Pertanika J. Trop. Agric. Sci. 22(2): 167 - 170 (1999)

ISSN: 1511-3701

Economic Valuation of Tree Species Diversity at Ayer Hitam Forest, Selangor, Peninsular Malaysia

I. FARIDAH HANUM, P. PIUS and AWANG NOOR ABD. GHANI

Faculty of Forestry
Universiti Putra Malaysia
43400 Serdang, Selangor Darul Ehsan, Malaysia

Keywords : Tree species diversity, 1-ha plot, economic valuation, stumpage value, Ayer Hitam Forest

ABSTRAK

Daripada satu kajian di plot 1-ha di Hutan Ayer Hitam, Selangor, sejumlah 177 spesies yang terangkum dalam 92 genus dan 44 famili telah dikira. Ketumpatan dirian ialah 909 pokok setiap ha. Nilai stumpej bagi had tebangan bawah ialah RM 8707.52 dan had tebangan atas ialah RM 17514.12 setiap ha. Jumlah nilai stumpej ialah RM 26221.64 setiap ha. Famili Sapotaceae memberikan nilai stumpej tertinggi dan merupakan separuh dari jumlah nilai stumpej yang diperolehi. Kumpulan komersial nyatoh memberikan 52% manakala kedondong memberikan 25% dari jumlah nilai stumpej.

ABSTRACT

From a study conducted on a 1-ha plot at the Ayer Hitam Forest, Selangor, a total of 177 species in 92 genera and 44 families were enumerated. The stand density was 909 trees per ha. Stumpage values for below cutting limit were RM 8707.52 and RM 17514.12 per ha for upper cutting limit. The total stumpage value was RM 26221.64 per ha. The family Sapotaceae contributed the highest stumpage value accounting for half the total stumpage value obtained. The commercial groups nyatoh and kedondong accounted for 52% and 25% of the total stumpage value, respectively.

INTRODUCTION

The economic potential of species diversity has not been fully investigated (IUCN, 1987). To ensure that the components of biodiversity are utilised in a sustainable manner for the continued progress and socio-economic development of the nation, the revised Malaysian National Forestry Policy 1993 emphasized the importance of conservation and valuation of biological resources to the economy of Malaysia.

This study is part of an on-going project on the economic valuation of forest goods and services funded by the Malaysian Government through its IRPA grant. Before any reasonable value can be put on a forest in monetory terms, we believe that the diversity on the forest must be well studied. The question we hope to answer here is whether knowing the detail composition of tree species can give a better estimate on the economic value of a forest? In doing so we used the stumpage value i.e. the value of standing tree at the stump as a measure of economic value of tree species diversity.

METHODOLOGY

The study area was located in Compartment 6/9 of Ayer Hitam Forest, Puchong, Selangor (3° 4'N 101° 41'E), which was now excised for a housing project (Lestari Perdana). The details of this forest is given in Faridah Hanum (1999). A 1-ha (100 x100m) study plot was established at altitude 50 metres a.s.l. The plot was further divided into contiguous 10m x 10m sub-plots. All trees > 5 cm at diameter breast height (dbh) were tagged, labelled, measured and identified from all the sub-plots. Stumpage values were obtained by modifying the formula of Davis (1966) to indicate the differences in species and diameter class and is shown below:

$S_{ij} = V_{ij} (P_{ij} - C - PM)$ where,

- S_{ij} = Stumpage value for each species and diameter class (RM/m^3)
- V_{ij} = Volume of timber for each species and diameter class (m^3)
- P_{ij} = Log price for each species at mill gate and diameter class (RM/m^3)
- C = Average logging cost per cubic meter (RM/m^3)
- PM = Profit margin (RM/m^3)
- i = an index for each species (i = 1,2,3,....., n)
- j = an index for diameter class (j = 1,2,3,....., k)

The volume formula adopted here was the one used widely by the Selangor State Forestry Department, Malaysia which is as follows:

$V_i = \{P_i \times (dbh)^2 \times h \times F\} / \{4 \times 10000\}$ where:

- V = Volume of timber of each tree (m^3)
- P_i = 22/7
- dbh = diameter at breast height (cm)
- h = merchantable tree height (m)
- F = (0.65) form factor
- i = an index for individual trees (1,2,3,.....n)

The profit margin PM was calculated using the following formula:

$PM = (P_{ij} \times PR) / (1 + PR)$ where,

- PM_{ij} = Profit margin
- P_{ij} = Log price for each species at mill gate and diameter class
- PR = Profit Ratio
- i = an index for each species (i = 1,2,3,.....n)
- j = an index for diameter class (j = 1,2,3,.....k)

The log prices at mill gate were obtained from Maskayu (1996), price reduction factor, average logging and transportation costs from Awang Noor and Mohd. Shahwahid (1995). The total stumpage was finally calculated by summing up all the stumpage values for each species and diameter class in the study area.

RESULTS AND DISCUSSION

There were 177 tree species belonging to 92 genera and 44 families per ha from this forest, a stand density of 909 stems per ha and 67% of trees were under 15 cm at diameter breast height (Faridah Hanum and Pius 1997). Since the availability of present stumpage values on species was limited to trees with diameter at breast heights of 15 cm and above, only 33% of the trees were assigned stumpage values. Table 1 summarizes the stumpage values contributed by the diversity of tree species from various families. Stumpage values for trees below cutting limit (<15 cm dbh) was RM 8707.52 and above cutting limit (> 15 cm dbh) RM 17514.12 per ha, respectively. The total stumpage value for all trees below and above cutting limits was RM 26221.64 per ha (Table 1). Sapotaceae contributed to almost half this total stumpage value, followed by Burseraceae (Table 1). Nyatoh and Kedondong were the two species groups that contributed the most to the total stumpage value, with the former amounting to RM 13681.52 and the latter amounting to RM 6366.13 (Table 2). The percentage distribution of trees by commercial group showed that more than 95% are non-dipterocarps (Table 3). Among the non-dipterocarps, the light hardwood group contributed 25% of the total percentage distribution followed by medium and heavy hardwood which accounted for 23% and 18%, respectively (Table 3). The contribution of dipterocarps to the stumpage value is very small as only 4% (Table 3) were recorded from this plot and they were all below cutting limit amounting to RM 2021.99 as shown earlier in Table 1. Nearly 70% of the total stumpage value was derived from trees in diameter class > 45 cm dbh (Table 4).

The total stumpage value obtained from this study was higher, almost doubled that obtained by Timin (1997) from a similar study in the same compartment which was RM 14,500.36 per ha. The difference in these values can only be explained by the different methods employed in sampling the area. In the present study, a 100% sampling of trees > 5 cm dbh was employed but only 10% sampling was undertaken by Timin (1997). The values obtained from the present study showed a similar trend with those obtained from Ulu Muda Forest Reserve, a hill forest in the northern part of Peninsular Malaysia (Faridah Hanum *et al.* 1999, Awang Noor and Mohd. Shahwahid 1995). A higher species diversity does not necessarily mean a higher economic value of the forest. This was proven in

TABLE 1
Stumpage value by family in 1-ha plot

Family	Stumpage value (RM)		Total stumpage(RM)
	Below cut	Upper cut	
SAPOTACEAE	3070.26	9988.19	13058.45
BURSERACEAE	1084.27	5281.86	6366.13
DIPTEROCARPACEAE	2021.99	-	2021.99
MYRTACEAE	370.97	1416.20	1787.17
MELASTOMATACEAE	64.77	557.40	622.17
FLACOURTIACEAE	543.69	-	543.69
EUPHORBIACEAE	76.31	270.47	346.78
GUTTIFERAE	290.55	-	290.55
STERCULIACEAE	252.20	-	252.20
LAURACEAE	185.49	-	185.49
EBENACEAE	128.65	-	128.65
ANACARDIACEAE	90.24	-	90.24
LEGUMINOSAE	88.11	-	88.11
RUBIACEAE	85.47	-	85.47
MYRISTICACEAE	75.29	-	75.29
SAPINDACEAE	73.21	-	73.21
FAGACEAE	70.97	-	70.97
VERBENACEAE	21.98	-	21.98
RHIZOPHORACEAE	17.17	-	17.17
BOMBACACEAE	16.23	-	16.23
ELAEOCARPACEAE	15.06	-	15.06
THYMELAEACEAE	12.90	-	12.90
MORACEAE	10.69	-	10.69
CORNACEAE	8.89	-	8.89
OLACACEAE	8.32	-	8.32
POLYGALACEAE	6.35	-	6.35
ANNONACEAE	4.91	-	4.91
THEACEAE	4.43	-	4.43
MELIACEAE	4.33	-	4.33
ULMACEAE	3.82	-	3.82
	RM 8,707.52	RM 17,514.12	RM 26,221.64

TABLE 2
Stumpage value by species group in 1-ha plot

Species Group *	Stumpage value (RM)		Total stumpage alue (RM)	Percentage total stumpage value (%)
	Below cut	Upper cut		
NY	3070.26	10611.27	13681.52	52
KDD	1084.27	5281.86	6366.13	25
LRM	2021.99	-	2021.99	8
OMHW	911.46	513.21	1424.67	5
OHHW	843.33	557.40	1400.74	5
OLHW	524.09	550.38	1074.46	4
KS	252.52	-	252.52	1
	8707.52	17514.12	26221.64	100

* NY = Nyatoh; KDD = Kedondong; LRM = Light Red Meranti; OMHW = Other Medium Hardwood; OHHW = Other Hard Hardwood; OLHW = Other Light Hardwood; KS = Kembang Semangkuk

TABLE 3
Percentage distribution of trees by commercial group

Commercial * group	Species** group	Percentage (%)
DIPT	LRM	4
NON-DIPT	KDD	14
NON-DIPT	NY	14
NON-DIPT	OLHW	25
NON-DIPT	OMHW	23
NON-DIPT	OHHW	18
NON-DIPT	KS	2

* DIPT = Dipterocarp; NON-DIPT = Non-Dipterocarp;

** NY = Nyatoh; KDD = Kedondong; LRM = Light Red Meranti;OMHW = Other Medium Hardwood; OHHW = Other Hard Hardwood; OLHW = Other Light Hardwood; KS = Kembang Semangkuk

TABLE 4
Stumpage values by dbh class

Dbh class (cm)	Stumpage value (RM)		Total stumpage value (RM)
	Below cut	Upper cut	
> 60.0	-	10807.44	10807.44
55.9 - 50.0	-	5148.48	5148.48
49.9 - 45.0	778.95	1558.20	2337.15
44.9 – 33.0	5611.35	-	5611.35
32.9 – 25.0	1368.26	-	1368.26
24.9 – 15.0	948.15	-	948.15
	RM 8707.52	RM 17514.12	RM 26221.64

an earlier study in Ulu Muda Forest Reserve where there were only 77 species per ha but the total stumpage value was RM 41445.30 per ha. The next question asked is whether species diversity studies will be necessary to improve the economic value of a forest? Present evidence undoubtedly gives the following answers viz., it will help place the species in the correct commercial group, thus the right pricing which would not over estimate or under estimate the economic value of the forest, it will tell the stocking of the forest, and also shows which dbh classes and commercial species group are contributing the most stumpage.

CONCLUSION

There is no doubt that many a time the forest is under estimated in its economic value because of the constraint taken in sampling and the high costs incurred, amongst others. However, should the government intend to increase its net revenue from the forest, it is recommended that a detail study on the species composition be made.

ACKNOWLEDGEMENTS

The authors would like to thank Ibrahim Edham Mohidin for the assistance provided in the field during the course of this study. Financial support was obtained from the University Seed Money 50204-97-06, IRPA 01-02-04-0183 and IRPA 08-02-04-0089 for which we are grateful.

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