Ministry of Environment and tourism
Directorate of forestry

Woody Resources Report of Hans Kanyinga Community Forest

Namibia Finland Forestry Programme

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List of figures:

List of maps:

List of tables:

List of appendices

1. INTRODUCTION

The Directorate of Forestry (DoF) under the Ministry of Environment and Tourism in Namibia has a mission to carry out forest resource assessments in Namibia. In this task the Government of Finland has supported it since 1995. Initially the aim of the support was to build up the capacity of the Directorate to carry out regional forest inventories of large areas (National Forest Inventory component, NFI). During the years, an increasing number of local level inventories have also been carried out to fulfill specific requests by projects and forest managers. The support from the Government of Finland today through Namibia-Finland Forestry Programme Phase II aims now more at strengthening the capacity of DoF to serve the needs for local level forest management planning.

Inventory of Hans Kanyinga forest is an example of a local level inventory. These local level inventories make it possible to produce forest management plans.

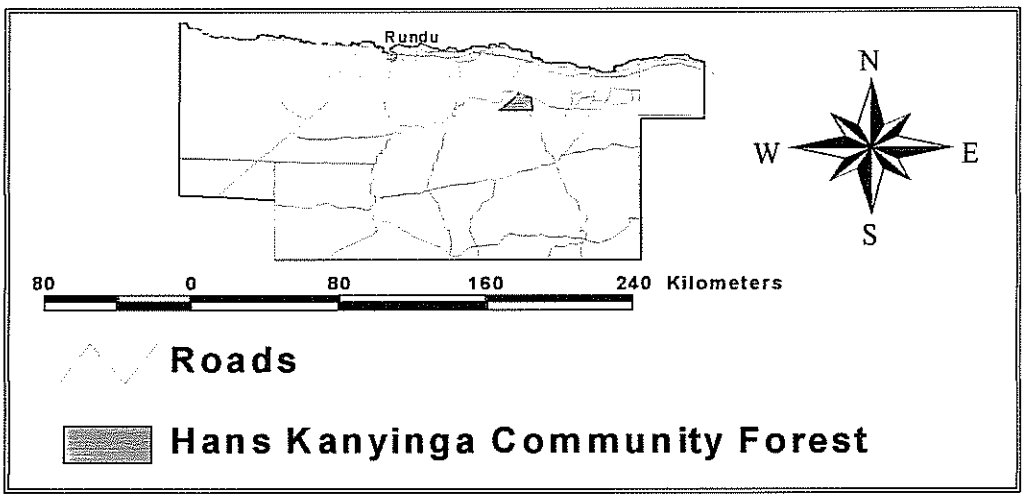
The inventory in Hans Kanyinga Community Forest was carried out by the National Forest Inventory team (NFI) between the 18th and 30th of April 2002. The forest inventory area covers a part of the Hans Kanyinga Community Forest that is an area of 12,107 hectares, in Rundu district, Kavango Region.

Another component of NFFP, which is the Participatory Integrated Forest Management (PIFM), is directly working with the community of Hans Kanyinga. They deemed it necessary to find out the amount of resources available in the area in order to compile a sound management plan. With regard to community forestry, the component is encouraging community participation in the management of their forest and forest products. More income generating activities for sustainable development are thought of in the near future, as the community will be familiarized with the concept of community forestry.

2. GENERAL DESCRIPTION OF THE AREA

The Kalahari sands predominate in the eastern parts of the country including Hans Kanyinga forest. The landscape is rather uniform. The soil fertility in and around Hans Kanyinga is rather low. Ferralic Arenosols dominates the soil (soils formed by deposition of sand and can be 1 m deep hence increasing drainage of water to depths to which most plant roots can't reach) (Mendelssohn et al., 2002).

The average annual temperature is usually more than 22°c. The annual rainfall is 500-550 mm. The average elevation is about 900 m above sea level. The inventory area is about 98 Kilometers to south–east of Rundu (see Map 1).

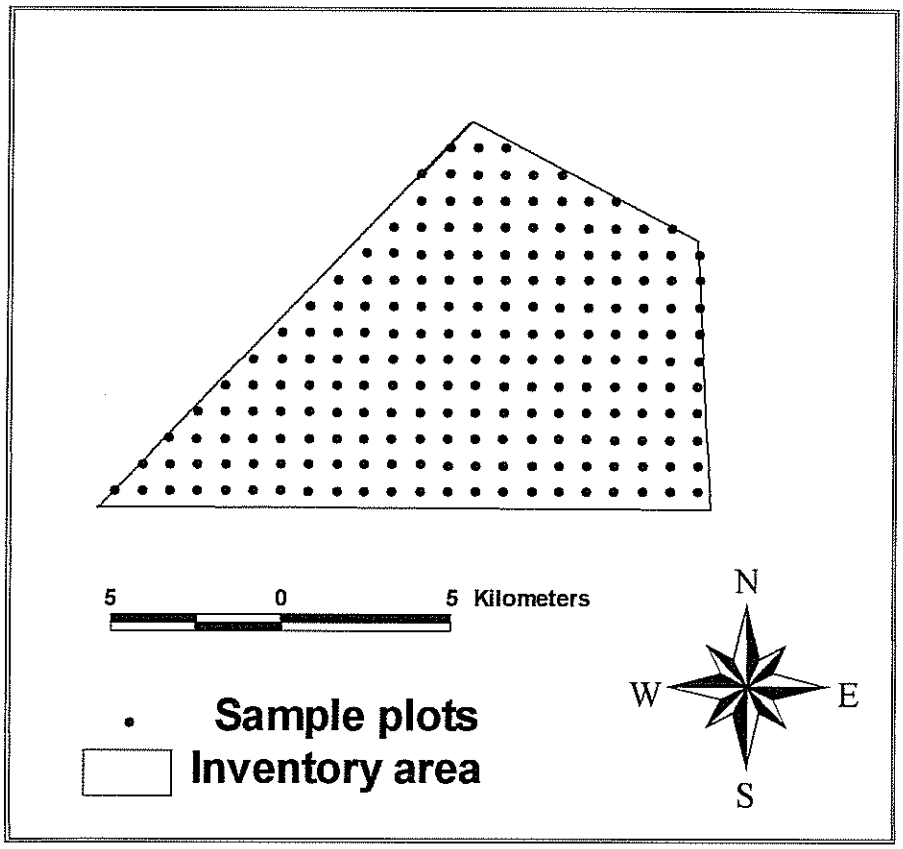


Map 1. Location of Hans Kanyinga inventory area.

3. INVENTORY DESIGN

3.1 Sampling method

The woody resources were estimated using a systematic sampling of field plots. A total of 203 sample plots were measured in Hans Kanyinga Community Forest. This was much dictated by the given number of working days available for the inventory. Also experience showed that satisfactory inventory accuracy should be possible to achieve with that number of plots. The aim was to reach an accuracy of 10 % (standard error) for mean volume per hectare and number of stems per hectare.



Map 2. Location of sample plots.

All trees, with at least 5 cm DBH, inside the circular plot were measured. The plot consisted of three concentric circles. The size of the plot depended on the size of the tree so that the radius of the plot is 30 m for trees with a breast height diameter (DBH) more than or equal to 45 cm; 20 m for trees with $20 \leq DBH < 45$ cm; and 10 m for trees with $5 \leq DBH < 20$ cm. Diameter, location, species, crown class, quality, length and quality of possible saw log were measured.

Height, canopy diameter, crown height and phenology were recorded for each tree in the plot (see figure 1). Damages were recorded for the stand in the sample plot.

In addition, shrubs and regeneration were measured using two circular sub plots of 3.99 m radius. Woody plants with a diameter at breast height less than 5 cm were recorded on the shrub and regeneration field form.

Several variables describing the site, soil and tree cover were observed for each plot. All measurements are described in more detail in the field instructions (Selanniemi and Chakanga, 2001).

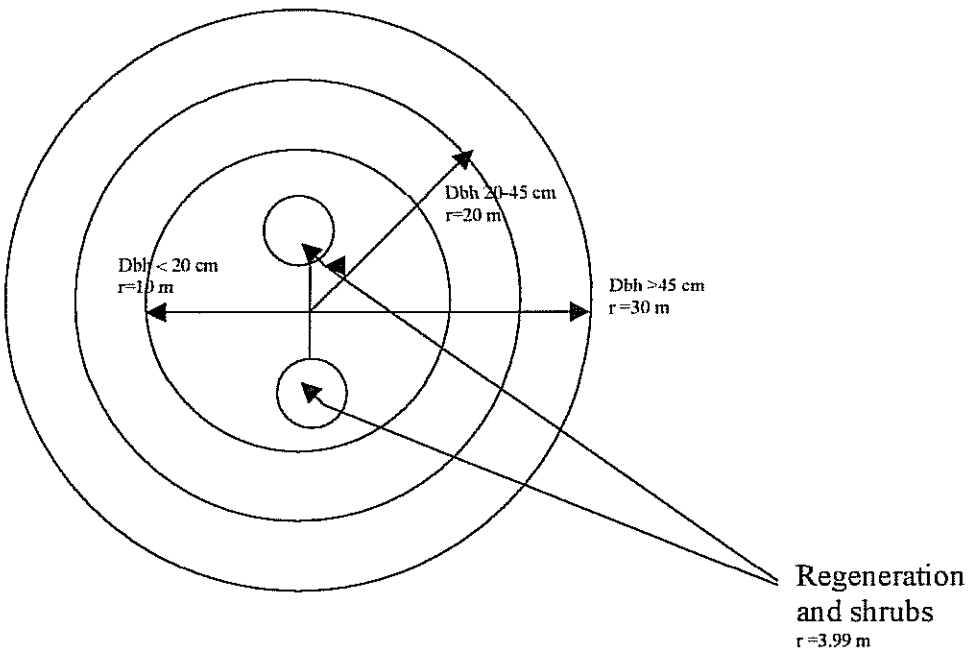


Figure 1: Plot design.

The inventory did not collect information specifically on the non-timber forest products (NTFPs) in the sense that it did not for example try to estimate the availability of fruits from different species or collect information on roots tubers etc. However, a considerable part of the NTFPs used in the region are related to trees. Therefore, the information on trees can be used to indicate the abundance or scarcity of some of the NTFPs.

4. INVENTORY RESULTS

4.1 Measured data

A total of 203 plots were measured on an area of 12,107 hectares. Each plot represents an area of 59.6 ha. A total of 2,290 trees with a diameter of at least 5 cm were measured on the plots. Table 1 shows the total number of measured trees by species. All trees were identified.

Species	Total No. of measured trees	% of measured trees
Acacia erioloba	11	0.5
Acacia fleckii	10	0.4
Baikiaea plurijuga	124	5.4
Bauhinia petersiana	1	0.0
Burkea africana	803	35.1
Combretum apiculatum (apiculatum)	2	0.1
Combretum collinum	100	4.4
Combretum hereroense	1	0.0
Combretum imberbe	2	0.1
Combretum molle	1	0.0
Combretum psidioides (psidioides)	9	0.4
Combretum zeyheri	30	1.3
Dialium engleranum	302	13.2
Guibourtia coleosperma	267	11.7
Lonchocarpus capassa	2	0.1
Ochna pulchra	42	1.8
Ozoroa insignis	40	1.7
Ozoroa paniculosa	9	0.4
Peltophorum africanum	3	0.1
Pterocarpus angolensis	319	13.9
Schinziophyton rautanenii	76	3.3
Strychnos cocculoides	30	1.3
Strychnos pungens	8	0.3
Swartzia madagascariensis	4	0.2
Terminalia sericea	93	4.1
Ximenia americana var Americana	1	0.0
Total	**2,290**	**100.0**

Table 1. Number of measured trees by species.

The three most frequent tree species in the data set were *Combretum apiculatum (apiculatum)* (35.1 %), *Pterocarpus angolensis* (13.9 %) and *Dialium engleranum* (13.2 %).

4.2 Average and maximum height by species

Species	Average height, (m)	Maximum height, (m)
Acacia erioloba	7.5	23.8
Acacia fleckii	4.8	9.4
Baikiaea plurijuga	7.5	20.1
Bauhinia petersiana	5.4	5.4
Burkea Africana	9.5	20.5
Combretum apiculatum (apiculatum)	2.8	5.6
Combretum collinum	5.5	14.5
Combretum hereroense	4.1	4.1
Combretum imberbe	7.6	15.2
Combretum molle	8.1	8.1
Combretum psidioides (psidioides)	6.2	8.7
Combretum zeyheri	4.9	9.8
Dialium engleranum	8.3	18.0
Guibourtia coleosperma	5.6	28.5
Lonchocarpus capassa	4.7	9.3
Ochna pulchra	4.4	9.6
Ozoroa insignis	2.9	10.2
Ozoroa paniculosa	3.2	7.7
Peltophorum africanum	2.1	6.3
Pterocarpus angolensis	10.8	23.9
Schinziophyton rautanenii	6.5	19.3
Strychnos cocculoides	4.5	10.3
Strychnos pungens	5.3	7.1
Swartzia madagascariensis	4.9	7.5
Terminalia sericea	6.0	13.7
Ximenia americana var Americana	5.9	5.9

Table 2. Average and maximum height by species found.

The highest tree that was measured was *Guibourtia coleosperma*, a tree with a height of 28.5 m. The second highest tree species is *Pterocarpus angolensis* with a height of 23.9 m. The third highest tree species is *Acacia erioloba* followed by *Burkea africana*.

4.3 Species diversity

A simple measure of species diversity is to express the number of species found in the area and the number of plots where each species was found. Table 3 shows the number of plots where each species was found for both trees (≥ 5 cm) and shrubs (<5 cm).

Species	No. of clusters, Dbh < 5 cm	No. of clusters, Dbh ≥ 5 cm
Acacia ataxacantha	1	
Acacia erioloba	1	3
Acacia fleckii	1	2
Acacia hebeclada (tristis)	1	
Baikiaea plurijuga	31	39
Baphia massaiensis	13	
Bauhia petersiana	163	1
Burkea africana	162	189
Combretum apiculatum (apiculatum)	1	1
Combretum hereroense		1
Combretum collinum	73	46
Combretum imberbe	1	1
Combretum molle	8	1
Combretum psidioides (psidioides)	53	8
Combretum zeyheri	85	20
Dialium engleranum	88	115
Erythrophleum africanum	8	
Grewia bicolor	7	
Grewia flava	1	
Grewia retinervis	17	
Guibourtia coleosperma	30	84
Lonchocarpus capassa	1	1
Ochna pulchra	147	25
Ozoroa insignis	26	11
Ozoroa paniculosa	82	5
Peltophorum africanum	2	
Piliostigma thonningii	1	
Pterocarpus angolensis	25	133
Salacia luebbertii	1	
Schinziophyton rautanenii	9	29
Securidaca longepedunculata	1	
Strychnos cocculoides	5	20
Strychnos pungens	4	7
Swartzia madagascariensis	1	3
Terminalia sericea	95	58
Vangueria infausta	2	
Ximenia americana var americana	4	1
Ximenia caffra var microphylla	14	
Peltophorum africanum		1

Table 3. Species diversity expressed by the number of plots where each species was found.

A total of 39 woody species were recorded in Hans Kanyinga community forest. 26 species are occurring as trees while 37 species are found in the shrub layer. 24 species are occurring both as trees and in the shrub layer.

Burkea africana trees were found on 93 % (189 plots) of the measured plots, while shrubs from the same species were found on 80 % (162 plots) of the measured sub plots.

4.4 Tree volumes and number of stems

The tree volumes were divided into dead and live tree volumes.

Live trees

Species	Total number of stems	Stems per ha	Total tree volume, m^3	Mean volume m^3/ha
Acacia erioloba	4,008	0.3	3,123	0.3
Acacia fleckii	17,086	1.4	669	0.1
Baikiaea plurijuga	109,795	9.1	34,661	2.9
Bauhinia petersiana	1,898	0.2	27	0.0
Burkea africana	802,946	66.3	169,072	14.0
Combretum apiculatum (apiculatum)	3,797	0.3	117	0.0
Combretum collinum	140,487	11.6	13,014	1.1
Combretum hereroense	1,898	0.2	21	0.0
Combretum imberbe	949	0.1	682	0.1
Combretum molle	475	0.0	125	0.0
Combretum psidioides (psidioides)	17,086	1.4	901	0.1
Combretum zeyheri	47,936	4.0	2,248	0.2
Dialium engleranum	296,372	24.5	56,880	4.7
Guibourtia coleosperma	267,420	22.1	78,249	6.5
Lonchocarpus capassa	2,373	0.2	249	0.0
Ochna pulchra	54,581	4.5	4,396	0.4
Ozoroa insignis	70,243	5.8	2,272	0.2
Ozoroa paniculosa	17,086	1.4	647	0.1
Peltophorum africanum	4,272	0.4	763	0.1
Pterocarpus angolensis	211,363	17.5	83,167	6.9
Schinziophyton rautanenii	49,677	4.1	23,772	2.0
Strychnos cocculoides	49,835	4.1	3,031	0.3
Strychnos pungens	15,188	1.3	1,423	0.1
Swartzia madagascariensis	6,170	0.5	1,040	0.1
Terminalia sericea	123,400	10.2	8,495	0.7
Ximenia americana var americana	1,898	0.2	68	0.0
Total	**2,318,239**	**191.5**	**489,112**	**40.4**

Table 4. Volumes and number of stems for live trees.

Table 4 above shows that there are in total 2,318,239 stems, which is 191.5 stems per hectare. The biggest share of stems is of *Burkea africana, Dialium engleranum* and *Guibourtia coleosperma.*

The mean volume of all species is 40.4 m3/ha. The 4 most common species represent 86 % of the total volume.

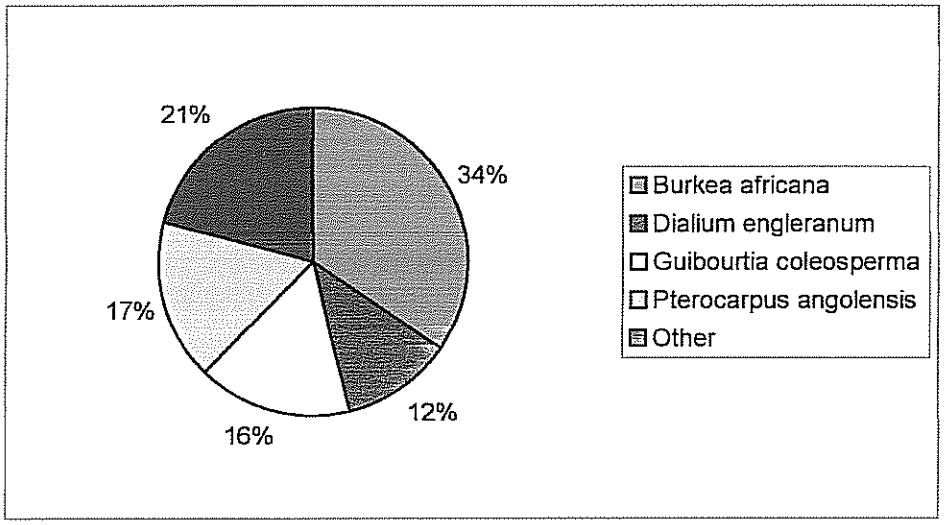


Figure 2: The volumes of the main live species expressed in % of the total volume of all species (489,112 m^3).

The total volume of all live trees is 489,112 m^3. The total volume of *Burkea africana* is 169,072 m^3, *Pterocarpus angolensis* is 83,169 m^3 and the total volume for *Guibourtia coleosperma* is 78,249 m^3.

Dead trees

The majority of dead trees in Hans Kanyinga are *Burkea africana* and *Dialium engleranum* trees. The total volume for *Burkea africana* is the highest (see table 5). The 4 most common species represent 54 % of the total dead wood volume.

Species	Total number of stems	Stems per ha	Total tree volume, m^3	Mean volume m^3/ha
Acacia erioloba	3,797	0.3	213	0.0
Acacia fleckii	1,898	0.2	316	0.0
Baikiaea plurijuga	16,137	1.3	871	0.1
Burkea africana	71,878	5.9	12,521	1.0
Combretum collinum	11,865	1.0	429	0.0
Combretum zeyheri	7,594	0.6	363	0.0
Dialium engleranum	31,747	2.6	3,281	0.3
Guibourtia coleosperma	23,256	1.9	2,822	0.2
Ochna pulchra	16,137	1.3	1,297	0.1
Ozoroa insignis	5,695	0.5	471	0.0
Pterocarpus angolensis	14,238	1.2	3,026	0.2
Schinziophyton rautanenii	2,109	0.2	899	0.1
Terminalia sericea	25,629	2.1	1,215	0.1
Total	**231,982**	**19.2**	**27,724**	**2.3**

Table 5. Volumes and number of stems for dead trees.

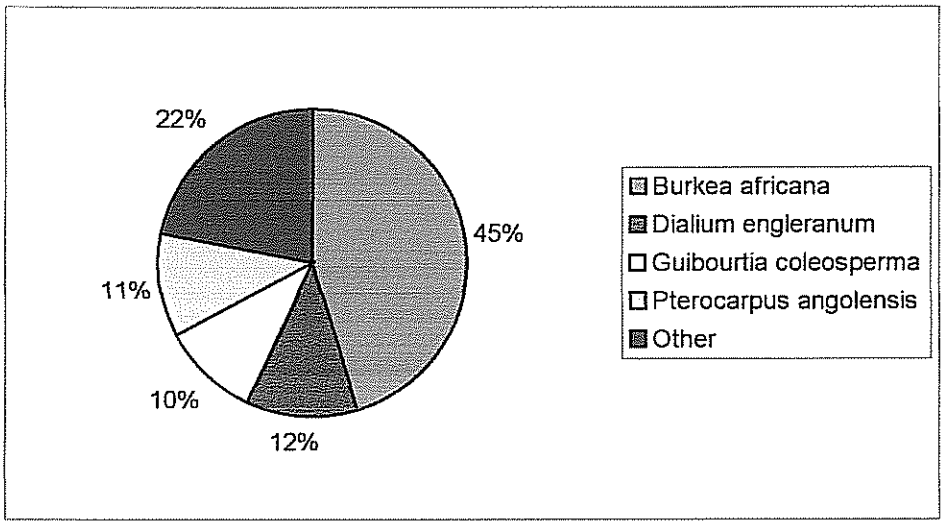


Figure 3: The volumes of the main dead species expressed in % of the total volume of all species (27,724 m^3).

4.5 Diameter distribution

Live trees

Appendix 1 shows the diameter distribution of live trees. The bulk of the trees in Hans Kanyinga community forest are in the small and medium sized diameter classes. The distribution also gives indications on which tree species have a potential to grow into big size trees in the area. The biggest live trees in Hans Kanyinga community forest are *Burkea africana, Dalium engleranum* and *Guibourtia coleosperma*-trees. Their diameter distribution is also good in the sense that the majority of the stems are in lower diameter classes. These trees, if managed properly, will grow into bigger trees and provide poles also in the future.

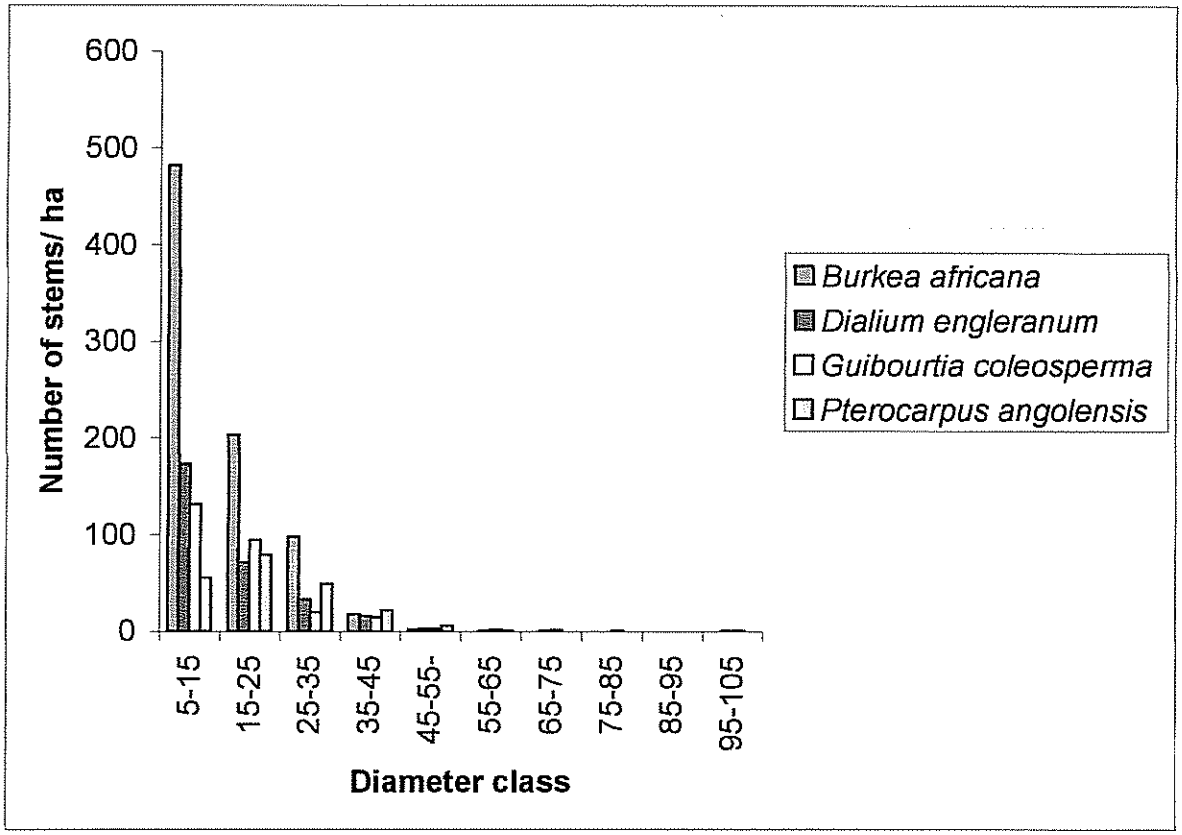


Figure 4. Live wood diameter distribution for the main species.

The number of small size *Burkea africana* stems is very high, 482 stems with dbh between 5 and 15 cm (see figure 4).

Dead trees

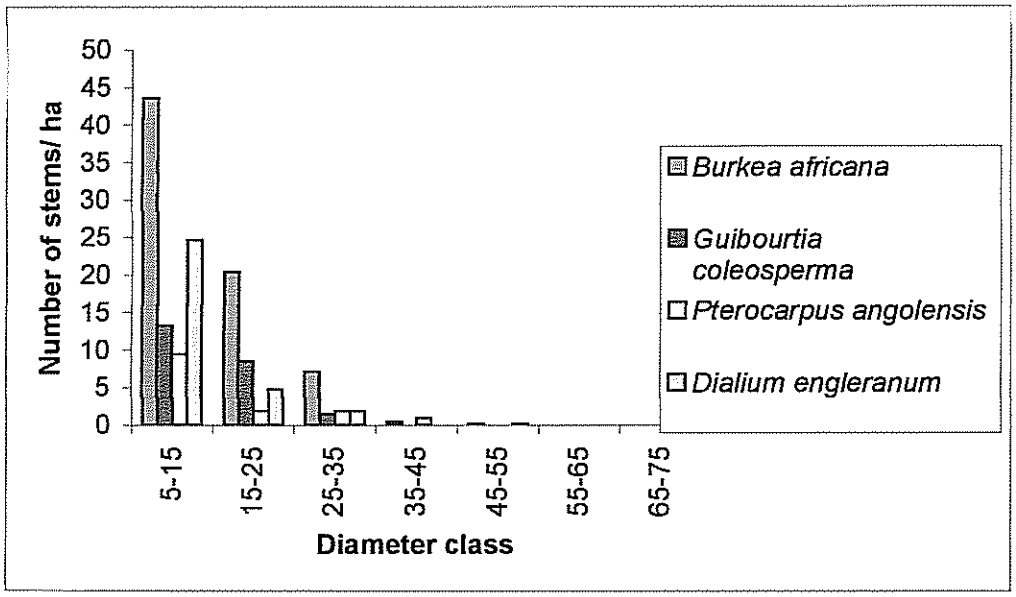


Figure 5. Dead wood diameter distribution for the main species.

Figure 5 and Appendix 2 show that most of dead stems are of *Burkea africana*. They are mainly small size trees, less than 25 cm at breast height. The biggest dead trees shown in fig. 5 are *Dialium engleranum* trees within 65-75 cm diameter class and *Burkea africana* and *Pterocarpus angolensis* trees with dbh within 35-45 and 45-55 cm diameter classes.

4.6 Regeneration and shrubs

Table 6 and 7 below shows the number of tree seedlings and shrubs by height classes in Hans Kanyinga community forest. It should be noted that regeneration deals only with diameters less than 5 cm.

Tree seedlings

	Height class, in cm								
Species	0-25	26-50	51-100	101-150	151-200	201-250	251-300	300+	Total
Baikiaea plurijuga	12	12	24	13	5	1			67
Burkea africana	34	98	133	49	40	14	1	8	378
Combretum collinum	10	35	36	11	7	4	1	6	110
Combretum psidioides (psidioides)	9	18	36	12	7	1		2	86
Combretum zeyheri	9	31	42	13	9	4	1		108
Erythrophleum africanum			4	6	1				12
Guibourtia coleosperma	3	10	9	17	15	1		4	60
Ochna pulchra	101	140	112	32	6	2		1	395
Ozoroa paniculosa	3	5	47	47	18	9			130
Peltophorum africanum	7								7
Pterocarpus angolensis	4	6	2	2	1	3			19
Schinziophyton rautanenii			4	2				1	7
Strychnos cocculoides		1			1				2
Strychnos pungens		2							2
Terminalia sericea	15	11	39	22	8	4		4	105
Total	207	369	488	226	118	43	3	26	1,488

Table 6. Number of tree seedlings per hectare.

On average, there are 395 *Ochna pulchra* and 378 *Burkea africana* seedlings, 60 *Guibourtia coleosperma* and 19 *Pterocarpus angolensis* tree seedlings. It seems that *Ochna pulchra* and *Burkea africana* are regenerating reasonably well, as in the case of *Burkea africana* (Figure 4). *Terminalia sericea, Ozoroa paniculosa*, *Combretum zeyheri* and *Combretum collinum* are quite frequent tree seedlings as well, more than 100 individuals per hectare of each species.

Shrubs

	Height class, in cm								
Species	0-25	26-50	51-100	101-150	151-200	201-250	251-300	300+	Total
Baphia massaiensis	18	13	3	2					36
Bauhinia petersiana	23	77	159	91	41	6	4		402
Dialium engleranum	23	74	62	51	13	7	0	3	233
Grewia bicolor	5	5	4	1					16
Grewia flava				2					2
Grewia retinervis		4	16	3	1				24
Ozoroa insignis	1	3	7	14	9	3	1	1	39
Vangueria infausta			3						3
Total	70	176	254	164	64	16	5	4	755

Table 7. Number of shrub per hectare.

On average, there are 402 *Bauhinia petersiana,* 233 *Dialium engleranum* and *Ozoroa insignis* shrubs.

4.7 Timber Quality

The quality classification used in the inventory is the following:

- Expected good quality: There is at least 2 m long straight stem without damages
- Expected medium quality: The stem is slightly curving or sweeping or having other damages but still having at least 2 m sawable log.
- Expected poor quality: It is possible to find only 1.2-2 m long meeting the minimum timber quality requirement.
- Not sawable: The log is not sawable and will probably never develop sawable quality.

The above classification was applied to all species. However, only the main species are discussed in this report. Table 8 below shows the timber quality of the main species with dbh ≥ 45 cm. There is a considerable 4850 stems of *Pterocarpus angolensis* with good expected timber quality, 2110 stems for *Dialium engleranum*, 840 stems for *Guibortia coleosperma* and 420 stems for *Burkea africana*.

Species	Quality	Stems per ha	Total number of stems, 1000s	Total log volume 1000 m^3	Average log volume, m^3/ ha
Burkea africana	Expected good quality	0.03	0.42	0.25	0.02
	Not sawable	0.03	0.42	0.00	0.00
Dialium engleranum	Expected good quality	0.17	2.11	1.29	0.11
	Expected medium quality	0.12	1.48	0.67	0.06
	Not sawable	0.03	0.42	0.00	0.00
Guibortia coleosperma	Expected good quality	0.07	0.84	0.93	0.08
	Expected medium quality	0.14	1.69	1.49	0.12
	Poor quality	0.03	0.42	0.22	0.02
	Not sawable	0.40	4.85	0.00	0.00
Pterocapus angolensis	Expected good quality	0.40	4.85	3.33	0.27
	Expected medium quality	0.10	1.27	0.43	0.04
	Poor quality	0.02	0.21	0.07	0.01
	Total	1.57	18.98	8.68	0.72

Table 8. Distribution of volume in timber quality classes (dbh≥ 45 cm) for main species.

Species	Quality	Stems per ha	Total number of stems, 1000s	Total log volume, 1000 m^3	Average log volume m^3/ ha
Burkea africana	No code	39.98	484.11	0.26	0.02
	Expected good quality	12.35	149.50	22.60	1.87
	Expected medium quality	8.58	103.94	10.26	0.85
	Poor quality	2.27	27.53	2.98	0.25
	Not sawable	2.98	36.07	0.00	0.00
Dialium engleranum	No code	14.39	174.18	0.11	0.01
	Expected good quality	3.68	44.61	7.91	0.65
	Expected medium quality	2.63	31.80	2.62	0.22
	Poor quality	1.37	16.61	1.53	0.13
	Not sawable	2.08	25.15	0.00	0.00
Guibortia coleosperma	No code	14.07	170.39	1.20	0.10
	Expected good quality	1.53	18.51	2.59	0.21
	Expected medium quality	2.16	26.10	1.96	0.16
	Poor quality	0.90	10.92	0.79	0.07
	Not sawable	2.78	33.70	0.00	0.00
Pterocarpus angolensis	No code	5.17	62.65	1.09	0.09
	Expected good quality	8.86	107.26	19.34	1.60
	Expected medium quality	2.43	29.43	2.97	0.25
	Poor quality	0.04	0.47	0.03	0.00
	Not sawable	0.39	4.75	0.00	0.00
	Total	128.66	1557.69	78.24	6.46

Table 9. Distribution of volume in timber quality classes (dbh< 45 cm) for main species.

Table 9 above indicates that there is a considerable amount of trees with good expected timber qualities, that is they are trees which are less than 45 cm at breast height today. *Burkea africana* has the highest number of stems (149,500) with good expected timber quality. *Pterocarpus angolensis* has 107,000 trees with good expected quality.

4.8 Damage to woody vegetation

Damage to the woody vegetation was recorded only at stand level. In the damage assessment the damages were classified into 5 different classes; (1) no damage, (2) mild, (3) moderate, (4) serious and (5) fatal damage.

	Severity of damage						
Damaging Agent	No Damage	Mild	Moderate	Serious	Fatal	Total	% of total area
No damage	477					477	4
Fire		9,304	2,087	179	60	11,630	96
Total	477	9,304	2,087	179	60	12,107	
% of total area	4	77	17	1	1		100

Table 10. Damages caused by fire, in hectares.

No damages were observed on 477 hectares. Fire has damaged most of the area: 1,160 hectares (see table 9).

4.9 Reliability of the results

The following error sources are always present in sampling based forest inventories: Sampling error, measurement error including coding error, errors in data processing and errors in models for volume estimation. In this work, specific attention was paid to guarantee good quality of the field data. Several cross checkings were done to find out possible errors and inconsistencies in the data.

The applied volume functions are probably the main source of errors. The size of the material collected for constructing the functions was moderate. A total of 252 trees were felled in West Tsumkwe, Caprivi, Omusati and Oshikoto regions and these were used for modeling.

The sampling error was estimated using the formula for random sampling. The standard error for the mean volume (40.4 m^3/ha) was 1.9 m^3/ha, which is 3.5 % of the mean volume. The true volume with 95 % probability is between 36.7 m^3/ha and 44.1 m^3/ha.

A much higher accuracy was achieved than was actually aimed at. The variation inside the forest was much less than was expected. Therefore, a somewhat smaller number of sampling plots would have been enough.

5. INVENTORY COSTS

All inventories require financial inputs, which are either direct or indirect costs. The design of the inventory determines the financial implications that will be incurred during the inventory activities on the ground. The inventory in Hans Kanyinga was carried out by the National Forest Inventory team (NFI) between the 11th and the 28th of November 2002. One field trip was undertaken for 18 days. Seven men did the actual fieldwork. In the calculation, a cost for a man-day includes the salary plus the daily subsistence costs. Three cars (813 km one way, from Windhoek to Hans Kanyinga Community Forest) were used to reach the area from Windhoek. Four ATVs were used for moving from one plot to another. The costs for fuel are more or less real, but the cost for vehicle maintenance is an estimate, which has been derived from annual maintenance costs. This calculation only includes immediate costs of the inventory. It does not include fixed costs and overhead costs like office facilities, computers, supervision etc. The total cost of the inventory is about N$ 71,642, which is N$ 5.9 per hectare.

Cost item	Units	Cost/unit, N$	Total cost, N$
Inventory planning	1 week	1000	1,000
Inventory equipment			4,000
Inventory field work	126 man-days	267	33,642
Fuel	1667 litres	3.55	6,000
Vehicle maintenance			15,000
Data entry	4 weeks	1,000	4,000
Data analysis	2 weeks	1,000	2,000
Report writing	3 weeks	1,000	4,000
Report printing			2,000
Total			**71,642**

Table 11. Inventory costs.

The inventory cost per hectare in Hans Kanyinga community forest is N$ 5.90. This is much higher than the cost to inventory one hectare in Uukolonkadhi (N$ 1.98), where a stratification was done for a large area (Kanime and Laamanen, 2003). In Sikanjabuka, the cost per hectare was N$17.40, which is the highest cost analyzed so far (Kamwi and Laamanen, 2002). In Sikanjabuka, a uniform grid with a relatively high number of plots was laid on a small area of 5000 hectares.

6. CONCLUSION

This inventory provides quantitative estimates of the present state of the forest in Hans Kanyinga Community Forest and indicates that the resources are still remarkable in terms of volume and stems per hectare.

The most common damage (threat) to the woody vegetation is fire. The stand level classification indicates that, on 96 % of the area there are visible signs of damages to trees caused by fires. Although the woody vegetation on a big part of the area shows signs of fire damage, surprisingly few trees are damaged, and the damage is usually mild or moderate.

The majority of people depend on the forest resources for fuel wood and poles for house construction and grass for thatching. The area inventoried has very good potential for management by the local community.

7. REFERENCES

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Appendix 1. Diameter distribution for live trees in 1000s

Species	5-15	15-25	25-35	35-45	45-55	55-65	65-75	95-105	Total	% of total
Acacia erioloba		1	1	2					4	0.2
Acacia fleckii	15	2							17	0.7
Baikiaea plurijuga	74	14	11	6	3	1			110	4.7
Bauhinia petersiana	2								2	0.1
Burkea africana	482	203	98	18	2				803	34.6
Combretum apiculatum (apiculatum)	4								4	0.2
Combretum collinum	106	29	5						140	6.1
Combretum hereroense	2								2	0.1
Combretum imberbe			1						1	0
Combretum molle										0
Combretum psidioides (psidioides)	13	4							17	0.7
Combretum zeyheri	42	6							48	2.1
Dialium engleranum	173	71	33	16	3	1			296	12.8
Guibourtia coleosperma	131	94	20	15	3	2	1	1	268	11.5
Lonchocarpus capassa	2						1		3	0.1
Ochna pulchra	46	9							55	2.4
Ozoroa insignis	68	2							70	3
Ozoroa paniculosa	15	2							17	0.7
Peltophorum africanum	2	2							4	0.2
Pterocarpus angolensis	55	79	49	22	6	1			211	9.1
Schinziophyton rautanenii	19	11	11	5	2	1			50	2.1
Strychnos cocculoides	40	9	1						50	2.1
Strychnos pungens	8	8							15	0.7
Swartzia madagascariensis	4	2							6	0.3
Terminalia sericea	95	28	1						123	5.3
Ximenia americana var americana	2								2	0.1
Total	1,399	575	231	84	17	6	3	1	2,320	
% of total	60.3	24.8	10.0	3.6	0.7	0.3	0.2	0.1		100.0

Appendix 2. Diameter distribution for dead trees in 1000s

Species	5-15	15-25	25-35	35-45	Total	% of total
Acacia erioloba	4				4	1.6
Acacia fleckii		2			2	0.8
Baikiaea plurijuga	15	1	1		16	7
Burkea africana	44	20	7	1	72	31
Combretum collinum	11	1			12	5.1
Combretum zeyheri	6	2			8	3.3
Dialium engleranum	25	5	2		32	13.7
Guibourtia coleosperma	13	9	1		23	10
Ochna pulchra	13	3			16	7
Ozoroa insignis	4	2			6	2.5
Pterocarpus angolensis	9	2	2	1	14	6.1
Schinziophyton rautanenii	2				2	0.9
Terminalia sericea	25	1			26	11
Total	171	46	13	1	232	
% of total	**73.7**	**19.8**	**5.5**	**0.6**		**100**