Profitability Potential of Forest Plantations in Forest Conservancies of Kenya

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Abstract

Eastern, Central and Mau Forest conservancies constitute about 90% of all forest plantations in Kenya. The Kenya government banned timber harvesting in 1999, which is still in force in some conservancies. Forest plantations have subsequently deteriorated in volume and value due to over-maturity. The main objective of this study was to show the profitability potential of Forest plantations in Eastern, Central and Mau Forest Conservancies with the intention of showing their worth before deteriorating further and losing value. Data was collected from selected forest stations in Eastern, Central and Mau Conservancies. Compartment data was obtained from both mature and over-mature plantations. Volume tables were used to convert compartment data to volumes. Kenya Forest Service General Order was then used to convert volumes to revenues and Cost benefit analysis used to determine the profitability. Results showed that revenues per hectare for *Pinus patula* over-mature plantations were between Kshs 508,170 and 821,156 while for mature plantations between Kshs. 297,695 and 864,355. Revenues for over-mature *Cupressus lusitanica* ranged between Kshs. 475,243 and 894,381 while for mature ranged from Kshs 664,411 to Kshs. 1,063,993. Per hectare forest management cost was found to average Kshs. 80,000. Profits per hectare were found to range from Kshs. 220,576 to 975,700. This study concluded that the profitability potential of forest plantations in Eastern, Central and Mau forest conservancies is great and recommends that an inventory of all mature and over-mature forest plantations be taken to be a basis for fast tracking timber harvesting especially of the mature and over-mature forest plantations, which over time would decay and deteriorate in volume and value.

Keywords: *Profitability, Forest Plantations, Forest Conservancies*

Introduction

Forest Plantations on public lands were established primarily for the production of wood and other forest products and services for commercial purposes such as production of timber of commercial and industrial value, fibres and fuel (Ludeki et al., 2006). Forest Plantations of Kenya are divided into 10 Forest conservancies namely; Ewaso North Conservancy, Coast Conservancy, North Eastern Conservancy, Eastern Conservancy, Central Highlands Conservancy, North Rift Conservancy, Mau Conservancy, Western Conservancy, Nyanza Conservancy and Nairobi Conservancy (KFS, 2012).

Eastern, Central Highlands and Mau Forest conservancies constitute about 90% of all forest plantations in Kenya. These conservancies have been leading nationally in the production of commercial timber (Odwori, et al., 2007) and subsequently revenue generation from forest plantations. However the Kenya government put a ban on timber harvesting in 1999, which is still currently in force in some conservancies such as Eastern, Central Highlands and Mau Forest conservancies, inorder to allow auditing of the industrial forests. The government took this decision after concerns were raised that the harvesting and management practices used in forest plantations were unsustainable (KFMP, 1994).

The forest estate presently contain a lot of mature and over mature forest plantations whose merchantable timber volumes, and their resultant revenue and profit potentials are yet to be ascertained. Forest plantations have subsequently deteriorated in volume and value due to wood decay and other problems associated to over-maturity. Stock taking of merchantable volumes of mature and over-mature forest plantations would be important as it would show the worth of these plantations. This may assist forest estate policy makers and stakeholders in making inter-temporal and spacial timber harvesting decisions, such that optimum merchantable volumes, revenues and profits are realized from the forest estate. The main objective of this study was to show the profitability potential of forest plantations in Eastern, Central and Mau Forest Conservancies with the intention of showing their worth before deteriorating further and losing value. Hopefully this will be a basis for fast tracking timber harvesting especially of the mature and over-mature forest plantations, which over time would decay and deteriorate in volume and value.

Materials and Methods

Study area

The study was conducted in Forest Plantations of Eastern, Central and Mau Forest Conservancies of Kenya (Figure 1).

Mau forest conservancy comprise of 9 forest zones namely, Transmara, Kajiado, Koibatek, Nakuru, Kericho, Buret, Bomet, Narok, and HOC Mau conservancy (KFS, 2012).
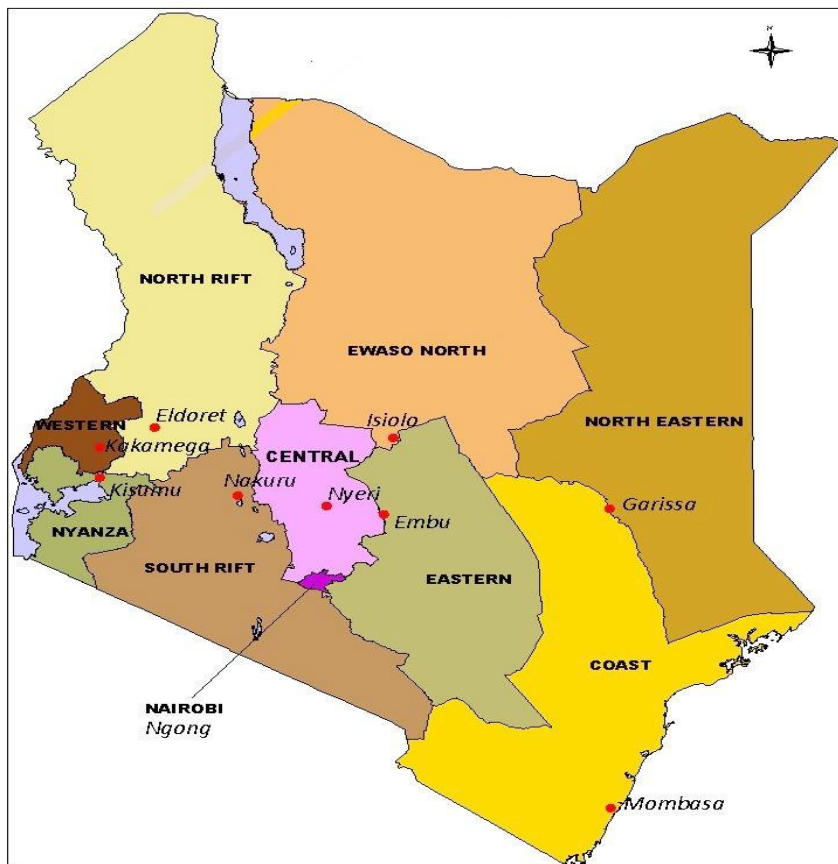

Figure 1: Map of Kenya showing the location of Forest Conservancies (adopted from KFS, 2012)

Research Design

Sampling Design

Purposive sampling was used that selectively targeted forest stations that had both mature and over-mature plantations in Eastern, Central and Mau Forest Conservancies. Mature and Over-mature plantations were used because these are the only plantations currently with merchantable volumes that would yield revenues. The mature plantations were the forests aged between 25 and 30 years old while the over-mature plantations were those aged above 30 years old.

Data Collected

Data was obtained from Forest Station Compartment registers. The compartment data used was Mean Diameter at Breast Height (DBH), Mean height, Density and Area for both mature and over-mature plantations. Forest establishment and maintenance costs per hectare of plantation forest were also obtained from forest station records.

Data Analysis

Volume tables from Kenya Forest Service (KFS) inventory were used to convert compartment data to volumes. The saw wood volume of forest plantations per hectare was determined through multiplying the Density of the plantation (i.e. stems per hectare) by the saw wood volume per tree. This was done for the two species, *C. lusitanica* and *P. patula*, for the three conservancies, and for both mature and over-mature forest plantations.

Kenya Forest Service General Order was used to convert the saw wood volumes to revenues. The revenue per hectare was determined through multiplying volume per hectare by the stumpage royalty. This was done for each species and age class per hectare for the forest plantations in the three conservancies. Total revenue was then obtained through multiplying revenue per hectare by the total area under forest plantations.

Profitability of the forest plantations was determined by use of Cost-Benefit analysis. The profit per hectare of forest plantation was obtained by subtracting the management cost per hectare from revenue per hectare. The management cost was the sum of cost incurred in establishing a forest plantation and cost of maintaining the plantation till harvesting age.

Results

The Plantation areas by species and age class in hectares were as shown in Table 1. The Compartment inventory averages were as shown by Table 2 and Saw wood volumes by species and age class were as shown by Table 3. Table 4 shows the revenues by species and age class per hectare while Table 5 shows the total potential revenues by species and age class. The results of potential profits by species and age class per hectare are shown in table 6.

Table 1: Plantation areas by Species and Age Class in Hectares

CONSERVANCY	SPECIES	AGE CLASS	
		25 - 30 YEARS	>30 YEARS
Eastern	C. lusitanica	1,492	923
	P. patula	36	1,378
Mau	C. lusitanica	5,037	6,828
	P. patula	642	3,325
Central Highlands	C. lusitanica	2,458	3,344
	P. patula	182	3,142

Table 2: Compartment inventory averages

Conservancy	SPECIES	25 – 30 YEARS			> 30 YEARS		
		DBH (cm)	TOP HEIGHT (m)	DENSITY (stems/Ha)	DBH (cm)	TOP HEIGHT (m)	DENSITY (stems/H)
Eastern	C. lusitanica	32.97	23.5	426	37.5	22.0	303
	P. patula	36.8	19.3	142	40.7	26.5	133
Mau	C. lusitanica	31.0	23.6	300	37.0	26.0	250
	P. patula	36	27.1	300	39.1	32.2	200
Central	C. lusitanica	35	21.1	287	36.6	21.1	179
Highlands	P. patula	37.2	26.7	252	42.7	28.5	159

Table 3: Saw wood volumes by Species and age class

Conservancy	SpecieS	AGE CLASS					
		25 – 30 YEARS			> 30 YEARS		
		Volume/ tree (M₃)	Density (stems/Ha)	Volume/ Hectare	Volume/ tree (M₃)	Density (stems/Ha)	Volume/ Hectare
Eastern	C. lusitanica	0.923	426	393.198	1.066	303	322.998
	P. patula	0.845	142	119.99	1.515	133	201.495
Mau	C. lusitanica	0.827	300	248.1	1.239	250	309.75
	P. patula	1.166	300	349.8	1.641	200	328.2
Central Highlands	C. lusitanica	0.874	287	250.838	0.963	179	172.377
	P. patula	1.233	252	310.716	1.795	159	285.405

Table 4: Revenues by species and age class per hectare

Conservancy	Species	AGE CLASS					
		25 – 30 YEARS			> 30 YEARS		
		Stumpage Royalty Kshs/m₃	Volume per hectare	Revenue per hectare	Stumpage Royalty Kshs/m₃	Volume per hectare	Revenue per hectare
Eastern	C. lusitanica	2,706	393.198	1,063,993.8	2,769	322.998	894,381.46
	P. patula	2,481	119.99	297,695.19	2,522	201.495	508,170.39
Mau	C. lusitanica	2,678	248.1	664,411.8	2,757	309.75	853,980.75
	P. patula	2,471	349.8	864,355.8	2,502	328.2	821,156.4
Central Highlands	C. lusitanica	2,732	250.838	685,289.42	2,757	172.377	475,243.39
	P. patula	2,481	310.716	770,886.4	2,539	285.405	724,643.3

Table 5: Total potential revenues by species and age class

CONSERVANCY	SPECIES	AGE CLASS					
		25 – 30 YEARS		> 30 YEARS			
		Revenue per hectare	Total area (Ha)	Total Revenue	Revenue per hect-are	Total area (Ha)	Total Revenue
Eastern	C. lusitanica	1,063,993.8	1,492	1,587,478,749.6	894,381.46	923	825,514,087.6
	P. patula	297,695.19	36	10,717,026.84	508,170.39	1,378	700,258,797.4
Mau	C. lusitanica	664,411.8	5,037	3,346,642,236.6	853,980.75	6,828	5,830,980,561.0
	P. patula	864,355.8	642	554,916,423.6	821,156.4	3,325	2,730,345,030
Central Highlands	C. lusitanica	685,289.42	2,458	1,684,441,394.4	475,243.39	3,344	1,589,213,896.20
	P. patula	770,886.4	182	140,301,324.8	724,643.3	3,142	2,276,829,248.6
TOTAL				7,324,497,155.80			13,953,141,620.80

Table 6: Potential profits by Species and age class per hectare

CONSERVANCY	SPECIES	25 – 30 YEARS			> 30 YEARS		
		Revenue /ha	Management cost/ha	Profit /ha	Revenue /ha	Management cost/ha	Profit /ha
Eastern	C. lusitanica	1,063,993.8	88,293.75	975,700.05	894,381.46	88,293.75	806,087.71
	P. patula	297,695.19	77,119.10	220,576.09	508,170.39	77,119.10	431,051.29
Mau	C. lusitanica	664,411.8	88,293.75	576,118.05	583,980.75	88,293.75	765,687.70
	P. patula	864,355.8	77,119.10	787,236.7	821,156.4	77,119.10	744,037.30
Central High-lands	C. lusitanica	685,289.42	88,293.75	596,995.67	475,243.39	88,293.75	386,949.64
	P. patula	770,886.4	77,119.10	963,767.3	724,643.3	77,119.10	647,524.20

Discussion

Mau forest conservancy had the largest area of land under mature and over-mature plantations of *Pinus patula* and *Cupressus lusitanica* (Table 1). This agrees with findings of KFMP (1994), GOK/FAO (1994) and Odwori and Ogweno (2001). The study also showed that revenues per hectare for *Pinus patula* over-mature plantations were between Kshs 508,170 and 821,156

while for mature plantations between Kshs. 297,695 and 864,355 (Table 4). Revenues for over-mature *Cupressus lusitanica* ranged between Kshs. 475,243 to 894,381, while for mature plantations between Kshs. 664,411 to 1,063,993 (Table 4). Revenues from over-mature plantations were lower compared to those from the mature plantations. According to White (1997), Wanene (1994) and Owino and Ndinga (2004), the low revenues from over-mature plantations are due to incomplete silvicultural treatments done, severe game damage, severe windthrows and loss of volume and value due to decay and rotting.

Total potential revenues from over-mature *C. lusitanica* ranged from Kshs 825,514,087 to 5,830,980,561, while for mature ranged from Kshs 1,587,478,749 to 3,346,642,236 (Table 5). Over-mature forest *P.patula* gave total potential revenues of between Kshs 700,258,797 and Kshs 2,730,345,030, while mature forest yielded from Kshs. 10,717,026 to 554,916,423 (Table 5). The mature and over-mature forest plantations of both *C. lusitanica* and *P.patula* from the three conservancies gave a total revenue sum of Kshs 21,277,638,766.60 (Table 5). Per hectare forest establishment and management cost upto plantation maturity was found to average Kshs. 80,000. *C.lusitanica* over-mature plantations gave potential profits ranging from Kshs 386,949.60 to 806,087.70 per hectare while mature plantation gave profits of between Kshs 576,118 and 975,700 per hectare (Table 6). *P. patula* over-mature plantations gave potential profits ranging from Kshs 431,051 to Kshs 744,037 per hectare while mature plantations gaveprofits of between Kshs 220,576 to Kshs 963,767. The study has shown that the profitability potential of Eastern, Central and Mau forest conservancies is great, however timber volumes and value may decrease if harvesting is delayed due to decay and rotting hence lowering resultant revenues and profits.

Conclusions

The study showed that:

1. Mau forest conservancy has the highest area under mature and over-mature forest plantations of 10,153 hectares.

2. The highest per hectare revenue was Kshs 1,063,993 from mature *C. lusitanica* forest plantations of Eastern forest conservancy.

3. The highest potential profit per hectare was Kshs 975,700 from mature *C. lusitanica* forest plantations of Eastern forest conservancy.

Recommendations

The study recommends that further research should be carried out on the other remaining mature and over-mature plantations in the other forest conservancies to take stock of the merchantable volumes therein and possible resultant revenues. This information may be useful in the process of merchantable volume inventory and fast tracking of timber harvesting especially of the mature and over-mature forest plantations, which over time would decay and deteriorate in volume and value.

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