EFFECTS OF DEVIATING FROM RECOMMENDED THINNING PRACTICES ON CYPRESS PLANTATIONS IN KENYA

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MUCHIRI M.N. 1993. Effects of deviating from recommended thinning practices on cypress plantations in Kenya. Practical adherence to the recommended thinning and cutting practices and their effects on the development of *Cupressus lusitanica* (cypress) plantations in Kiambu District, Kenya in terms of total volume and value yields, and distribution of trees and volume to diameter classes are examined. Data were collected from 27 plantations aged between 3 and 26 y in Kiambu District during the period August-November 1984. Although the original plan was to collect data from the plantations which had attained the rotation age (30 y), it was not possible to do so because the plantations were clearfelled much earlier - mostly between 24 and 26 y. Analysis of the data showed that the recommended thinning and cutting practices were not adhered to.

Key words: *Cupressus lusitanica* - thinning - Kenya - volume - value - fields - diameter classes

MUCHIRI, M.N. 1993. Kesan penyisihan dari amalan penjarangan yang disyorkan diladang cypress di Kenya. Penelitian telah dibuat terhadap amalan penjarangan dan penebangan yang disyorkan dan kesannya kepada pembangunan ladang-ladang *Cupressus lusitanica* (cypress) di Daerah Kiambu, Kenya, dari segi jumlah isipadu dan nilai hasil, dan taburan pokok dan isipadu buah kelas-kelas diameter dikaji. Data dikumpul dari 27 ladang-ladang berumur diantara 3 hingga 26 tahun dalam jangkamasa Ogos hingga November 1984. Walaupun pada cadangan asal hanya data dari ladang-ladang yang telah mencapa giliran pusingan 30 tahun. ianya tidak mungkin kerana ladang tersebut ditebang habis lebih awal, kebanyakanya antara 24-26 tahun. Analisis data menunjukkan amalan penjarangan dan penebangan yang disyorkan tidak dipatuhi.

Introduction

Cupressus lusitanica (cypress) is the most important exotic softwood grown for saw and veneer logs in Kenya. At present there are 73,000 *ha* of established plantations of cypress (FAO 1989), which is 44.7% of the plantation area; and over 80% of the annual plantations planting programme (10,000 ha) for saw and veneer wood has been taken up by this species (Anonymous 1969, 1983, FAO 1974, Mathu & Philip 1979). However, following the outbreak of *Cinara cupressi* (cypress aphid), which was first detected in 1990, cypress plantations will in future account for 30% of the annual plantations planting programme (Anonymous 1990).

The standard thinning regime prescribed for saw timber and pulpwood for all site classes is shown in Table 1.

Table 1. Thinning schedule for cypress in Kenya (Forest Department 1969)

Treatment	Top height or age	Stems per *ha* after treatment	Leave fraction (= No. of trees/No. of planting spots)
	Category I (Permanent pulpwood)		
Plant		1322	
Clearfell	15-20 *y*	-	-
or Thin	15 *y*	880	2/3
	Category II (Temporary pulpwood)		
Plant		1680	
Thin	9.25 *m*	1120	2/3
Clearfell	15-20 *y*	-	
or Thin	15 *y*	840	1/2
	Category III (Saw timber)		
Plant		1600	
Thin	11-25*m* but not before age 6 *y*	888	5/9
Thin	5 *y* after 1st thinning was prescribed	533	1/3
Thin	10 *y* after 1st thinning was prescribed	266	1/6

An extrapolation of the FAO (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 cannot be over-emphasized. Unfortunately, this has not been the case because the Forest Department's plantation development has been on area expansion at the expense of adequately managing the existing plantations. This has led to accumulation of a large backlog of thinnings because of insufficient transport to mobilise 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, but it is estimated to be around 10,000 *ha* on a national basis. Though it is believed that 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 y elds.

Materials and methods

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 in Kenya, *i.e.* Nairobi (Freeman & Solberg 1978) and it is o:ne of the leading forestry districts in the country - accounting for 4.2% of the Forest Department's plantation area.

Data collection

Measurements were taken from 27 plantations aged between 3 and 26 *y*. Although the original idea was to include plantations which had attained the rotation age (30 *y*), not even a single plantation of this age existed because final felling was done much earlier - mostly at 24 to 26 *y*. The plantations were grouped into age classes of less than 5, 6 to 10, 11 to 15, 16 to 20, 21 to 25 and 26 to 30 *y*. Those sampled were then randomly chosen and sample plots located. The sampling design was therefore stratified systematically (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 stand - rectangular ones were of more than 0.08 *ha* while the circular ones were less than 0.08 *ha*.

The data collected for a sample plot were:-

- breast height diameter (DBH) in *cm* for each tree at 1.3 *m* above the ground using a diameter tape.
- heights in *m*, DBH and the base diameters in *cm* of trees chosen systematically.
- DBH and height of dominant trees: the number depended on the size of the plot and for this study dominant trees were taken as the one hundred trees per hectare which had the largest diameters and were defect free and unforked.
- trees dying from suppression.
- stem quality; either straight and good form; slight bends and good form; and crooked with excess taper.
- in the plots where thinning had been done, the following observations/ measurements were made:
  - a) Year of felling as per the Forest Department's records.
  - b) Stump height in *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.

Data analysis

From the sample plot measurements the following predictions were made:

i) Dominant height/age dependency and site classification
ii) Initial basal area, dominant height and stocking
iii) Basal area and mean diameter
iv) Total volume
v) Stem quality
vi) Size of thinned trees
vii) Growth and yield - total yield was simulated over a rotation so as to enable comparison of the sample plot data with those of the prescribed management regime. The comparison's initial starting point was the plantations' ages at the time of measurements and it was assumed that the plantations would henceforth be managed as per the prescribed management schedule.
viii) Plantation stumpage value - plantation stumpage values were calculated from the predicted volume data and the Forest Department's stumpage royalty tables presented in Appendix 1. Present discounted stumpage values were then calculated at an interest rate of 8% per annum which is the Forest Department's investments accepted rate of return (FAO Omwami 1983, 1974).

Results and discussion

Dominant height/age dependency and site clarification

Since 92% (Wanene & Wachiuri 1975, Mathu & Philip 1979) of the cypress plantations in Kenya are of Site Class II, the sampled plantations dominant height/age dependency curve was compared to that of that site class. The results are presented in Figure 1 and it can be seen that the sampled plantations data conform to those of the prescribed regime for Site Class II. Consequently, growth and yield figures for *C. lusitanica* plantation of the prescribed regime Site Class II are presented in Appendix 2.

Basal areas, number of stems and total volume

Total standing basal area and number of trees per *ha* calculated from the sample plots are compared with those values of the prescribed regime in Table 2. The table shows no clear relationship between the 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 standing 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 schedule, that is smaller trees have to be removed (cf. Petterson 1967, Wanene & Wachiuri 1975). Further, the tables show that the basal area calculated from the sample plots is generally less than that predicted in the prescribed regime. However, when compared as basal area percentage stocking, most of the plantations are within the acceptable range, that is 75 - 125% (see Dubiansky 1981).

In Table 3 total standing volume per *ha* calculated from the sample plots is compared with that predicted in the prescribed regime. The table shows that

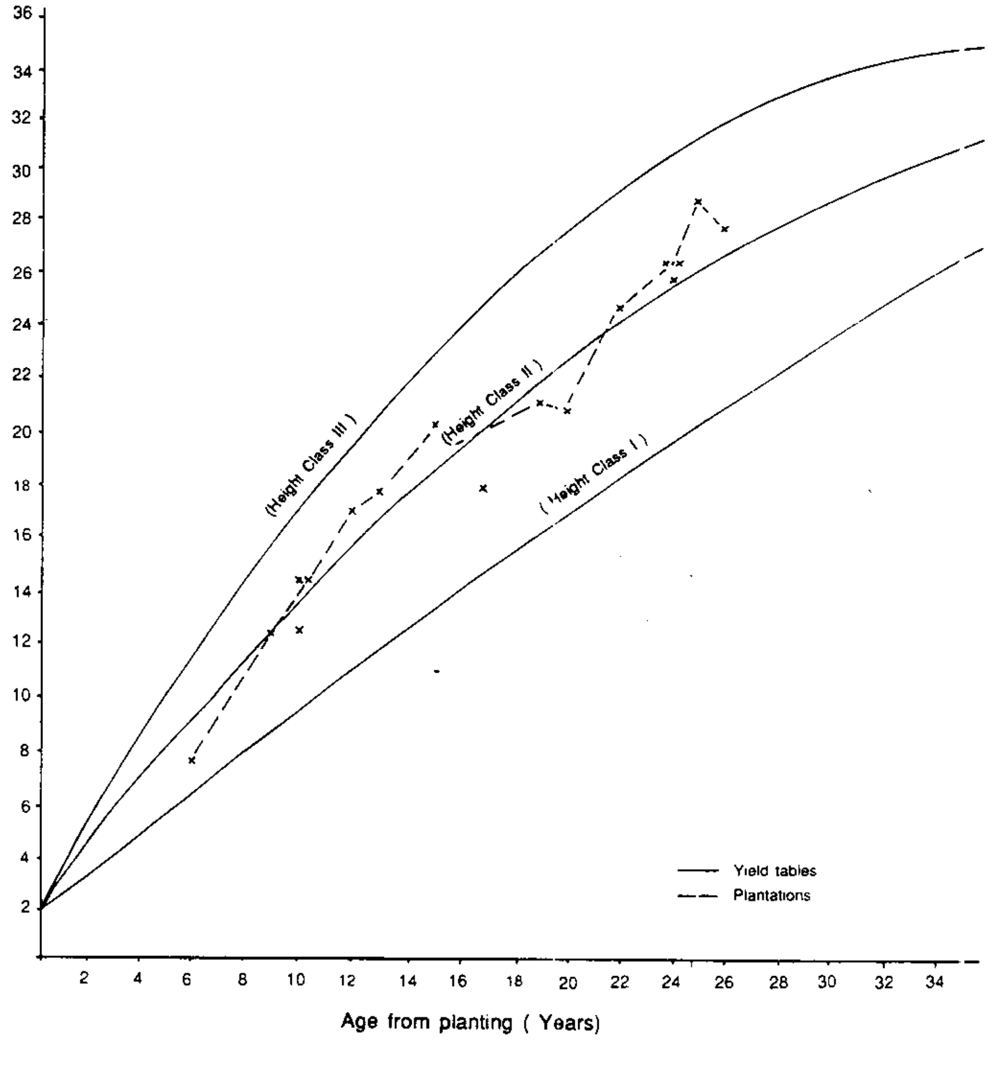

Figure 1. Comparison of average dominant height on the sample plots with those in the yield tables

Table 2. Comparison of total standing basal and number of trees calculated from sample plots with those predicted in the yield tables*

Plantation No.	Forest station	Age *y*	Site class	Basal area, m^2		No. of trees		Basal area Stocking, %
				Sample plots	Yield tables	Sample plots	Yield tables	
8A	Kinale	6T	II	9.5	13.5	757	1300	70.4
12C	Kieni	9T	II	18.8	19.1	596	888	98.4
12A	Kieni	10T	II	20.1	20.8	450	"	96.6
5A	Kerita	10T	II	26.9	20.8	713	"	129.3
4E	Kinale	10T	II	32.2	20.8	730	"	154.3
4I	Kerita	12T	I	20.0	33.6	368	"	59.3
15A	Kerita	12T	II	18.7	21.6	508	"	86.6
4W	Kinale	13T	II	26.5	23.5	433	533	114.5
11A	Kerita	15T	II	31.8	28.3	464	"	112.4
2I	Kerita	15T	III	24.7	20.7	483	"	119.3
12K	Kinale	16T	II	24.7	29.5	398	"	83.7
4L	Kinale	17T	II	20.5	29.6	480	"	69.3
2A	Kieni	17T	II	36.6	29.6	480	"	123.6
4S	Kinale	19T	II	25.8	31.1	426	355	82.9
3C	Kieni	19U	II	43.8	31.1	426	"	139.9
7D	Kerita	20T	II	31.6	33.3	208	"	94.9
7I	Kieni	22T	II	31.0	36.6	220	266	84.7
7K	Kieni	22T	II	55.5	37.7	350	"	147.2
2G	Kieni	24T	II	29.8	37.9	255	"	78.6
6F	Kieni	24T	II	35.4	37.9	363	"	93.4
10C	Kinale	24T	II	41.7	37.9	283	"	110.0
9E	Kerita	24T	II	39.5	37.9	300	"	104.2
12C	Kinale	25T	II	35.1	38.2	401	"	91.9
3C	Kieni	26T	II	33.9	39.7	213	"	85.4

U = Unthinned
T = Thinned
*Assuming strict adherence to thinning prescriptions.

about half of the plantations are generally overstocked and one eighth is understocked, that is they have volumes more that 125% and less than 75% of that predicted in the prescribed regime. The growing stock held in inventory is therefore more than the expected. Consequently, the plantations' economic efficiency is reduced and capital is unnecessarily tied up. This does not reflect well for a country like Kenya with a large deficit of payments (Anonymous 1983, Omwami 1983). The overstocked plantations are generally the younger ones (less than 15 *y* 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 forest industry in the area). The situation could be improved by establishing other forestry industries such as a fiberboard or paper pulp mill. This would, however, depend on the quantity of raw materials available in the district. Establishing such industries would be a boon to the economy in that at the national economy level, some foreign exchange would be saved.

In Figure 2 the calculated standing basal area for the plantations is compared to that of the prescribed regime in relation to age. On the average the older

Table 3. Comparison of total standing volume per *ha* calculated from sample plots with that predicted in the yield tables*

Plantation No.	Forest station	Age, y	Site Class	Volume per *ha* (m^3) Sample plots	Yield tables	Volume stocking percentage
8A	Kinale	6T	II	61	72	84.7
12C	Kieni	9T	II	129	115	112.2
12A	Kieni	10T	II	136	131	103.8
5A	Kerita	10T	II	238	131	181.7
4E	Kinale	10T	II	203	131	154.9
41	Kerita	12T	I	174	285	61.1
15E	Kerita	12T	II	155	152	102.0
4W	Kinale	13T	II	224	173	129.5
11A	Kerifa	15T	11	291	223	130.5
21	Kerita	15T	III	191	108	176.9
12K	Kinale	16T	II	219	240	91.3
4L	Kinale	17T	II	172	252	68.3
2A	Kieni	17T	II	349	252	138.5
4S	Kinale	19T	II	230	283	81.3
3C	Kieni	19U	II	428	283	151.2
7D	Kerita	20T	II	281	311	90.4
7I	Kieni	22T	II	316	360	87.8
7K	Kieni	22T	II	563	360	156.4
2G	Kieni	24T	II	325	381	85.3
6F	Kieni	24T	II	171	381	44.9
10C	Kinale	24T	II	443	381	116.3
9E	Kerita	24T	II	414	381	108.7
12C	Kinale	25T	II	401	399	100.5
3C	Kieni	26T	II	374	428	87.4

*Assuming strict adherence to thinning prescriptions.

plantations are 2.4% overstocked while the younger ones are 27.7% overstocked. It can therefore be said that the plantations are irregularly treated (cf. Petterson 1967, Wanene & Wachiuri 1975).

Mean diameter

In Figure 3 the mean DBH on the sample plots is compared with that of the prescribed regime. From the figure it can be seen that the mean DBH on the sample plots is less than that of the prescribed regime in the older plantations while it is slightly more in the younger plantations. It could therefore be deduced that the stipulated thinning rules are not followed or that there has been no response in diameter growth as a result of thinning, if it is assumed that the prescribed regime is ideal. On the average, the younger plantations mean DBH is 1.59% more than that of the prescribed regime and in the older plantations it is less by 14.33%.

Stem quality

Figure 4 shows stem quality variation with age on the sample plots. On average 92% of the stems sampled were in stem quality one, 7% in stem quality two and 1%

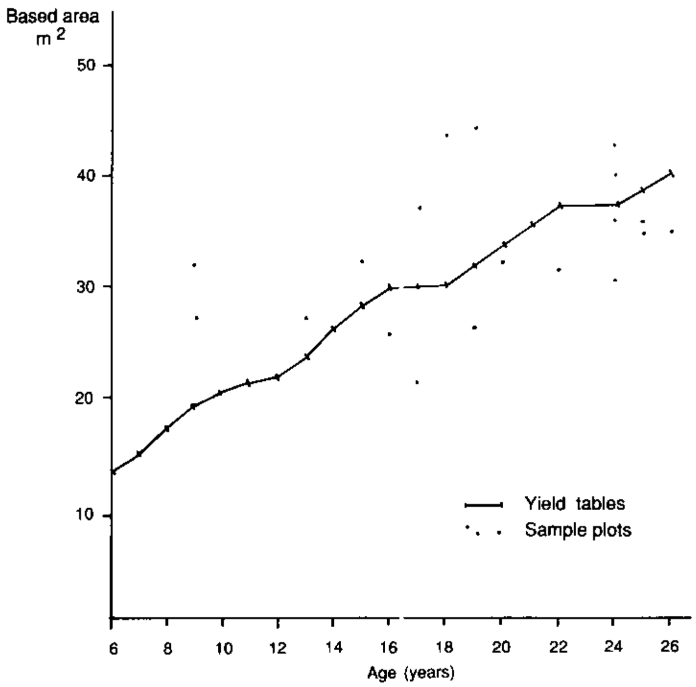

Figure 2. Standing basal area per *ha* on the sample plots and from the yield tables

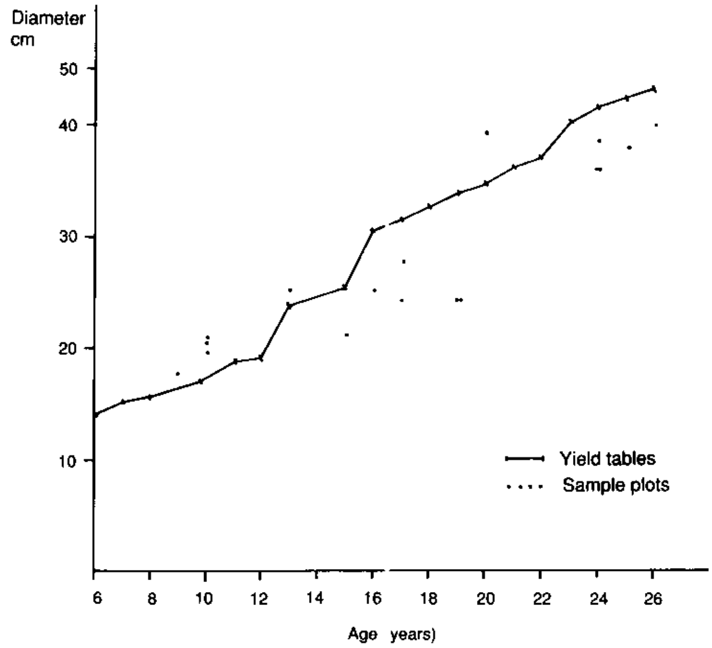

Figure 3. Mean diameter at breast height of standing crop before thinning on the sample plots and in the yield tables

in stem quality three. From Figure 4 it is evident that there is no definite trend in stem quality variation in any of the three quality classes with age. However, there are differences between unthinned and thinned plantations of the same age; in the unthinned plantation, 70% of the stems were in stem quality class one, 29% in the stem quality class two and 1% in stem quality class three, while the respective percentages for a thinned plantation were 97, 3 and 0%. It would, however, be erroneous to make inferences from this aspect because observations were made in only two plantations.

Total volume yield

In Table 4 the simulated total volume yield data of the sampled plantations over two rotations are compared with the corresponding values of the prescribed regime.

The results show 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, is less than that predicted in the yield tables.

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

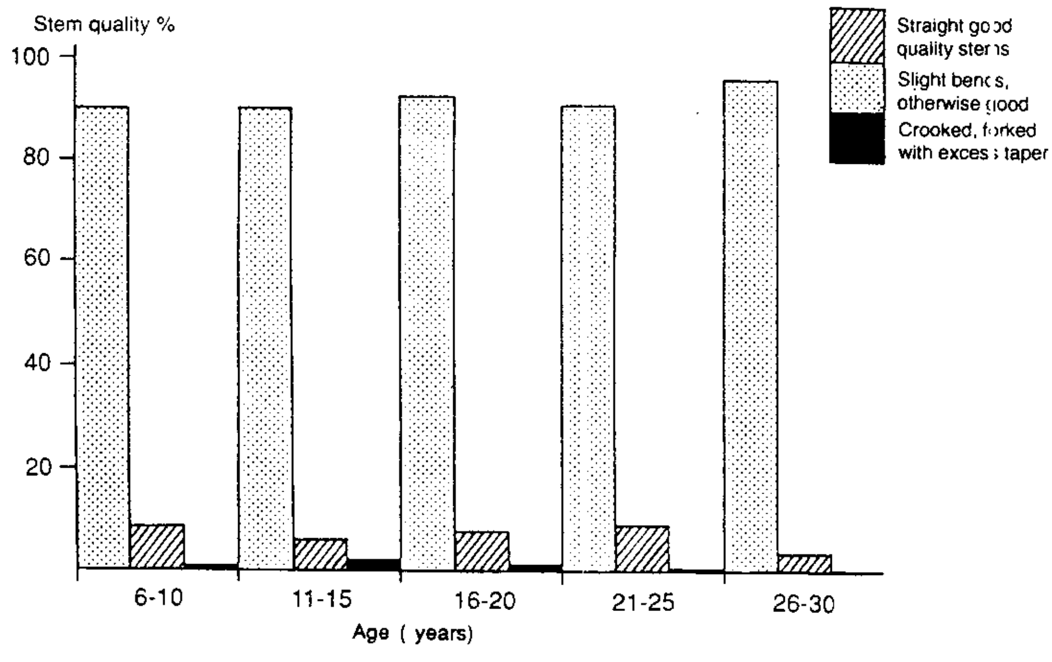

Figure 4. Stem quality variation by age classes in *Cupressus lusitanica* plantations in Kiambu district

When expressed in percentage, the losses range from 2-3% 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. The same is true for plantations where basal area stocking is more than that of the yield tables.

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

Table 4. Comparison of simulated total volume yield of sampled plantations to that of the prescribed regime yield tables over rotation

Plantation	Forest station	Sample plots volume, m^3		Yield tables volume, m^3		Percentage deviation from yield tables	
		30 *y*	25 *y*	30 *y*	25 *y*	30 *y*	25 *y*
8A	Kinale	682	602	742	651	- 8.1	- 7.5
12C	Kieni	671	589	713	622	- 5.9	- 5.3
12A	Kieni	607	514	713	622	- 14.9	- 17.4
5A	Kerita	697	615	713	622	- 2.4	- 1.1
4E	Kinale	744	659	713	622	4.3	5.9
15A	Kerita	516	437	650	559	- 20.6	- 21.8
4W	Kinale	637	551	650	559	- 2.0	- 1.4
11A	Kerita	623	541	650	559	- 4.2	- 3.2
12K	Kinale	531	432	650	559	- 18.3	- 22.7
4L	Kinale	409	358	650	559	- 37.1	- 39.5
2A	Kieni	614	532	650	559	- 5.5	- 4.8
4S	Kinale	530	452	568	477	- 6.7	- 5.2
3C	Kieni	569	493	713	622	- 20.0	- 20.7
7D	Kerita	468	387	568	477	- 17.6	- 18.8
7I	Kieni	449	387	568	477	- 23.0	- 18.8
7K	Kieni	566	477	568	477	- 0.4	0.0
2G	Kieni	420	355	496	405	- 15.3	- 17.3
6F	Kieni	489	392	496	405	- 1.4	- 3.2
10C	Kinale	554	451	496	405	11.7	11.4
9E	Kerita	553	431	496	405	11.5	6.4
12C	Kinale	454	393	496	405	- 8.5	- 3.0
3C	Kieni	432	-	496	-	-12.9	-

yield, if and whenever the thinning and felling practices are not adhered to. Over a rotation of thirty years, the average loss is 9.5%.

Stumpage value

Comparison of discounted stumpage value of the plantation calculated from the sample plots with the corresponding values of the yield tables results in explanations and observations similar to those for the total volume with one notable exception, that is losses in total discounted stumpage value are generally less 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 managed as per the current thinning schedule, it would be more profitable to clearfell at twenty-five years instead of thirty years if the Forest Department's objective is to maximise 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 society's point of view (cf. Kilkki 1985). In deciding whether to change the rotation age from, for example, thirty to twenty-five years, other factors such as the structural quality of the wood, size of the trees, logging costs and recovery, *et cetera* should be incorporated.

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 volumes are 27.7% more in the younger plantations (plantations of 15 y old or less) and 2.4% more in the older plantations (plantations more than 15 y old).

The mean DBH of the older plantations is less than that stipulated by 14.3% and in the younger ones it is more by 1.59%. In cases where plantations are not managed as per the stipulated prescriptions during the earlier stages of a rotation, losses in both total volume and value yield are incurred. In other words, if the plantations are understocked or overstocked during the earlier stages of a rotation, the inflicted volume and value yield losses cannot be compensated in the future, even if the plantations are strictly managed 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 years.

The diameter classes are normally distributed and more than 90% of the sample 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 unthinned and thinned plantations of the same age.

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

a) Why the recommended management schedules are not followed;

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

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Appendix 1. Stumpage royalty for pine & cypress 1984/85

	Pine		Cypress		
Mean DBH *cm*	Clearfellings Ksh/m^3	Thinnings Ksh/m^3	Clearfellings Ksh/m^3	Thinnings Ksh/m^3	Mean DBH *cm*
-			67.57	60.81	15
-			75.55	68.00	16
-			83.40	75.06	17
-			91.06	81.95	18
-			98.48	88.63	19
20	89.85	80.42	105.70	95.13	20
21	95.78	85.72	112.68	101.41	21
22	101.52	90.86	119.44	107.50	22
23	107.06	95.80	125.95	113.36	23
24	112.40	100.60	132.24	119.02	24
25	117.53	105.19	138.27	124.44	25
26	122.51	109.65	144.13	129.72	26
27	127.26	113.00	149.72	134.75	27
28	131.87	118.00	155.14	139.63	28
29	136.31	128.00	160.36	144.32	29
30	140.58	125.82	165.39	148.85	30
31	144.70	129.51	170.24	153.22	31
32	148.67	133.06	174.90	157.41	32
33	152.49	136.48	179.40	161.46	33
34	156.20	139.80	183.76	165.38	34
35	159.77	142.99	187.96	169.16	35
36	163.21	146.07	192.01	172.81	36
37	166.54	149.05	195.93	176.34	37
38	169.73	151.91	199.68	179.71	38
39	172.84	154.69	203.34	183.01	39
40	175.84	157.38	206.87	186.18	40
41	178.75	159.98	210.29	189.26	41
42	181.57	162.51	213.61	192.25	42
43	184.27	164.92	216.79	195.11	43
44	186.91	167.28	219.89	197.90	44
45	189.47	169.58	222.90	200.61	45
46	191.93	171.78	225.80	203.22	46
47	194.33	173.93	228.62	205.76	47
48	196.66	176.01	231.37	208.23	48
49	198.93	178.04	234.04	210.64	49
50	201.11	179.99	236.60	212.94	50
51	203.23	181.89	239.09	215.18	51
52	205.31	133.75	241.54	217.39	52
53	207.33	185.56	243.92	219.53	53
54	209.27	187.30	246.20	221.58	54
55	211.18	189.01	248.45	223.61	55
56	213.02	190.65	250.61	225.55	56
57	214.83	193.27	252.74	227.47	57
58	216.58	193.84	254.80	229.32	58

Appendix 1. Stumpage royalty for pine & cypress 1984/85 (Cont'd)

	Pine		Cypress		
Mean DBH *cm*	Clearfellings Ksh/m^3	Thinnings Ksh/m^3	Clearfellings Ksh/m^3	Thinnings Ksh/m^3	Mean DBH *cm*
59	218.29	195.37	256.81	231.13	59
60	219.96	196.86	258.78	232.90	60
61	221.58	193.31	260.68	234.61	61
62	223.15	199.72	262.53	236.28	62
63	224.70	201.11	264.35	237.92	63
64	226.19	202.44	266.10	239.49	64
65	227.64	203.74	267.81	241.03	65
66	229.08	205.03	269.50	242.55	66
67	230.49	206.29	271.17	244.05	67
68	231.85	207.51	272.76	245.48	68
69	233.17	208.69	274.32	246.89	69
70	234.47	209.85	275.85	248.27	70
71	235.76	211.01	277.36	249.62	71
72	236.93	212.10	278.80	250.92	72
73	238.20	213.19	280.23	252.21	73
74	239.39	214.25	281.64	253.48	74
75	240.53	215.27	282.98	254.68	75
76	241.69	216.31	284.34	255.91	76
77	242.79	217.30	285.64	257.08	77
78	243.88	218.27	286.92	258.23	78
79	244.95	219.23	288.18	259.36	79
80	245.99	220.16	289.40	260.46	80
81	247.03	221.09	290.62	261.56	81
82	248.01	221.97	291.78	260.60	82
83	249.00	222.86	292.94	263.65	83
84	249.96	223.71	294.07	264.66	84
85	250.91	224.56	295.19	265.67	85
86	251.82	225.38	296 26	266.63	86
87	252.72	226.18	297 32	267.59	87
88	253.62	226.99	298 38	268.54	88
89	254.51	227.79	299 42	269.48	89
90	255.36	288.55	300 42	270.38	90
91	256.17	209.27	301.38	271.24	91
92	257.00	230.02	302.35	272.12	92
93	257.82	230.75	303.32	272.99	93
94	258.60	231.45	304.23	273.81	94
95	259.39	233.15	305.16	274.64	95
96	260.16	232.84	306.07	275.46	96
97	260.92	233.52	306.96	276.26	97
98	261.66	234.19	307.83	277.05	98
99	262.37	234.82	308.67	277.80	99
100	263.09	235.47	309.52	273.57	100

Appendix 2. Growth and yield for *C. lusitanica* plantation in Kenya

Age	Standing crop before thinning					Thinnings			
	Hdom	Stems/*ha*	Mean diameter	Ba/*ha*	Vol/*ha*	Stems/*ha*	Mean diameter	Ba/*ha*	Vol/*ha*
y	*m*		*cm*	m^2	m^3		*cm*	m^2	m^3
6	9.0	1347	14.1	12.5					
7	10.2	1347	14.7	15.1					
8	11.4	888	15.7	17.3	100	-	12.7	5.6	29
9	12.5	"	16.5	19.1					
10	13.6	"	17.3	20.8					
11	14.7	"	17.4	21.2					
12	15.7	533	22.7	21.6	153	355	18.7	9.7	63
13	16.8	"	23.7	23.5					
14	17.7	"	24.9	26.0					
15	18.7	"	26.0	29.3					
16	19.5	"	26.5	29.5					
17	20.5	"	26.6	29.6					
18	21.4	355	32.6	29.7	262	178	25.9	9.4	82
19	22.3	"	33.4	31.1					
20	23.1	"	34.6	33.3					
21	23.8	"	35.5	35.1					
22	24.6	266	41.9	36.6	360	89	32.0	7.1	72
23	25.3	"	42.5	37.7					
24	26.0	"	42.7	39.9					
25	26.7	"	42.8	38.2	405				
26	27.3	"	43.6	39.7					
27	27.9	"	44.0	40.5					
28	28.5	"	44.5	41.3					
29	29.0	"	44.9	42.1					
30	29.5	"	45.3	42.9	496				

(Hdom = dominant height ; Ba = basal area ; Vol = volume)