PRACTICAL ADHERANCE TO CYPRESS PLANTATIONS' THINNING SCHEDULES IN KENYA

Mbae Njugi Muchiri
Kenya Forestry Research Institute
P. O. Box 20412
NAIROBI

A Paper Presented at the First KEFRI Scientific Conference
October 17 - 18, 1990

INTRODUCTION

Cupressus lusitanica Miller (Cypress) is the most important exotic softwood grown for saw and veneer logs in Kenya. At present there are about 73 000 ha (World Bank, 1989) of established plantations of cypress, which is 44.7% of the plantation area; and over 80% of the annual plantation planting programme (10 000 ha) of the saw and veneer wood management circle is of this species (Annon 1969, 1983b; FAO, 1974 and Mathu and Philip, 1979).

An extrapoliation of the World Bank (1989) saw and veneer logs supply and demand projection data from year 1990 to 2020, indicates that cypress will on yearly average account for 53.2% of the saw and veneer logs supply. Consequently, efficient management of cypress plantations need not be over emphasized. Unfortunately, this had not been the case because the Forest Department's plantation development has been on the area expansion at the expense of adequately managing the existing plantations. This had led to accummulation of a large backlog of thinnings because of insufficient transport to move labour and to provide supervision. In addition, poor road repair and maintenance hinders access to plantations, and there is insufficient equipment and hand tools. The extent of the backlog over all plantations is not clearly known, though it is estimated to be around 10 000 ha on a national basis. Though it is believed that this lack of thinning has reduced yields in the affected plantations, the extent is not well known. This study therefore attempts to quantify these effects in terms of total volume yield per hectare, mean diameter, stem quality, volume and value yields, and distribution of the number of trees and volume to diameter classes.

2. MATERIALS AND METHODS

2.1 The Study Area

Data were collected from Kiambu District during the period August to November 1984. The district was chosen because of its proximity to the main timber market i.e. Nairobi (Freeman and Solberg, 1979) and it is one of the leading forestry districts in the country - it accounts for 4.2% of the Forest Department's plantation areas.

2.2 Data Collection Methodology

Measurements were taken from twenty seven plantations aged between three and twenty six years. Though the original idea was to include plantations which had attained the rotation age (thirty years), not even a single plantation of this age existed because final felling is done much earlier - mostly at twenty four to twenty six years. The plantations were grouped into age classes of less than five years, six to ten, eleven to fifteen, sixteen to twenty, twenty one to twenty five and twenty six to thirty. Those sampled were then randomly chosen and sample plots located. The sampling design was therefore stratified systematic (Snedecor and Cochran, 1974; Freese, 1980). Sampling intensity varied from 0.5 to 3.9% within the stands;

increasing with the stand's age. Plots were either circular or rectangular and their sizes varied between 0.02 to 0.09 ha but were kept constant within a stand - rectangular ones were of more than 0.08 ha while the circular ones were less than 0.08 ha.

The data collected from a sample plot were:-

- breast height diameter (DBH), cm for each tree at 1.3 m above the ground using a diametre tape

- heights, m, DBH and the base diameters, cm of height of trees chosen systematically

- DBH and height of dominant trees, m; the number depended on the size of the plot and for this study dominant trees were taken as the one hundred largest diameters, defect tree and unforked trees per hectare

- trees dying from suppression and whether alive or dead

- stem quality; either straight and good form; slight bends and good form; crooked with excess taper

- in sample plots where thinning had been done, the following observations/measurements were made:

(a) year of cutting as per the Forest Department's records

(b) height, cm, measured as a vertical distance from the top of a stump down to the ground at a distance of 0.5 m from the centre of the stump; with the measuring point being kept to a distance of 25 cm or more from the edge of the stump.

2.3 Data Analysis

From the sample plots measurements, the following predictions were done:-

(a) Plantation's growth and yield by simulation upto the rotation age

(b) Initial basal area, dominant height and stocking

(c) Dominant height/age dependency

(d) Site classification

(e) Basal area and mean diameter

(f) Total volume

(g) Stem quality assessment

(h) Site of thinned trees

(i) Stand stumpage volume

3. RESULTS AND DISCUSSION

3.1 Comparison of Plantations Characteristics with those of Yield Tables

Since different types and intensities of thinning have been shown to have no significant differences on dominant height, the purpose of comparing plantations' average dominant heights to those of the yield tables was to find out whether the plantations conditions are similar to those under which the yield tables were built; and if they warrant being managed as per yield tables prescriptions. The comparison was done for site class II because 92% of the sampled plantations were in this site class.

3.1.2 Basal areas, number of stems and total volume

Total standing basal area and number of trees per ha calculated from the sample plots were compared with that predicted in the yield table. There was no clear relationship between number of stems and the basal area calculated from the sample plots, except in instances where the number of stems is abnormally large. This is contrary to expectations that stands with large number of standing trees should have higher basal areas (Karani, 1976). The reason for this could be that the trees removed during the thinning are not selected as stipulated in the thinning schedules i.e. smaller trees have to be removed (cf Wanene and Wachiuri, 1975; Peterson, 1967). Further, the tables show that the basal area calculated from the sample plots is generally less than that predicted in the yield table. When compared however as basal area percentage stocking, most of the plantations are within the acceptable range i.e. 75 - 125% (see Dubiansky, 1981; Davis, 1966).

Comparison of calculated total standing volume per ha from the sample plots to that predicted in the yield tables shows that about half of the plantations are generally overstocked and one eigth is understocked i.e. they have volume more than 125% and less than 75% of that predicted in the yield tables. It can therefore be said that the growing stock held in inventory is more than the expected. Consequently, the plantations' economic efficiency is reduced and that capital is unnecessarily tied up. This does not reflect well for a country like Kenya with a large deficit of payments (Omwami, 1983; Annon, 1984). The overstocked plantations are generally the younger ones (less than fifteen years old). The probable reason is that the size of trees in these plantations is smaller than that of those taken by sawmills (sawmilling is so far the only forestry industry in the area). The situation could be improved by establishing other forestry industries e.g. fibreboard or paper and pulp mill. This would however depend on the quantity of raw materials available in the district. Establishing of such industries would be a boom to the economy in that at the national economy level, some foreign exchange would be saved. Comparison of plantations' standing basal area calculated from the sample plots to that predicted in the yield tables in relation to age shows that on the average,the older plantations are 2.4% overstocked while the younger ones are 27.7% overstocked. It can therefore be said that the plantations are irregularly treated.

3.1.3 Mean Diameter

A comparison of mean diameter at breast height on the sample plots with that predicted in the yield tables shows that mean diameter at breast height on the sample plots is less than that predicted in the yield tables in the older plantations, while in the younger plantations there are no differences. The trend shows that thinning has not followed the stipulated thinning rules or that there has been no response in diameter growth as a result of thinning. On the average, the younger plantations mean dbh is 1.59% more than that in the yield tables and in the older plantations it is less by 14.33%.

3.2 Distribution of number of trees and volume by diameter classes

The distribution of number of trees and volume shows that the number of trees is normally distributed with diameter. However, when volume and number of trees' distribution are compared, the percentages number of stems in the smaller diameter classes is more than that of volume table and vice versa is true.

3.3 Stem Quality

Analysis of the collected data showed that in average, 92% of the stems sampled were in stem quality class one, 7% in stem quality class two and 1% in stem quality class three. However, there is no definite trend in any of the three quality classes with age. Differences were however observed between thinned and unthinned plantations of the same age.

3.4 Growth and Yield Prediction

The reason for predicting plantations' growth and yield was to quantify the effects of ovethinning, underthinning and delayed thinning on plantations' future growth and yield.

3.4.1 Total Volume Yield

The plantations' simulated total yield over a rotation are compared with the corresponding value of the yield tables. By corresponding values, it is implied that plantations history was not taken into account because it was suspected that thinning volumes are not recorded accurately. The comparison initial starting point was plantations' ages at the time the measurements were taken, and it was assumed that the plantations would henceforth be tendered as per the prevailing thinning and cutting schedules.

The results showed that the total yield of the plantations which are initially understocked in terms of both basal area and volume (basal area and volume less than 75% of that predicted in the yield tables) over a rotation of either twenty five or thirty years, would be less than that predicted in the yield tables.

In cases where plantations' initial basal area is less than that of the yield tables, total yield would be less than that of the yield tables over a rotation. The vice versa is however not true.

It can therefore be said that overthinning in the earlier age results to losses in total yield and that, these losses cannot be compensated in future, even if the plantations are strictly tendered as per the prevailing thinning and cutting shedules henceforth.

When expressed in percentage, the losses range from 2 - 37% and they tend to increase as the understocking percentage increases. Total yield in the overstocked plantations (basal area and volume stocking more than 125% of that of yield tables) is not much different from that of yield tables. Same is true for plantations where basal area stocking is more than that of the yield tables.

In the only plantation (3C Kieni) where thinning was delayed, there is a loss of about 20% in total yield.

A comparison of the two rotations show that the losses are generally more in the twenty five years' rotation.

From the foregoing observations, it can be seen that there are losses in total yield, if and whenever the thinning and cutting practices are not adhered to. Over a rotation of thirty years, the average losses are 9.5%.

3.4.2 Stumpage Value

Comparisons of the plantation's discounted stumpage value calculated from the sample plots to the corresponding values of the yield tables resulted to parallel explanations and observations to that of section 3.4.1 with one notable exception i.e. losses in total discounted stumpage value are generally more over a rotation of twenty five years (average 4.9%) than a rotation of thirty years (average 7.6%). It can be said that if the plantations continue to be tendered as per the current thinning schedule, it would be more profitable to clearfell at twenty five years instead of at thirty years if the Forest Department's objective is to maximize total discounted stumpage value.

One would however question the wisdom of thinning at age twenty two and clearfelling at twenty five years. Further, it should be borne in mind that the alternative most profitable to the Forest Department is not necessarily the most profitable from a national economy or a society's point of view (cf Kilkki, 1985). In deciding whether to change the rotation age from e.g. thirty to twenty five years, other factors such as the structural quality of the wood, size of the trees from logging costs and recovery point of view, etc, should be incorporated.

4. CONCLUSIONS AND RECOMMENDATIONS

The results of the study show that the current thinning schedules and practices have not been adhered to. As a result, the plantations standing volumes are more than that stipulated. On the average, the standing volumes are 27.7% more in the younger plantations (plantations of 15 years old or less) and 2.4% more in the older plantations (plantations more than 15 years old).

The older plantations, mean diameter at breast height is less than that stipulated by 14.33% and in the younger ones it is more by 1.59%. In cases where plantations are not tendered as per the stipulated prescriptions during the earlier stages of a rotation, losses in both total volume and value yields are incurred. In other words, if the plantations are understocked or overstocked during the earlier stages of a rotation, the inflicted volume and value losses cannot be compensated in future, even if the plantations are strictly tendered as per the stipulated prescriptions thereafter. It was further noted that value yield losses could be reduced if a rotation of twenty five years is adopted instead of the current one of thirty five years.

The trees are normally distributed to diameter classes; and more than 90% of the sampled trees are of good quality and there are no observed differences in variation of the stem quality with age. It was however observed that there are significant variations in the quality of stems in an unthinned and a thinned plantation of the same age.

In view of the foregoing observations, it is felt that the Forest Deparmtent should look into the possibility of improving cypress plantations management. Further studies should therefore be undertaken to find out:

(a) why the recommended thinning and cutting schedules are not followed

(b) whether the prevailing thinning and cutting schedules are optimal from an economic efficiency point of view. In this study, effects of overthinnning, underthinning and delayed thinning on timber structural quality and end use value should be incorporated.

REFERENCES

Annon, 1984: Republic of Kenya: Economic Survey. Central Bureau of Statistics, Nairobi.

1983b: Republic of Kenya 5th Development Plan. Government Printer, Nairobi

1969: Republic of Kenya. Forest Department, Technical Order No. 42, Nairobi

Dixon, W. J. 1983: (Chief Editor) BMDP Statistical Software. University of California Press Berkeley. Los Angeles. London, 733 pp.

Dubiansky, V. M. 1981: An Evaluation of Three Methods of Marking for First Thinning in Plantation Forest. South Africa Forestry Journal 116: 89 - 92.

FAO, 1974: Economic Analysis of Forestry Projects: Case Study No. 5. Kenya II Sawlog and Pulpwood Plantation Project/Rome, 51 pp.

Freeman, D. B. and Solberg, B. 1978: Journal of Economic Geography LXIX 3. Oslo, Norway.

Freese, F., 1980: Elementary Statistical Methods for Forests. Agriculture Handbook 317. U.S. Department of Agriculture, Forest Service. Washington, D.C. 20402. 87 pp.

Mathu, W. T. and Philip, M. S., 1979: Growth and Yield Studies of Cupressus lusitanica in Kenya. Division of Forestry, Faculty of Agriculture, Forestry and Veterinary Science, University of Dar es Salaam. Record No. 5.

Omwami, R. K. 1983: Economic Analysis of Plantation Forests in Kenya, LMST Method Applied. Master of Science Thesis in the Department of Social Economics, University of Helsinki.

Wanene, A. G. and Wachiuri, P., 1975: Variable Density Yield Tables for the Cypresse of Cupressus lusitanica group in Kenya. Forest Inventory Section, Karura.