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

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formula:

where n = number of plots
p = the precision
CV = Coefficient of Variation of the chosen parameter
(CV = (s/0) where s = sample standard deviation and 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

Rank	***End-use***
1	*Fuelwood*
2	*Poles*
3	*Rope fibre*
4	*Fruit*

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

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

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

3.2 Kamundi catchment (Mangochi)

Table 3. Description of the Woodland Classes

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

3.2.1 Precision of the results

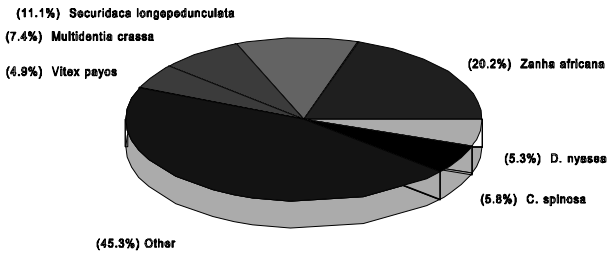
The results presented below for the Kamundi catchment must be viewed with some idea of the precision of the data in mind. Within each of the three Woodland Classes, there was time to lay only three sample plots. The precision of these plots are presented in Table 4.

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).



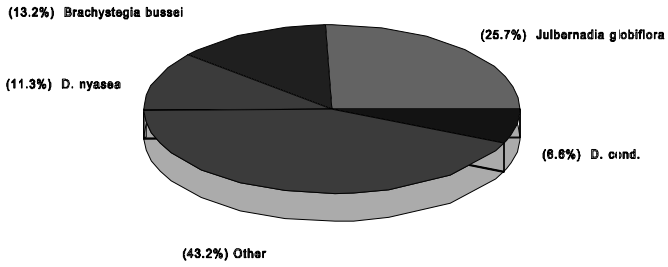
The three groups open, regeneration, and scrub, were originally separated by the satellite imagery. These were all put into one Class after ground truthing the area. This Class is known as Class 3. Class 4 is the low canopy cover woodland and Class 6 is the denser canopy cover woodland.

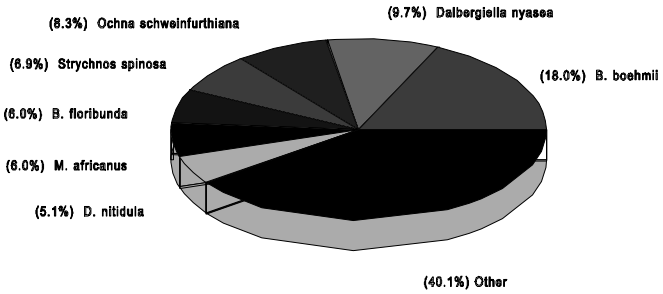
Class 3 woodland consists of areas that have either been badly degraded/deforested or is agricultural land left fallow. The dominant species can be seen in Figure 1.

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 1st) and Diplorhynchus condylocarpon (Ranked 11th=) in Class 4, and Brachystegia boehmii (Ranked 2nd) and Brachystegia floribunda (Ranked 14th=) 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%*

	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.

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

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.

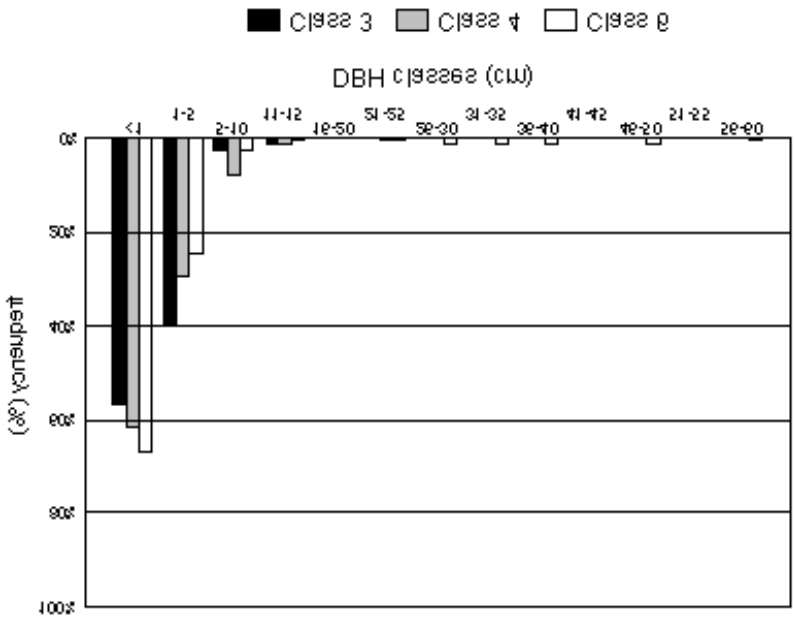


Figure 4. Diameter distribution of Kamundi catchment woodlands.

Table 8. Stems per Hectare of the Three Woodland Classes

Woodland Class	*Stems per hectare*
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 $^{2}/_{3}$ of the current stocking followed by another thinning within the next 5 years down to $^{1}/_{3}$ - $^{1}/_{2}$ 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

Class	
11	*Scrub/regeneration woodland*
22	*Forest*

3.3.1. Precision of the results

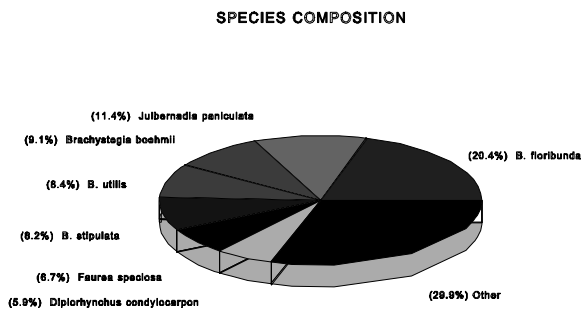
The precision of the plots are presented below :

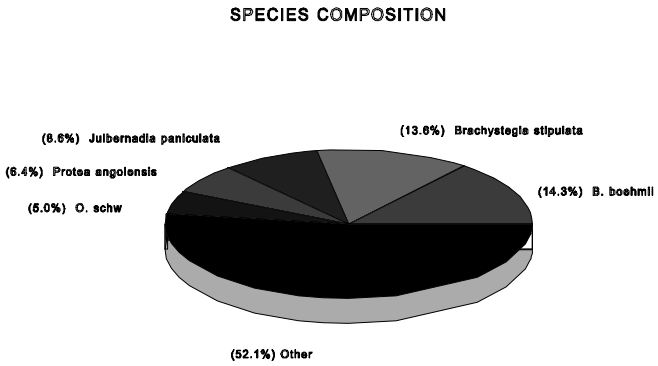
Table 10. Precision of Plots in Chulu Catchment by Woodland Class with Regard to DBH

	Class 11	*Class 22*
DBH	*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%*

Carvings	*8*	*0.1%*
Fence	*8*	*0.1%*
SUM	*6,258*	*100%*

Table 12. End-Uses within the Class 22 Woodlands

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

3.3.4 Diameter distribution and stocking of the woody resource

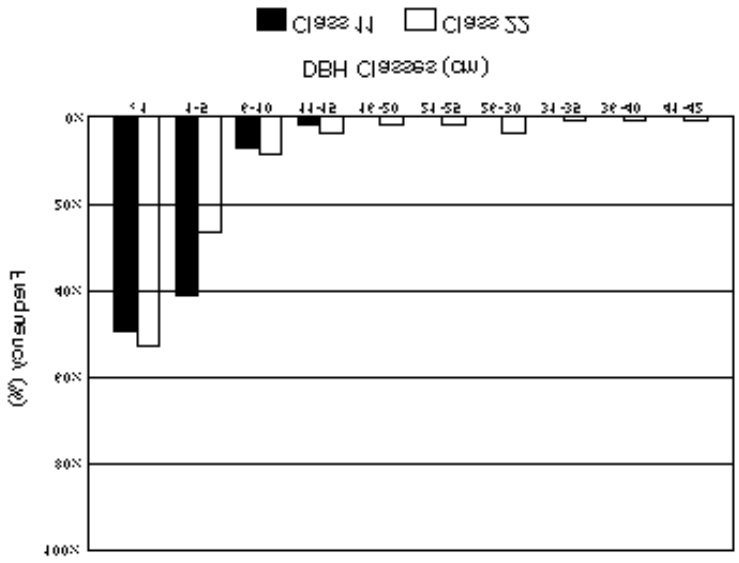


Figure 7. Diameter distribution of the Chulu catchment woodlands.

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

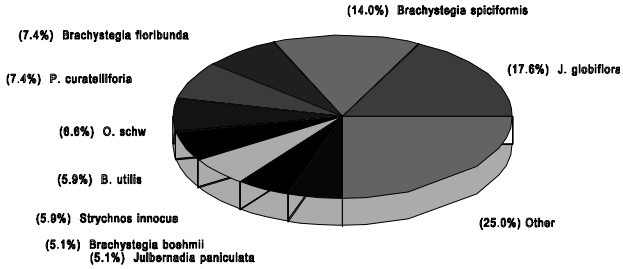
The precision of the plots are presented in Table 15.

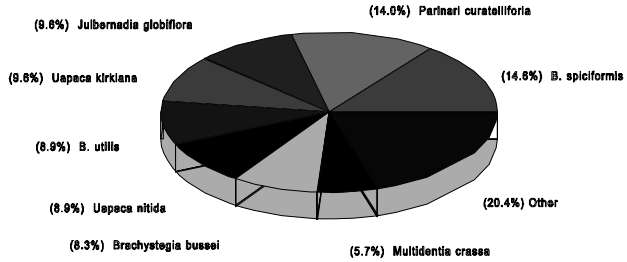
Table 15. Precision of Plots in Chilindamaji Catchment by Woodland Class in Regard to DBH

	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

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

3.4.3 End-uses of the woody resource

Table 17. End-Uses within Class 1 Woodlands

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

Table 18. End-Uses within Class 2 Woodlands

Class 2		
firewood	*2,333*	*27%*
small	*1,900*	*22%*
pole	*1,800*	*21%*
fruits	*1,167*	*14%*
fibre	*867*	*10%*
racks	*500*	*6%*
SUM	*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 Class1. 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

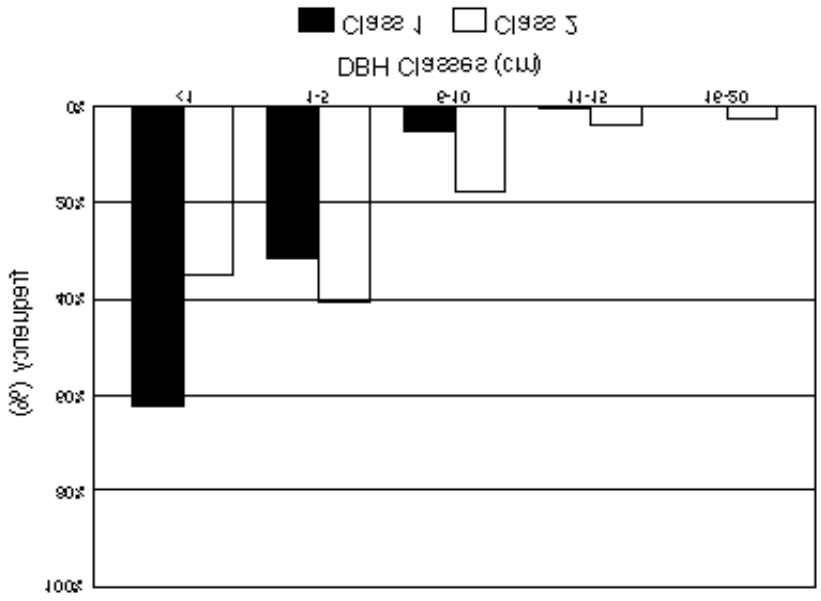


Figure 10. Diameter distribution of the Chilindamaji catchment woodlands.

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

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

Julbernadia globiflora	943	600	57	114	200	0	129	0	0	0
Brachystegia bussei	486	171	143	186	229	0	0	0	14	0
Dalbergiella nyasea	414	300	43	0	71	0	0	0	0	0
Diplorhynchus condylocarpon	243	71	71	0	129	0	0	0	43	0
Bridelia cathartica	157	86	43	0	71	0	0	0	0	0
Dichrostachys cinerea	129	71	0	0	57	0	0	0	0	0
Lannea discolor	114	29	0	0	0	0	0	86	0	0
Brachystegia boehmii	100	57	0	0	43	0	0	0	0	0
Pericopsis angolensis	100	43	14	0	43	0	14	0	0	14
Brachystegia utilis	71	43	29	0	0	0	0	0	0	0
Terminalia sericea	71	0	29	0	71	0	43	0	0	0
Unknown	71	29	0	0	29	0	0	0	0	0
Diospyros kirkii	57	14	0	0	43	0	0	0	0	0
Uapaca nitida	57	29	14	0	29	0	0	0	0	0
Vangueria infausta	57	29	14	0	14	14	14	0	0	0
Annona senegalensis	43	29	14	0	14	0	0	0	0	0
Brachystegia spiciformis	43	29	0	14	0	0	0	0	0	0
Cussonia arborea	43	14	0	0	29	0	0	0	0	0
Dalbergia nitidula	43	29	14	0	14	0	0	0	0	0
Multidentia crassa	43	14	14	0	14	14	0	0	0	0
Pseudolachnostylis maprouneifolia	43	14	0	0	29	0	0	0	0	0
Pterocarpus angolensis	43	0	14	0	29	0	0	0	0	0
Terminalia stenostachya	43	29	14	0	14	0	0	0	0	0
Brachystegia floribunda	29	0	0	14	29	0	0	0	0	0
Ochna schweinfurthiana	29	0	0	0	29	0	0	0	0	0
Turraea nilotica	29	29	0	0	0	0	0	0	0	0
Acacia goetzei	14	14	0	0	0	0	0	0	0	0
Bauhinia thonningii	14	0	0	0	0	0	0	0	0	0
Brachystegia longifolia	14	14	0	0	0	0	0	0	0	0
Combretum molle	14	0	14	0	14	0	0	0	0	0
Dalbergia melanoxylon	14	14	0	0	0	0	0	0	0	0
Faurea saligna	14	0	0	0	14	0	0	0	0	0
Julbernadia paniculata	14	14	0	0	0	0	0	0	0	0
Lonchocarpus capassa	14	0	0	0	0	0	0	0	0	0
Monotes africanus	14	0	14	0	14	0	0	0	0	0
Psorospermum febrifugum	14	14	0	0	0	0	0	0	0	0
Stereospermum kunthianum	14	0	0	0	0	0	0	14	0	0
Zanha africana	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)									
		End-Use No./ha							
SPECIES	*No/ha*	*small*	*pole*	*fibre*	*firewood*	*fruits*	*racks*	*medicine*	*rafter*
Brachystegia boehmii	325	225	25	42	92	0	0	0	0
Dalbergiella nyasea	175	100	17	0	50	0	17	8	0
Ochna schweinfurthiana	150	42	58	0	108	0	0	0	0
Strychnos spinosa	125	117	0	0	8	0	0	0	0
Brachystegia floribunda	108	58	0	0	42	0	33	0	8
Monotes africanus	108	83	0	0	17	0	25	0	0

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

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

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

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

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

SPECIES COMPOSITION											
		No./ha									
Species	No.	Small	F. wood	Fibre	Poles	Medicine	Gum	Racks	Latex	Fruits	House-ware
Brachystegia boehmii	167	117	42	33	8	0	0	8	0	0	0
Brachystegia stipulata	158	125	25	0	8	0	0	0	0	0	0
Julbernadia paniculata	100	25	50	0	58	8	8	0	8	8	8
Protea angolensis	75	42	17	8	17	0	0	0	0	0	0
Ochna schweinfurthiana	58	25	33	8	25	0	0	8	0	0	0

Dichrostachys cinerea	50	33	17	0	17	0	0	0	0	0	0
Pseudolachnostylis maprouneifolia	50	17	25	8	17	0	0	0	0	0	0
Bridelia cathartica	50	33	8	8	8	0	0	0	0	0	0
Diplorhynchus condylocarpon	50	50	0	0	0	0	0	0	0	0	0
Ximenia caffra	42	25	17	0	0	0	0	0	0	0	0
Monotes africanus	33	17	8	0	17	8	8	0	0	0	0
Brachystegia floribunda	33	25	0	0	8	0	0	0	0	0	0
Acacia amythe	33	25	8	8	8	0	0	0	0	0	0
Combretum molle	25	8	17	0	0	0	0	0	0	0	0
Multidentia crassa	25	25	0	0	0	0	0	0	0	0	0
Zanha africana	17	8	0	0	0	0	0	0	8	0	0
Burkea africana	17	8	0	8	0	0	0	0	0	0	0
Pleurostylis africana	17	0	8	8	8	0	0	0	8	0	0
Flacourtia indica	17	17	0	0	0	0	0	0	0	0	0
Faurea speciosa	17	8	8	0	0	0	0	0	0	0	0
Rothmannia engleriana	17	0	0	8	17	0	0	0	0	0	0
Turraea nilotica	17	8	0	0	0	8	0	0	0	0	0
Combretum zeyheri	8	8	0	0	0	0	0	0	0	0	0
Swartzia madagascariensis	8	8	0	0	0	0	0	0	0	0	0
Zizyphus mucronata	8	0	8	0	0	0	0	0	0	0	0
Brachystegia spiciformis	8	0	8	0	8	0	0	0	0	0	0
Terminalia stenostachya	8	0	8	0	0	0	0	0	0	0	0
Lannea discolor	8	8	0	0	0	0	0	0	0	0	0
Senna singueana	8	0	0	0	0	0	0	0	0	8	0
Pericopsis angolensis	8	0	8	0	8	0	0	0	0	0	0
Diospyros kirkii	8	8	0	0	0	0	0	0	0	0	0
Uapaca nitida	8	8	0	0	0	0	0	0	0	0	0
Brachystegia utilis	8	8	0	0	0	0	0	0	0	0	0
Dalbergia nitidula	8	8	0	0	0	0	0	0	0	0	0
SUM	1,16/	700	317	100	233	25	17	17	25	17	8

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

SPECIES COMPOSITION									
		No./ha							
Species	*Number*	*small*	*pole*	*fibre*	*F.wood*	*fruits*	*racks*	*medicine*	*rafter*
Julbernadia globiflora	*800*	*467*	*267*	*267*	*300*	*0*	*67*	*0*	*0*
Brachystegia spiciformis	*633*	*300*	*267*	*333*	*333*	*0*	*67*	*0*	*0*
Brachystegia floribunda	*333*	*267*	*33*	*33*	*33*	*0*	*0*	*0*	*0*
Parinari curatelliforia	*333*	*133*	*200*	*0*	*200*	*167*	*0*	*0*	*0*
Ochna schweinfurthiana	*300*	*300*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Brachystegia utilis	*267*	*167*	*33*	*33*	*67*	*0*	*33*	*0*	*0*
Strychnos innocua	*267*	*167*	*0*	*0*	*67*	*0*	*67*	*0*	*0*
Brachystegia boehmii	*233*	*33*	*33*	*167*	*133*	*0*	*0*	*0*	*0*
Julbernadia paniculata	*233*	*200*	*33*	*33*	*33*	*0*	*0*	*0*	*0*
Diplorhynchus condylocarpon	*200*	*167*	*33*	*0*	*33*	*0*	*0*	*0*	*0*
Multidentia crassa	*167*	*133*	*0*	*0*	*0*	*0*	*33*	*0*	*0*
Brachystegia longifolia	*133*	*33*	*67*	*33*	*33*	*0*	*0*	*0*	*0*
Vitex payos	*133*	*67*	*0*	*0*	*67*	*33*	*0*	*0*	*0*
Combretum molle	*100*	*100*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Dalbergia nitidula	*100*	*67*	*33*	*0*	*33*	*0*	*0*	*0*	*0*
Bridelia micrantha	*67*	*67*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Pericopsis angolensis	*67*	*33*	*0*	*33*	*33*	*0*	*0*	*0*	*0*
Dalbergiella nyasea	*33*	*33*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Rothmannia englerana	*33*	*33*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Stereospermum kunthianum	*33*	*0*	*33*	*0*	*0*	*0*	*0*	*0*	*0*
Syzygium guineense	*33*	*0*	*0*	*0*	*33*	*33*	*0*	*0*	*0*
Uapaca nitida	*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									
		No./ha							
Species	*Number*	*small*	*pole*	*fibre*	*F.wood*	*fruits*	*racks*	*medicine*	*rafter*
Brachystegia spiciformis	*767*	*367*	*333*	*367*	*333*	*0*	*33*	*0*	*0*
Parinari curatelliforia	*733*	*33*	*200*	*0*	*500*	*600*	*67*	*0*	*0*
Julbernadia globiflora	*500*	*300*	*100*	*133*	*67*	*0*	*67*	*0*	*0*
Uapaca kirkiana	*500*	*100*	*333*	*0*	*367*	*333*	*0*	*0*	*0*
Brachystegia utilis	*467*	*100*	*233*	*267*	*267*	*0*	*67*	*0*	*0*
Uapaca nitida	*467*	*300*	*100*	*0*	*33*	*0*	*33*	*0*	*0*
Brachystegia bussei	*433*	*267*	*67*	*33*	*33*	*0*	*67*	*0*	*0*
Multidentia crassa	*300*	*133*	*33*	*0*	*100*	*167*	*0*	*0*	*0*
Olax obtusifolia	*133*	*0*	*100*	*0*	*133*	*0*	*33*	*0*	*0*
Pericopsis angolensis	*133*	*33*	*33*	*0*	*33*	*0*	*33*	*0*	*0*
Rothmannia englerana	*133*	*100*	*0*	*0*	*33*	*0*	*0*	*0*	*0*
Vitex payos	*133*	*0*	*67*	*0*	*100*	*0*	*0*	*0*	*0*
Unknown	*100*	*33*	*0*	*0*	*33*	*0*	*0*	*0*	*0*
Brachystegia boehmii	*67*	*0*	*33*	*33*	*33*	*0*	*0*	*0*	*0*
Bridelia micrantha	*67*	*0*	*33*	*0*	*67*	*33*	*33*	*0*	*0*
Combretum molle	*67*	*33*	*0*	*0*	*0*	*0*	*33*	*0*	*0*
Dalbergia nitidula	*67*	*33*	*0*	*0*	*33*	*0*	*33*	*0*	*0*
Diospyros zombensis	*67*	*33*	*33*	*33*	*33*	*0*	*0*	*0*	*0*
Allophylus africanus	*33*	*0*	*33*	*0*	*0*	*0*	*0*	*0*	*0*
Bauhinia thonningii	*33*	*0*	*33*	*0*	*33*	*0*	*0*	*0*	*0*
Brachystegia longifolia	*33*	*33*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Bridelia cathartica	*33*	*0*	*0*	*0*	*33*	*0*	*0*	*0*	*0*
Erythria abyssinica	*33*	*0*	*0*	*0*	*33*	*0*	*0*	*0*	*0*
Ficus natalensis	*33*	*0*	*33*	*0*	*33*	*33*	*0*	*0*	*0*
SUM	***5,233***	***1,900***	***1,800***	***867***	***2,333***	***1,167***	***500***	***0***	***0***