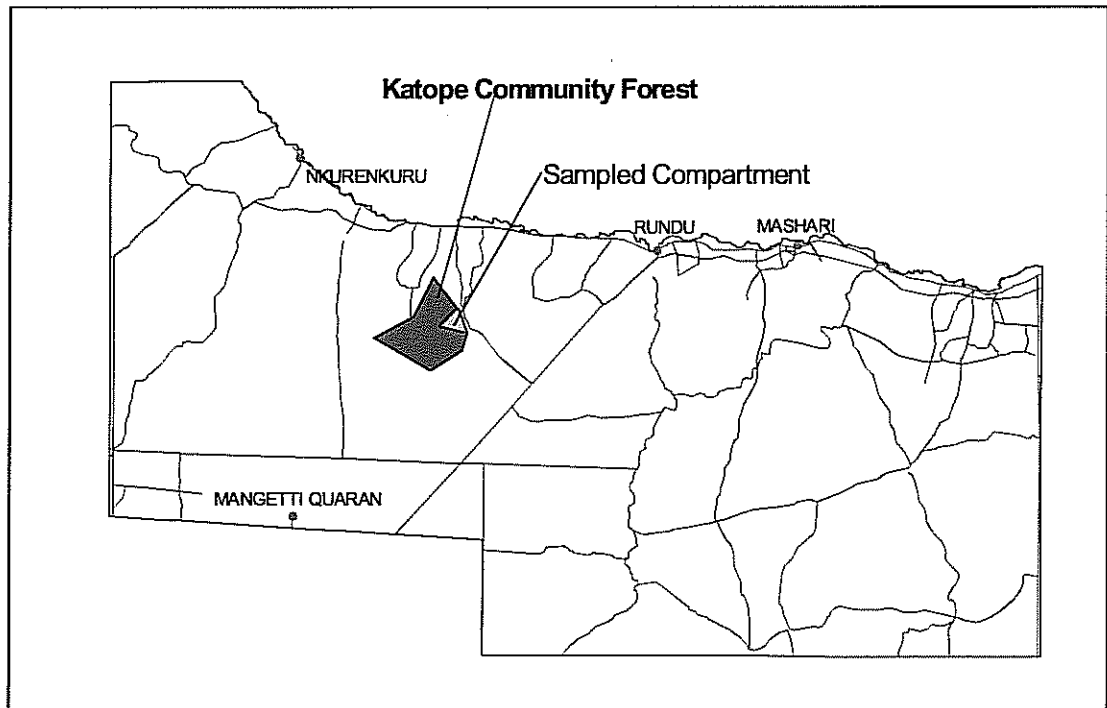


**Ministry of Environment and tourism
Directorate of forestry**



**Woody Resources Report of Katope Community
Forest**



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Windhoek, July 2004

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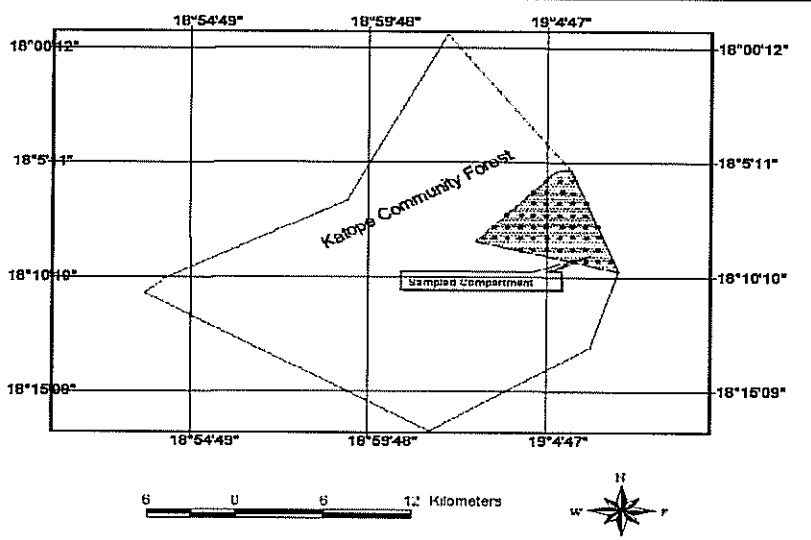
1. Introduction

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 supported the National Forest Inventory program since 1995. Initially the aim of the support was to build the capacity of the Directorate in order to carry out regional forest inventories of large areas. Through the years, an increasing number of local level inventories have been carried out to fulfill specific requests by District forest officers, communities, conservancies, etc. The support from the Government of Finland 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.

The total area of Katope Community Forest is approximately 49,499 hectares. The inventory was done only on 7% (3,816 ha) of the area. The inventory was carried out by the community, DED officers and district forest officers with the support from NFI team in April 2004. The forest inventory area covers one compartment of the Community Forest that is an area of 3816 hectares, in Rundu district, Kavango Region.

2. Location of the area

The Katope Community Forest is located in the Kavango region, about half way between Rundu and Nkurenkulu. It is approximately 30 km from the main road to the south and 90 km from Rundu. According to Atlas of Namibia vegetation map, the area is classified as tree and shrub savanna and the soil is classified as sandy soil (Aeolian Kalahari sand) (Erkkila and Siiskonen, 1992). This area is affected by seasonal rainfall (summer rainfall) with average range between 500 to 600 mm per annum. Because of the climatic conditions, the soil conditions are even and the variations in vegetation are mainly caused by soil depth and topology (Erkkila and Siiskonen, 1992).

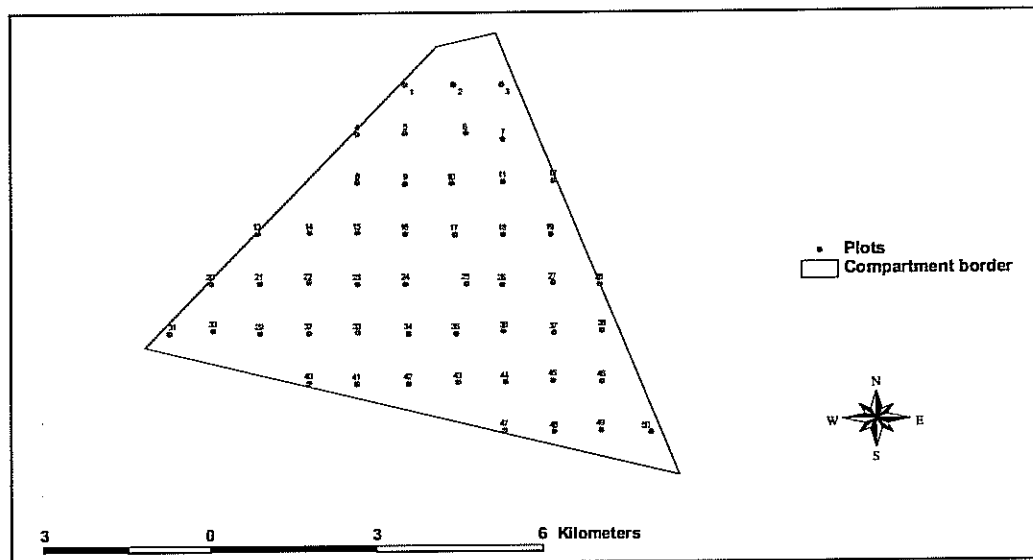


Map 1: Location of Katope Community Forest

3. Inventory design

3.1 Sampling method

The woody resources were estimated using a systematic sampling. A total of 50 sample plots (Map 2) were measured in Katope Community Forest. This was limited by the number of working days available for the inventory and also the fact that there is a need for training of local staffs and the community. The aim was to reach an accuracy of at least 10 % (standard error) of the mean volume and number of stems per hectare.



Map 2: Location of sample plots in the sampled compartment

The inventory focuses on three species such as *Baikiaea plurijuga*, *Guibourtia coleosperma*, and *Pterocarpus angolensis*. All stems from three mentioned species, 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 $20 \leq \text{DBH} < 45$ cm; and 10 m for trees with $5 \leq \text{DBH} < 20$ cm. Diameter, species, status, distance, timber quality, reason, saw-log length and deformed base was recorded on each plot, while height was recorded in each third 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.

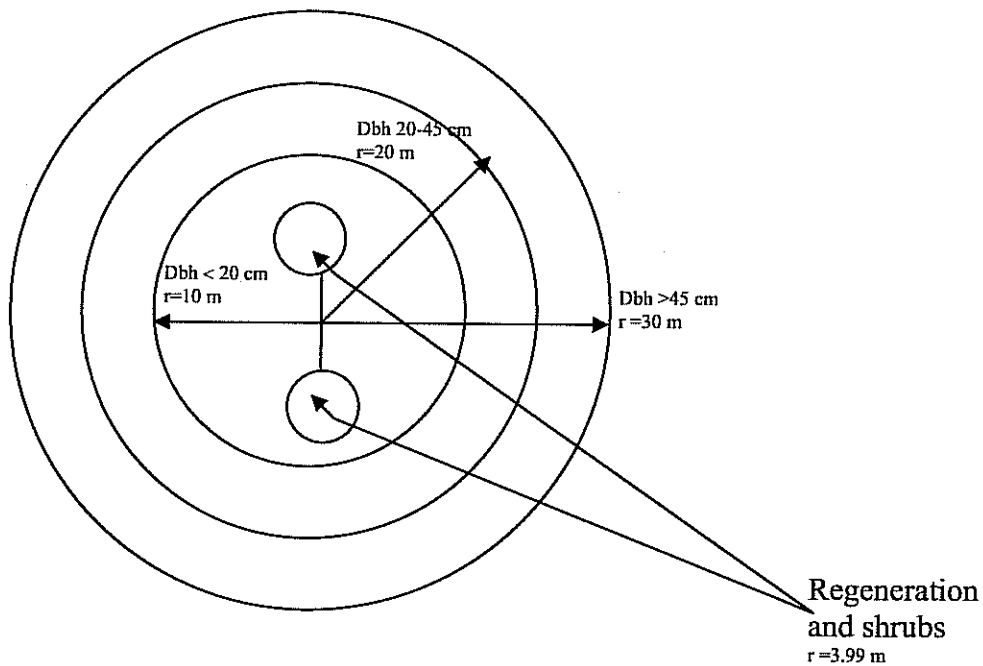


Figure 1: Plot design.

4. Inventory Results

4.1 Measured data

The inventory field work for Katope Community Forest was carried out in April 2004. A total of 50 plots were measured on an area of 3816 hectares. Each plot represents an area of 76.3 ha.

A total of 283 trees with a diameter of at least 5 cm were measured on the sample plots, which represent 6 stems/trees per plot. Figure 2 shows the total number of measured trees by species. Most of the stems (73%) were from *Baikiaea plurijuga*. This is indication rather that among the three commercial species, *Baikiaea plurijuga* is dominating the area. There was no assessment done on the other species to determine the abundance of other species, except *Guibourtia coleosperma* and *Pterocarpus angolensis* at a tree level.

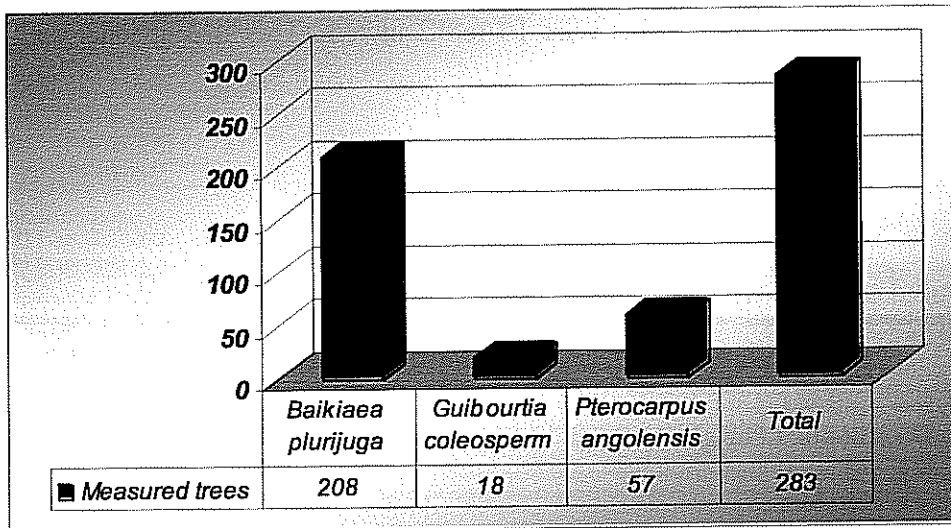


Figure 2: Number of measured trees

4.2 Average, minimum and maximum height by species

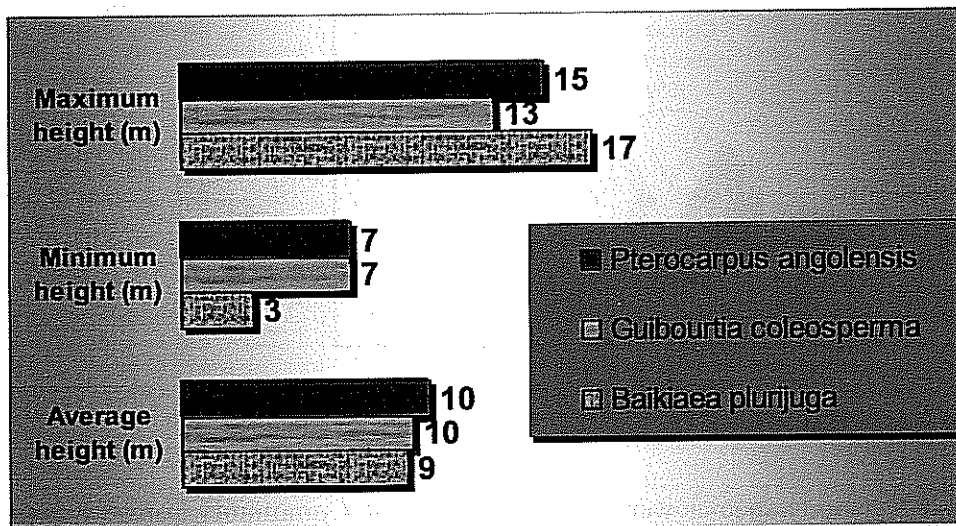


Figure 3: Average, minimum and maximum height by species

The maximum tree height varies from 13 to 17 meters by species. There is not much difference between these tree heights. The average height is around 10 meters. The tallest tree was from *Pterocarpus angolensis*. Most of the data were found between 7 and 10 meters from *Baikiaea plurijuga* and *Guibourtia coleosperma* (Figure 4), but height concentration of *Pterocarpus angolensis* is different from other species. Most of the data

from this species were found between 10 to 12 meters. This is a species with a tallest stem recorded in the area.

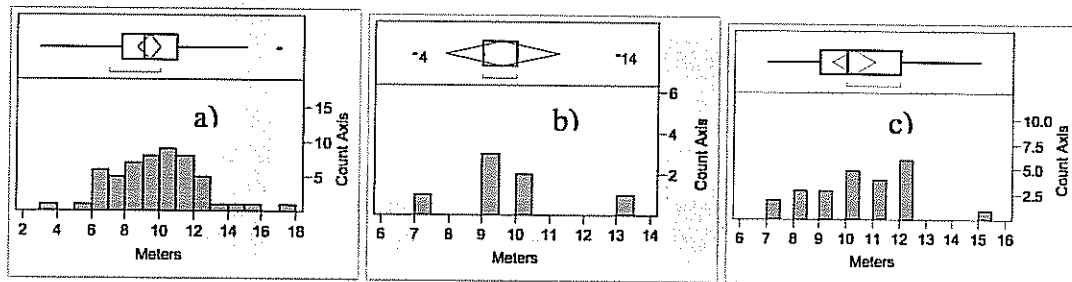


Figure 4: Distribution of height; a) Baipl, b) Guico and c) Ptean

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).

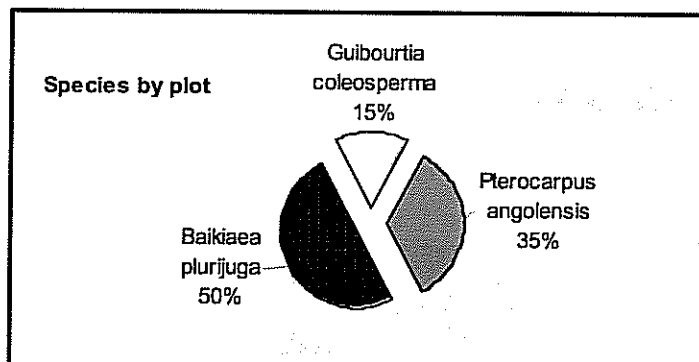


Figure 5: Species diversity expressed by the number of plots where each species was found for the three selected species.

A total of 20 woody species were recorded in Katope Community Forest. It is impossible in this paper to determine which of these species were occurring as trees except the three valuable species (*Pterocarpus angolensis*, *Baikiaea plurijuga* and *Guibourtia coleosperma*). *Baikiaea plurijuga* was preferably found in 50% of the measured plots Figure 5, which is comparable that it can be found in every second plot (Table 1). The shrub layer is rather dominated by *Baphia massaiensis*, *Croton gratissimus* and *Terminalia sericea* which generally from the measured stems, approximately can be found in every 3rd and 5th plot respectively (Table 1). Since there were 50 plots, it means *Guibourtia coleosperma* was found only in one plot hence every 50th plot (Table 1).

Table 1: Occurrence of species by plots

Species	Dbh > 5cm	Dbh < 5cm
Guibourtia coleosperma	Every 50 th plot	Every 6 th plot
Baikiaea plurijuga	Every 2 nd plot	Every 13 th plot
Baphia massaiensis		Every 3 rd plot
Croton gratissimus		Every 5 th plot
Terminalia sericea		Every 5 th plot
Pterocarpus angolensis	Every 3 rd plot	

4.4 Tree volumes and number of stems

Table 2 below shows that there are in total 298,415 stems, which is 78 stems per hectare. Most of the stems (72%) are from *Baikiaea plurijuga*. The mean volume of the three species is 24.4 m³/ha. Almost 70% of the total volume is from *Baikiaea plurijuga*.

Table 2: Total number of stems and volume of the measured species

Species	Total number of trees	Number of stems per ha	Total volume	Mean volume
Baikiaea plurijuga	215,832	56.6	64436.5	16.9
Guibourtia coleosperma	29,632	7.8	6185.8	1.6
Pterocarpus angolensis	52,951	13.9	22346.4	6.9
Total	298,415	78	92,968.6	24.4

4.5 Diameter distribution

Table 3: Distribution of stems by diameter classes

Species	5-15	15-25	25-35	35-45	45-55	55-85	Total
Baikiaea plurijuga	89,887	80,169	30,975	12,147	2,174	480	215,832
Guibourtia coleosperma	12,147	16,398	607			480	29,632
Pterocarpus angolensis	9,717	20,650	16,398	5,466	720		52,951
Total	111,751	117,217	47,981	17,613	2,894	959	298,415

Almost 95% of the stems were below 35 cm diameter. Two third of the stems were from *Baikiaea plurijuga*. Most of the *Guibourtia coleosperma* stems were found in the small diameter classes. *Pterocarpus angolensis* was within 5-55 diameter class. The largest

diameter recorded in the area is 85 cm which is from *Baikiaea plurijuga* and *Guibourtia coleosperma*.

Table 4: Status of measured trees

Species	Live trees	Standing dead trees
<i>Baikiaea plurijuga</i>	167	41
<i>Guibourtia coleosperma</i>	17	1
<i>Pterocarpus angolensis</i>	56	1
Total	240	43

Total number of 240 tree species were recorded as live, and 43 as dead standing trees. An amount of 41 *Baikiaea plurijuga* species were recorded as dead standing. This is an indication that the majority of dead trees were from *Baikiaea plurijuga*.

4.6 Regeneration and shrubs

Regeneration plays an important role in the renewal and perpetuation of forest or woodland ecosystems. If the regeneration is not disturbed, it will depict how the structure of the forest will look like in the future. Hence it is important to display the structure of the regeneration to give the shape on how the forest stand is likely to be in the near future.

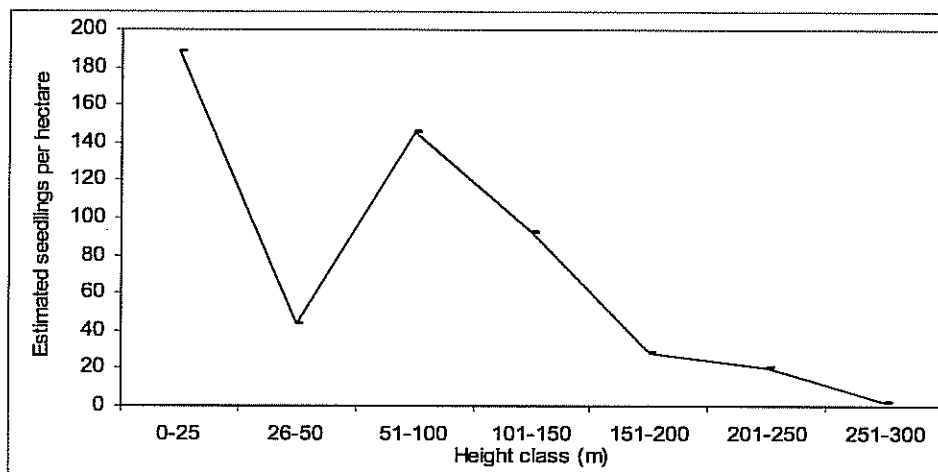


Figure 6: Height class by the number of seedlings per hectare

As have been described, all the stems recorded with a dbh below 5 cm are defined as shrubs regardless of their heights. Hence regeneration occurs in the shrub layer by this definition. There are three categories of regeneration in the shrub layer. Firstly, there are trees that never grow into bigger trees depending on the geographical area, meaning they remain as shrubs. The Second category of possible regeneration is due to some form of disturbances over the years, such as fire, tree coppiced, lack of nutrition, rainfall

variation, etc. These type of shrubs even though have sign of maturity, the dbh are small (less than 5 cm), hence falls under the shrub layer and counted as shrubs.

Thirdly, in the shrub layer there are seedlings that will grow into bigger trees, called saplings. Since the shrub types in this forest inventory were not differentiated, the figures represent the whole shrub layer regardless of different types. The wood resource assessment in this area, concentrated only on three species (*Pterocarpus angolensis* (ptean), *Baikiaea plurijuga* (baipl) and *Guibourtia coleosperma* (guico)). Hence it is very difficult to determine which of all the species found in the shrub layer are really shrubs or saplings, except the three mentioned species.

There is approximately 73% of shrubs with a height of 100 centimeters in the area per hectare, 25% of these seedlings were from *Bauhinia petersian* (baupe). Therefore the general idea is that in overall more than two third of the saplings are in the lower height class.

It is however disturbing to note that the regeneration in the area is not dominated by any of the species that were identified as potential by the communities (Figure 7) in this paper. There was no regeneration for *pterocarpus angolensis* (ptean), one of the variable rated species. *Bauhinia petersiana* (baupe) is the most common species in the shrub layer. It is not known if the same species is dominating the tree layer, because the information on the tree layer was mainly collected for the three species.

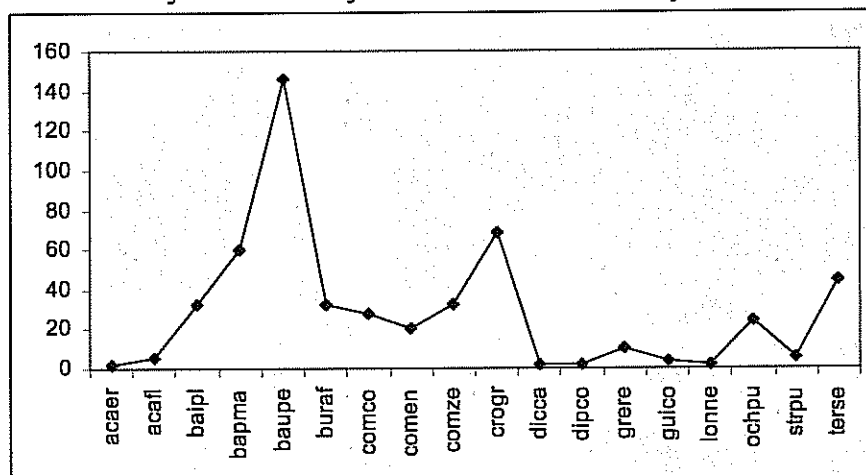


Figure 7: Species by number of seedlings per hectare

4.7 Reliability of the results

The following error sources are always present in the sampling based forest inventories: the 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. Felled data from West Tsumkwe, Caprivi, Omusati and Oshikoto regions were used to establish volume functions, and these are the functions that were used in the data analysis of this report to estimate volumes.

The sampling error was estimated using the formula for random sampling. The standard error for the mean volume and stems (24.4 m³/ha and 78.2) was 4.5 m³/ha and 14.7 stems/ha, which is 18.7% and 18.6% of the mean volume and stems respectively. The true volume and stems with 95 % probability is between 15.5 m³/ha and 33.2 m³/ha, and 49.5 and 106.9 stems per ha respectively.

A targeted accuracy of 10% (standard error) was achieved only in the mean volume this inventory. This is successful given the involvement of the communities and the district staff, who have participated in the inventory. The variation inside the forest was not known. This could be done to somewhat reduce the number of plots on areas with less vegetation.

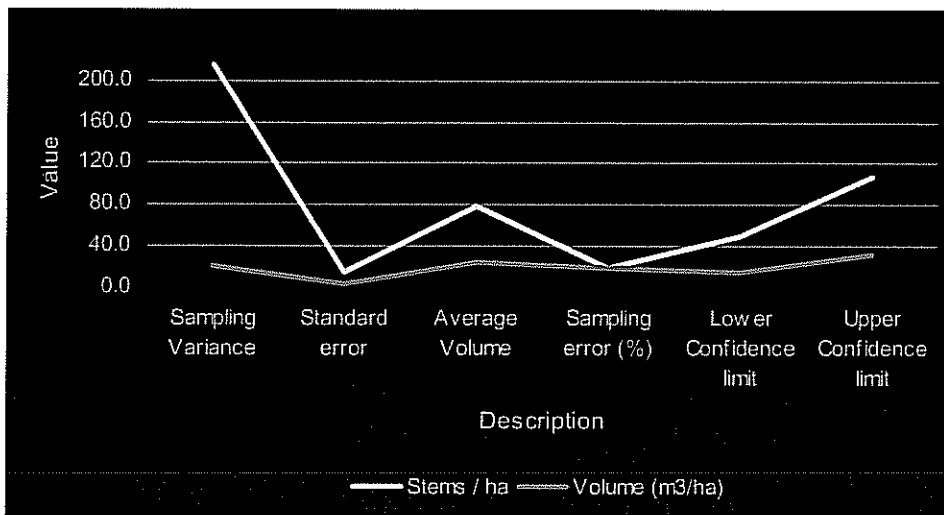


Figure 8: Sampling errors

5. Conclusion

This inventory provides quantitative estimates of the present state of the forest in Katope Community Forest and indicates that the resources are still remarkable in terms of volume and stems per hectare for the three selected species. Atleast the community can

be able to extract timber resources based on the management plan that is to drawn up using this forest inventory results.

Annex: Species abbreviation

Species Code	Full Species name
ACAER	Acacia erioloba
ACAFL	Acacia fleckii
BURAF	Burkea africana
COMCO	Combretum collinum
COMZE	Combretum zeyheri
DICCA	Dichrostachys cinerea (Africana)
GUICO	Guibourtia coleosperma
LONNE	Lonchocarpus nelsii
OCHPU	Ochna pulchra
STRPU	Strychnos pungens
TERSE	Terminalia sericea
BAIPL	Baikiaea plurijuga
BAPMA	Baphia massaiensis
BAUPE	Bauhia petersiana
COMEN	Combretum engleri
GRERE	Grewia retinervis
DIPCO	Diplorhynchus condylocarpon

REFERENCES

Selanniemi, T. and Chakanga, M., 2001. Manual for woody resource inventory. Namibia-Finland Forestry Programme. Directorate of Forestry. Windhoek.

Kamwi, J. and Laamanen, R., 2002. Inventory Report on the Woody Resources in Sikanjabuka Community Forest. Namibia-Finland Forestry Programme, Directorate of Forestry, Namibia.

Kanime, N. and Laamanen, R., 2003. Forest Inventory Report of Uukolonkadhi Community Forest. Namibia-Finland Forestry Programme, Directorate of Forestry, Namibia.

Erkkila, A. and Siiskonen, H., 1992. *Forestry in Namibia 1850-1990*. University of Joensuu, Finland.

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