystegia boehmii</i>	67	0	33	33	33	0	0	0	0
<i>Bridelia micrantha</i>	67	0	33	0	67	33	33	0	0
<i>Combretum molle</i>	67	33	0	0	0	0	33	0	0
<i>Dalbergia nitidula</i>	67	33	0	0	33	0	33	0	0
<i>Diospyros zombensis</i>	67	33	33	33	33	0	0	0	0
<i>Allophylus africanus</i>	33	0	33	0	0	0	0	0	0
<i>Bauhinia thonningii</i>	33	0	33	0	33	0	0	0	0
<i>Brachystegia longifolia</i>	33	33	0	0	0	0	0	0	0
<i>Bridelia cathartica</i>	33	0	0	0	33	0	0	0	0
<i>Erythria abyssinica</i>	33	0	0	0	33	0	0	0	0
<i>Ficus natalensis</i>	33	0	33	0	33	33	0	0	0
<b>SUM</b>	<b>5,233</b>	<b>1,900</b>	<b>1,800</b>	<b>867</b>	<b>2,333</b>	<b>1,167</b>	<b>500</b>	<b>0</b>	<b>0</b>