Economy and Environment Program
for Southeast Asia
Tanglin PO Box 101
Singapore 912404
Phone: (65) 6831-6854
Fax: (65) 6235-1849
E-mail: eepsea@idrc.org.sg
Web site: www.eepsea.org

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Forest Pricing Policy in Malaysia

Awang Noor Abd. Ghani
Department of Forest Management, Faculty of Forestry, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.
(awang@forr.upm.edu.my)

Mohd. Shahwahid Hj. Othman
Department of Hospitality and Recreation, Faculty of Economics and Management, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.
(msho@econ.upm.edu.my)

This report assesses the performance of the forest pricing system currently in force in Peninsular Malaysia. It estimates the hypothetical value of timber resources in two states in the region and compares this with the actual revenue the government receives from logging companies. It finds that government revenue is small relative to the commercial value of the trees. The report advises that such underpricing encourages the rapid depletion of forest resources, wasteful extraction methods, and a bias against conservation. Based on an investigation of alternative pricing mechanisms, the report recommends that a competitive bidding system should be introduced to increase government revenue and so encourage sustainable forestry.

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tel: +65-6235-1344, fax: +65-6235-1849, email: eepsea@idrc.org.sg

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Awang Noor Abd. Ghani and Mohd. Shahwahid Hj. Othman

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Comments should be sent to: Awang Noor Abd. Ghani, Department of Forest Management, Faculty of Forestry, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia and

Mohd. Shahwahid Hj. Othman, Department of Hospitality and Recreation, Faculty of Economics and Management, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

Email: awang@forr.upm.edu.my, msho@econ.upm.edu.my

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EXECUTIVE SUMMARY

Forest pricing policy has profound effects on sustainable forest management in developing countries. There are many forms of pricing policies such as taxes, royalties, levies, premiums and other types of forest charges, which affect decision-making and therefore optimum allocation of timber resource in different ways. A well-designed forest pricing policy will ensure greater utilisation of forest resources, encouragement of timber processing, long-term sustainable timber harvest, and minimum ecological and environmental damage. Empirical evidence on these effects in developing countries is still lacking and not well studied. This report presents the results on the amount of stumpage value at the concession in several logging compartments in two states, Pahang and Terengganu, in Peninsular Malaysia. The estimate of stumpage was done using a residual value technique based on pre-felling (pre-F) inventory data, log price and assumed logging cost. The results suggest that most of the timber that could be harvested are commercial timber species. Most of the sites have a substantial potential stumpage value (or potential rent value [up to MYR 42,532 (USD 11,193) per hectare]). About 90% of this value is prescribed stumpage value (stumpage value or rent above the prescribed cutting limit). The implementation of cutting limit under the Selective Management System (SMS) appears to be economically justified only if one assumes low interest rates (discount rates) and high non-timber benefits by imposing greater cutting limits. The government is expected to capture about 65% of the potential prescribed stumpage value based on trees above the cutting limits. Based on actual data of government revenue in some compartments, the actual stumpage (rent) captured by the government is low, averaging about 10% of the potential stumpage value. Tendering the compartment for timber harvest seems to be the most preferred revenue system as it will provide a –fair market value" to both the government and the concessionaires.

1.0 INTRODUCTION

1.1 Issues and Problems

Forest pricing policy, which involves forest taxation and royalties, is one of the key aspects of public forest policy in tropical developing countries (Gillis 1980). The implications of forest pricing policy in tropical developing countries extend well beyond revenue-raising function. Different forms of taxes, royalties, levies, premiums and other types of forest charges affect decision-making and therefore optimum allocation of resource in different ways. A well-designed forest pricing policy will ensure greater utilisation of forest resources, encouragement of timber processing, long-term sustainable timber harvest, minimum ecological and environmental damage, and maximum long-term social benefits. In other words, the equity and efficiency of forest resource management are fully considered under a well-designed forest pricing policy. On the other hand, the forest pricing policy focused solely on government revenue objective (i.e. raising revenue without given due consideration to efficiency objective) is likely to conflict with long-term management of forest resource endowments.

Virtually, forest revenue systems in most tropical countries are implemented by charging timber fees, either based on timber volume extracted or stumpage fees (for example, royalty and resource tax) or the concession area or license fees (for example premium and area tax). The royalty-based structures are characterized by inflexible, undifferentiated, low rates. The rates are commonly set administratively (uniform royalties) or set proportional to log prices (*ad valorem* royalties i.e., the percentage levied as a percentage of log price). Because of their low rates, they do not reflect the true stumpage value.[1] Low timber fees are associated with inadequate mechanisms to adjust for timber scarcity and failure to offset environmental costs of logging.

Competitive bidding (auction or tendering systems, either through open or sealed-bid), on the other hand, is a desirable method for granting forest concessions. This is because of its ability to capture resource rents for the government, eliminate rent seeking behavior of the concessionaires, improve transparency of timber disposal, and create incentives for developing efficient timber harvest at low cost. This method is popular in most of the temperate countries. It is anticipated that the method can reflect the true willingness to pay of the timber value, and sometimes it may be higher than that of the reserved price. However, this method can provide full capture forest rents only under certain conditions: (a) full information on timber volumes, log prices, and logging costs, which is used in calculating stumpage value; and (b) the absence of collusion among the bidders. This information is not usually encountered in tropical countries and hence it is not commonly practiced.

The effect of underpricing is low revenue generation for the government and consequently a large share of potential resource rent is captured by concessionaires (Awang Noor 1994; Boado 1988; Gillis 1980, 1988a, 1988b, 1988c; Page et al. 1976; Repetto and Gillis 1988; Ruzicka 1979; Vincent 1990; Vincent et al. 1993). Other problems include rapid depletion of

[1]Stumpage value is the commercial value of timber in a standing tree, i.e. "on the stump"; it equals the difference between the price a mill will pay for timber, and the costs of felling and transporting the timber from the forest to the mill.

forest resources (Gillis 1980), wasteful resource exploitation (Gillis 1992; Repetto 1988a), bias against conservation (Gillis 1980), and illegal logging (Repetto 1988b).

Another key issue of forest pricing policy is the impact of various forest charges on resource allocation in the long run. It has been shown that, even with full capture of forest rent to the government and privately profitable timber harvesting activities, the forest pricing policy in tropical countries is not socially optimal or economically efficient (Gillis 1980; Hyde and Sedjo 1992). In terms of efficiency, Gillis (1980) highlights the impact of various forest charges on high-grading (i.e. leaving valuable timber species in the forest or type I high-grading; or leaving timber stands unlogged due to less productive or high transportation cost or Type II high-grading). Empirical evidences in Malaysia have shown that high-grading is quite substantial (Vincent 1990; Awang Noor et al. 1992).

1.2 Objectives

The general objective of the project was to estimate stumpage value at the compartment level in Peninsular Malaysia and to compare government's current share of timber rents (stumpage) under the two different forest revenue policies (tendering and fixed revenue systems).

The specific objectives of the project were:

i. To determine the amount of stumpage value for areas logged under administered fees and access the effectiveness of the government in capturing this rent.

ii. To develop quantitative estimates of the components of the stumpage value from timber harvesting (i.e. government revenue and concessionaires share)

iii. To compute and compare the government‘s share of stumpage value under different forest revenue policies - tendering and fixed revenue systems.

2.0 FORESTRY SECTOR IN MALAYSIA

2.1 Forestry in National Economic Development

The forestry sector has played an important role in the Malaysian economy in the last few decades. The forest sector developed rapidly in the 1960s and 1970s because of significant timber harvests as a result of large-scale conversions of lowland forests for agricultural development. The total areas opened for logging in Peninsular Malaysia from 1989 to 1998 are presented in Table 1. The trend of areas logged has been decreasing since 1989. The total areas logged were 93,517 ha in 1998 compared to 235,831 ha in 1989, a decrease of about 60% over the decade. The decline in area logged was due to the reduction of the conversion of stateland natural forest areas for permanent agriculture. Agro-conversion has primarily been in rubber, oil palm and sugar cane. Rapid expansion of manufacturing sectors in the mid-1980s has altered the overall development of the agricultural sector. The latter was beset with problems such as labour shortages, rising wages, and increasing competition for land uses (Ministry of Agriculture 1999). Favourable policies toward industrialisation have also created conditions not attractive for agriculture investment for further expansion.

Table 1 Areas Opened for Logging by Forest Status in Peninsular Malaysia, 1989-98.

Year	*PFE (ha)*	*State Land Forest (ha)*	*Total (ha)*
1989	116,886	118,945	235,831
1990	133,221	104,464	237,685
1991	92,669	105,819	198,488
1992	71,027	116,095	187,122
1993	47,970	121,119	169,089
1994	51,158	109,064	160,222
1995	39,656	83,070	122,726
1996	43,707	69,211	112,918
1997	36,503	61,906	98,409
1998	51,668	41,849	93,517

Note: PFE – Permanent Forest Estate

Source: Forestry Statistics Peninsular Malaysia (various issues)

The continuing role of the forestry sector in Peninsular Malaysia's socioeconomic development will depend on the feasibility of sustainable forest management, particularly the management of Permanent Forest Estate (PFE). The total areas allocated for timber harvest from the PFE in Peninsular Malaysia has been fixed at 50,000 ha.

The Malaysian government is very much aware of the role of natural forests, and its policies allow it to manage these forests for the benefit of the present and future generations. Major public forest policies have been formulated and implemented to meet this ultimate goal. These include the Land Capability Classification (1965), the Protection of Wildlife Act (1972), the National Forest Policy (1978), the National Forestry Act (1984), the Wood-based Industries Act (1984), and the Industrial Master Plan (1985). In one way or another, all of these acts and policies have had a significant influence on the development of the forestry sector in Peninsular Malaysia.

Forests in Peninsular Malaysia can be divided into several types - Dipterocarp, Peat Swamp, and Mangrove forests - based on their ecological and physical conditions. Dipterocarp forests are the most extensive and the most important commercially (constituting about 4.4 million ha or 91% of the total forested land). In this forest, the family Dipterocarpaceae predominates the area, with many of the species from the genera Anisoptera, Dipterocarpus, Dryobalanops, Hopea, Shorea, and Parashorea. The dipterocarp forests are divided into lowland (0-300 m), hill (300-750 m), and upper hill (750-1200 m) forests. Lowland dipterocarp forests were subjected to rapid conversion during the 1960s and 1970s as a result of large-scale conversion of land for agricultural development. Most timber harvesting at present is carried out in hill dipterocarp forests. It is anticipated that the future timber harvest will come solely from the hill dipterocarp forest where the majority of the PFEs are located.

The National Forest Policy, which was formulated in 1978 calls for the establishment of PFEs, sufficient in area for timber production, water supplies, environmental protection, recreation, education, research, and conservation. These are strategically located throughout

the country in accordance with the concept of rational land use. The PFEs are divided into three major categories according to their functions and objectives: protective forests (environmental amelioration such as water catchments, soil protection and virgin jungle reserve), productive forests (timber production), and amenity forests (conservation and other services such as recreation and research). Forests intended to be converted to other uses are termed State Land Forests (SLF).

The total forested area in Malaysia for the year 1999 is estimated to be 20.3 million ha, 61.7% of the total land area (Table 2). Of this total, about 25.1% is under natural forest and forest plantation and other tree crops plantation (rubber, oil palm, coconut and cocoa) occupy about 14.6%. Of the total forested area, 14.32 million ha are PFE (Table 3). Productive forests cover an area of 10.83 million ha, while the remaining 3.49 million ha are protective forest. Forest plantations are becoming increasingly important in meeting future log requirements. To date, 45,368 ha of plantation forest have been established under the Compensatory Plantation Project.

Table 2 Forested Areas: Malaysia

Year	*Total Land Area (million ha)*	*Forested Area (million ha)*	*Percent*	*Other Tree Crops[1] (million ha)*	*Percent*	*Forest and Tree Covered Area (million ha)*	*Percent*
1980	32.9	20.5	62.3	3.5	10.6	24.0	72.9
1990	32.9	19.4	59.0	4.6	14.0	24.0	72.9
1991	32.9	19.2	58.4	4.6	14.0	23.8	72.3
1992	32.9	19.2	58.4	4.6	14.0	23.8	72.3
1993	32.9	19.1	58.1	4.8	14.6	23.9	72.6
1994	32.9	19.0	57.8	4.7	14.3	23.7	71.1
1995	32.9	19.2	58.4	4.8	14.6	24.0	72.9
1996	32.9	18.9	57.4	5.2	15.8	24.1	73.3
1997	32.9	20.6	62.6	4.8	14.6	25.4	77.2
1998	32.9	20.2	61.5	5.0	15.2	25.2	76.7
1999	32.9	20.3	61.7	4.8	14.6	25.1	76.3

Note: [1] Include rubber, oil palm, cocoa and coconut area only

Table 3 Permanent Forest Estates by Region: Malaysia

Region	*Protective*	*Productive*	*Total*	*Percent*
	Million ha			
Peninsular Malaysia	1.90	2.83	4.73	33.0
Sarawak	1.00	5.00	6.00	41.9
Sabah	0.59	3.00	3.59	25.1
Total	3.49	10.83	14.32	100.0
Percent	24.40	75.60	100.00	

Forest-based industrialization has grown rapidly during the past three decades. Table 4 shows the number of sawmills and plywood mills in the three regions of Malaysia. The number of mills is relatively stable during the 1980s. The tremendous growth has turned the forestry sector into a major contributor towards foreign exchange and has established a favorable image of the country as the top producer of high quality tropical hardwood. In the 1960s and 1970s, a large proportion of the logs that were harvested were exported. The banning of logs of some popular species for export began in 1972. Since 1978, virtually all logs were processed locally. In the mid-1980s, the government encouraged the development of vertically integrated wood-based processing industries. The Industrial Master Plan (IMP), launched in 1985, provides the general industrial-development objectives and strategies for sectors with promising growth potential. Wood-based industries are one of such sectors. The growth strategy advocated by the IMP for wood-based industries focusses on the manufacture of high value-added wood products, such as furniture, joinery, and mouldings. Table 5 shows the production of major forest products in Malaysia.

Table 4 Number of Wood-based Mills in Malaysia

Type		*1980*	*1995*	*1996*	*1997*	*1998*	*1999*
Sawmill	Sabah	221	234	235	233	218	216
	Sarawak	89	212	218	250	283	244
	Peninsular Malaysia	603	711	712	711	708	672
Sub-total		913	1,157	1,165	1,194	1,209	1,132
Plywood/veneer	Sabah	9	76	74	79	80	80
	Sarawak	3	53	46	39	45	53
	Peninsular Malaysia	36	48	46	50	50	50
Sub-total		48	177	166	168	175	183
Total		961	1,334	1,331	1,362	1,384	1,315

Malaysia has been experiencing shortage of log supply to meet domestic requirements. This is evident in Peninsular Malaysia where the acute log shortage began in 1995, with the estimated total timber volume of about 1.02 million m^3 (Table 6). To meet the shortage of domestic requirements for log, the timber industry has imported the logs from Sabah and Sarawak as well as from Indonesia. The scheduled reduction in the log production in Peninsular Malaysia is a major approach to maintaining a sustained yield from the natural forests. The government has taken several measures to address this situation. These include the designation of PFEs, which are being managed under sustained yield; practicing sustainable forest management through the Selective Management System (SMS); establishing plantations under the Compensatory Plantation Project; encouraging the development of downstream processing industries; improving the timber concession policy; ensuring sufficient funds for forest development projects; and enhancing research and development.

Table 5 Production of Major Forest Products: Malaysia

Year	*Logs*	*Sawn timber*	*Plywood*	*Veneer*	*Moulding*	*Heveawood Logs*[1]
	'000 m^3					
1980	27,916	6,237	500	410	n.a.	n.a.
1990	40,099	9,156	1,492	479	227	971
1991	39,854	8,926	1,607	692	415	1,622
1992	43,512	9,458	2,063	1,302	433	1,837
1993	37,135	9,224	2,766	2,123	491	1,075
1994	35,672	8,703	3,563	2,072	499	1,157
1995	31,642	9,175	3,685	2,297	643	881
1996	30,094	7,493	3,697	1,245	611	284
1997	31,161	7,176	4,447	1,165	743	38
1998	21,672	5,091	3,904	760	645	n.a.
1999	21,776	5,216	4,122	1,007	636	n.a.

Note: [1] Rubberwood

n.a. - not available

2.2 Forest Concession and Allocation Policy

Under the federal constitution of Malaysia, forest lands are under the jurisdiction of their respective state governments. This means that forests are owned by the states, which can decide on the methods of forest allocation, development of forest lands, and other related issues such as the levels of royalties and premiums, and the type of royalty payments.

The forest allocation system can be regarded as a transfer of rights to log a particular forest concession to individuals, independent private concessionaires, private mill operators, or government-owned timber complexes. The transfer of rights is made through a contract between the government and the concessionaire. The contract specifies the rules and regulations as provided in the National Forestry Act 1984 (NFA), as well as some regulations that may be added by the respective state government. With these rights, a concessionaire can harvest and extract timber, construct roads, or carry out any activity related to timber harvesting and forest management as specified in the contract. The states retain ownership of the concession area. Table 7 shows the areas granted for long-term concession in Peninsular Malaysia.

Table 6 Total Area of Timber Harvest, Log Production, Consumption and Log Balance from Peninsular Malaysia

Year	*Area Harvest ('000 ha) (1)*	*Production ('000 m^3) (2)*	*Consumption ('000 m^3) (3)*	*Percent Consumed (3/2)*	*Log Export ('000 m^3) (4)*	*Percent Export (4/2)*	*Log Balance ('000 m^3) (2-3-4)*
1971	368.6	7,166	4,290	59.90	2,051	28.60	825
1972	394.5	8,920	5,257	58.90	1,911	21.40	1,752
1973	433.7	9,695	6,418	66.20	848	8.70	2,429
1974	357.8	8,628	7,672	88.90	743	8.60	213
1975	302.3	7,538	5,959	79.10	418	5.50	1,161
1976	416.6	9,831	7,036	71.60	369	3.80	2,426
1977	350.5	9,717	8,910	91.70	240	2.50	567
1978	347.9	9,418	9,297	98.70	156	1.70	-35
1979	462.6	10,401	9,064	87.10	201	1.90	1,136
1980	336.0	10,453	9,277	88.70	1,329	12.70	-153
1981	211.6	10,226	8,296	81.10	232	2.30	1,698
1982	328.1	9,840	9,452	96.10	272	2.80	116
1983	280.1	10,237	9,908	96.80	144	1.40	185
1984	202.5	9,181	8,166	88.90	56	0.60	959
1985	186.1	7,914	7,355	92.90	19	0.20	540
1986	263.5	8,586	7,345	85.50	23	0.30	1,218
1987	250.5	10,318	9,016	87.40	73	0.70	1,229
1988	261.2	12,360	9,499	76.90	31	0.30	2,830
1989	245.7	13,155	11,475	87.20	14	0.10	1,666
1990	194.8	12,818	11,052	86.20	-	0.00	1,766
1991	155.4	12,286	10,538	85.80	-	0.00	1,748
1992	187.0	13,030	10,613	81.50	-	0.00	2,417
1993	169.0	11,234	9,452	84.10	-	0.00	1,782
1994	160.0	11,389	9,196	80.70	-	0.00	2,193
1995	168.3	9,030	10,047	111.30	-	0.00	-1,017
1996	164.2	8,419	9,174	109.00	-	0.00	-755
1997	139.7	7,380	9,173	124.30	-	0.00	-1,793
1998	115.0	5,100	5,533	108.50	-	0.00	-433

Source: Forest Statistics Peninsular Malaysia (various issues).

A concessionaire who violates any terms of the contract or commits any offence under the NFA is subject to a penalty imposed by the Forestry Department or can be prosecuted in court. However, fines imposed by the government and the terms of imprisonment under the existing NFA are inadequate to deter concessionaires from encroaching and practicing what is known as "illegal logging" (i.e., felling trees outside the demarcated boundary of the forest concession approved for timber harvesting).

In both PFEs and SLFs, Section 16 of the NFA clearly specifies that timber rights may be transferred by state authority in three ways: (a) tendering, (b) negotiation, and (c) other processes (depending on a particular case, such as grant or status).

Table 7 Long-term Agreement Area of Peninsular Malaysia, 1987-98

Year	Total Area		Annual Coupe		Logged Area		Total
	Permanent Forest Estate	State Land Forest	Permanent Forest Estate	State Land Forest	Permanent Forest Estate	State Land Forest	
	Hectares						
1987	1,115,285	136,175	52,998	5,688	369,304	74,715	807,441
1988	1,033,633	218,337	55,415	6,944	392,192	103,672	756,136
1989	1,001,045	220,475	54,361	6,988	388,292	118,541	714,687
1990	971,972	206,256	48,838	2,972	421,276	112,746	644,206
1991	990,243	205,600	37,416	9,452	453,993	175,308	566,542
1992	894,212	190,416	55,963	0	457,663	158,762	468,202
1993	935,514	206,469	54,426	11,377	449,509	162,576	529,898
1994	939,072	206,469	55,505	11,377	471,869	163,008	510,603
1995	940,338	206,008	50,187	11,377	493,203	168,216	484,927
1996	892,648	206,008	36,340	1,500	443,495	133,931	482,692
1997	788,038	174,496	18,730	1,557	318,919	148,551	456,525
1998	788,038	174,496	21,431	1,557	313,581	148,712	461,703

Source: Forest Statistics Peninsular Malaysia (various issues)

A short-term concession contract is allocated by two mechanisms - tender and negotiation. The duration of the contract is normally from one to three years. Each concession area averages 400 ha. The terms of the contract include definition of the felling area, description of forest products, period of harvesting, payments due, location of checking stations for log scaling, and a list of species not to be felled. Other harvesting regulations are prescribed in the guidelines of the Selective Management System (SMS)[2]. A typical forest allocation

system is depicted in Figure 1. The figure shows how the allocation of PFE is distributed to short and long-term concessionaires and various payments made to the government.

The management of natural forests in the PFE for timber production under short-term contracts is the responsibility of the State Forest Office (SFO). In some states of Peninsular Malaysia (for example Kedah, Pahang and Kelantan), tendering (auctioning) is a mechanism to allocate forest concessions into short-term concessioniares. Normally, there are two types of tenders: open tender (open bid) and closed tender (sealed bid). Closed tenders are limited to *bumiputera*,[3] whereas open tenders are conducted for non-bumiputera. In both mechanisms of forest allocation, the concession is normally awarded to the highest bidder.[4]

[2]The guidelines and regulations of the SMS apply only to Permanent Forest Estates.

[3]Malays and other indigenous groups; Chinese, Indians, and others are not considered *bumiputera*.

[4]Sometimes the successful concessionaire who obtains the concession rights is called the "concession holder" or "license holder." In this study, the terms "concessionaire," "concession holder," and "license holder" are used interchangeably.

Under the negotiation mechanism, an applicant (individual, independent concessionaire, or wood-based manufacturer) must meet certain requirements when submitting an application to the SFO. Under normal procedures, the decision is made by the Executive Council (EXCO). A successful applicant will be notified by the SFO and he will have to sign an agreement with the state that specifies the rights of the concessionaire and the state, and outline the regulations governing the harvesting operation. The applicant is issued a logging permit (for a concession in a Permanent Forest Reserve) or a license (for a concession in a State Land Forest) that is valid for a specified short duration.

A long-term concession contract or "long-term agreement" is granted to private wood-based manufacturers (contract period of three to 30 years) or to government-owned timber complexes (known as integrated timber complexes (ITC); a contract period of 15 to 60 years). The objectives of granting a long-term concession contract are to ensure a long-term timber supply for wood-based industrial activities and to maximize the use of timber resources. In some states, the granting of long-term concession is for generating public fund needed for education and project development purposes. The revenue generated from selling the concessions to concessionaires will be used directly for these purposes and not be included in the state treasury.

One important term of reference specified in the concession contract is that forest management activities should be carried out by the concessionaire with direct supervision from the SFO. For instance, the ITCs have their own management section, which is responsible for forest management activities such as forest inventory, preparation of management and working plans, forest rehabilitation, and research and development. The ITCs can be reimbursed for the amount they have spent on forest management and development activities. In these long-term concession areas, forest allocations are controlled by a separate permit, which differs from the permit issued for a short-term contract. In some cases, the ITCs are permitted to tender out concession areas to independent private concessionaires.

Table 8 shows the method of awarding concessions to the concessionaires in selected states of Peninsular Malaysia. The methods of award used to allocate the concession area in Peninsular Malaysia are tender and negotiation system. Prior to the 1980s, both of these methods were applied in the states of Selangor, Perlis, Kedah, Pahang and Terengganu.

After the 1980s, a new method, the bidding system was introduced in the states of Kedah and Pahang. The introduction was made because the state government wanted to increase its revenue. In 1980, the demand for timber and timber products increased, causing the price of timber and the number of the concessionaires engaged in timber business to increase too. Consequently, a certain degree of competition among the concessionaires in getting timber supply for the industry existed. Subsequently, the state governments introduced the competitive bidding system to arrive at a price for a forested area before allocating it to the concessionaires.

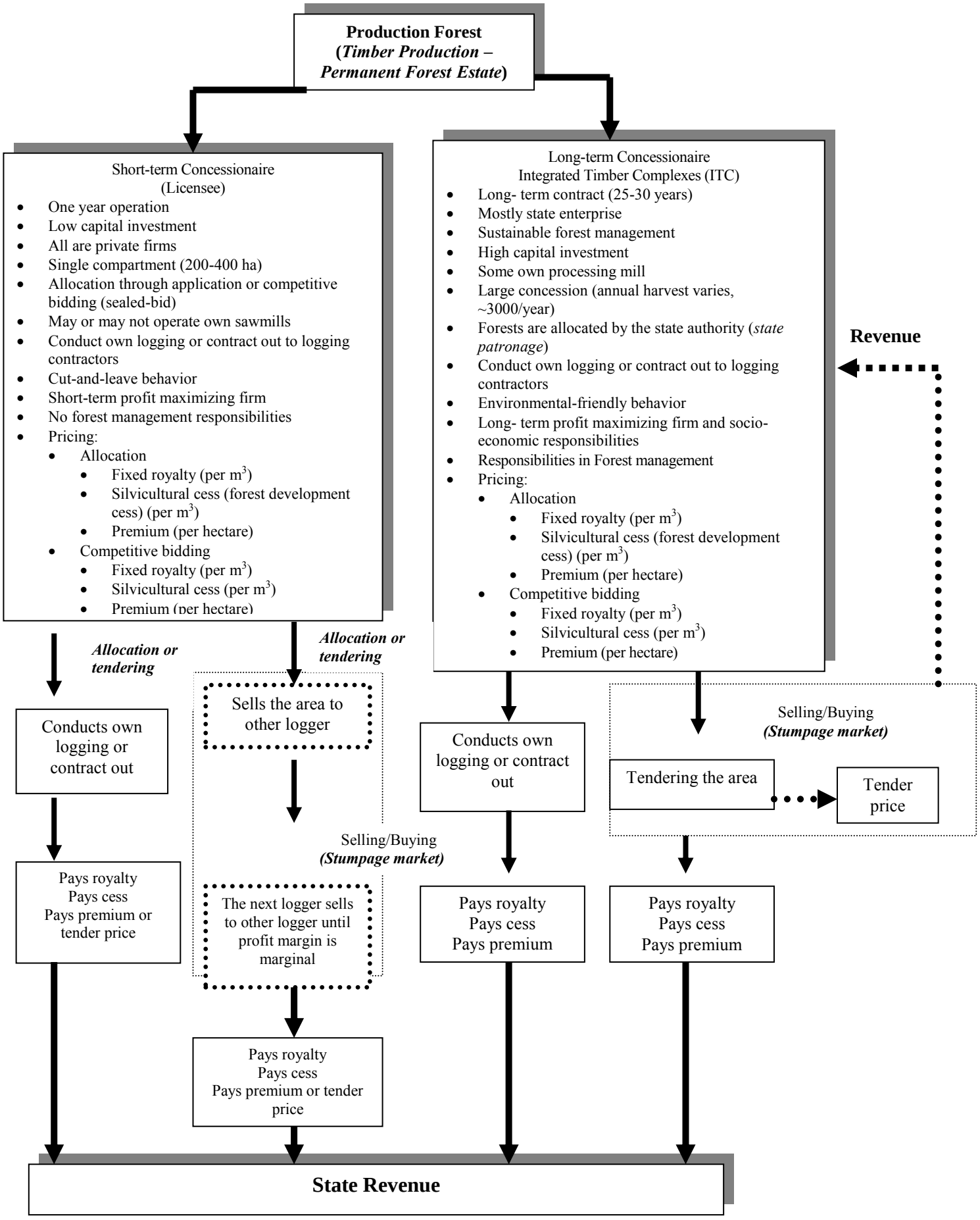

Figure 1 Forest Allocation System in Peninsular Malaysia

Table 8 Changes in Method of Awarding the Concession Area in Selected States of Peninsular Malaysia

State	*Prior to 1980s*	*After 1980s*	*Comment*
Selangor	Tender Negotiation	Tender Negotiation	Unchanged
Kedah	Tender Negotiation	Bidding Tender Negotiation	Introduce a new method in the 1980s
Perlis	Tender Negotiation	Tender Negotiation	Unchanged
Terengganu	Tender Negotiation	Tender Negotiation	Unchanged
Pahang	Tender Negotiation	Bidding Tender Negotiation	Introduce a new method in the 1980s

Source: Arunie (2002)

2.3 Forest Revenue and Pricing Policy

A broad structure and level of fees on timber harvesting is employed in Peninsular Malaysia. The methods of payment are related to the mechanisms of the forest allocation system. In practice, the systems typically comprise a mixture of volume-based charges ("royalties," "silvicultural cesses," and "tributes") and area-based charges ("premiums"). In some states, government revenue collected from these timber fees has been substantial and was a significant source of public funds.[5]

The forest revenue system has undergone several changes since 1935 (Table 10). In Forest Rules 1935, there were only two types of forest charges, namely, royalty and premium. The royalty rate was divided into five groups. Group 1 stands for the royalty rate for Chengal, which was MYR 0.50 (USD 0.13); group 2 symbolizes the royalty rate for Balau, Merbau, Giam and Resak, which was MYR 0.35 (USD 0.09); group 3 represents the royalty rate for Kapor and Keladang, which was MYR 0.30 (USD 0.08); group 4 is the royalty rate for Meranti, Seraya and Damar, which was MYR 0.25 (USD 0.07); and group 5 illustrates the royalty rate for other timber, which was MYR 0.25 (USD 0.07), respectively. However, the calculation and collection of premium, and royalty rates were not stated in the law. In the National Forestry Act 1984, the rate of royalty, premium and silviculture cess was not stated in the law, but the rate of forest development cess was stated. For round timber, the rate was MYR 2.50 (USD 0.66) per cubic meter and for converted timbers; the rate was MYR 5.60 (USD 1.47) per cubic meter. However, the calculation and collection of the forest charges were also not stated in the law. At present the rate is MYR 10.00 (USD 2.63) per cubic meter.

[5]Only royalties, premiums, charges on minor forest products, compensation, and fines are channelled to the public fund, whereas the collection of silvicultural cesses is used solely for forest management and development activities.

Table 9 Differences between the Forest Rules, 1935 and the National Forestry Act 1984 in Peninsular Malaysia on Forest Charges

1935	*1984*	*Comment*
Part 2 *Section 21* **The forest charges are:** a. Royalty b. Premium **Schedule ii** Rate : Royalty Rate list Group 1 : Chengal (MYR 0.50) Group 2 : Balau, Merbau, Giam, Resak (MYR 0.35) Group 3 : Kapor and Keladang (MYR 0.30) Group 4 : Meranti spp, Seraya, Damar (MYR 0.25) Group 5 : Other timber (MYR 0.25). Rate : Premium (Not stated in the law) Calculation: Not stated in the law Collection: Not stated in the law	Part 5 *Section 72 and 60* **The forest charges are:** a. Royalty b. Premium c. Silviculture Cess d. Forest Development Cess **Schedule iii** Rate : Royalty (Not stated in the law) Rate : Premium (Not stated in the law) Rate : Cess a). Round timber MYR 2.50 (USD 0.66) per cubic meter b). Converted timber MYR 5.60 (USD 1.47) per cubic meter Calculation : Not stated in the law Collection : Not stated in the law	The change in National Forestry Act (NFA) 1984 is that there were new forest charges introduced, namely silviculture cess and forest development cess. In NFA the rate was stated only in cess rate and the other charges were not stated in the law but in Forest Rules 1935 the rate was stated only in royalty rate and the others not stated in the law.

Source: Arunie (2002)

Note: 3.80 MYR = 1 USD

Since area and volume-based revenue systems were both analyzed in this study, they require further explanation. The area-based forest charge is known as a premium; it is a charge levied for the right to harvest a specific concession area granted under a permit or a license. The premium assessed per hectare, is based on the total area of the forest concession as shown in the permit or license. There are two types of premiums, tendered and standard. The tendered premium is the competitive bid price, appraised per hectare, for concessions that are allocated by a tendering mechanism. Conceptually, this fee is independent of harvest volume, and it may reflect the true total willingness or ―fair market value" of the concessionaire to pay in exchange for the concession right. Thus, the tendered premium is expected to vary with the productivity of the forest concession, location, accessibility, characteristics of the concessionaire, price of logs, and other costs associated with timber harvesting. Appendix 1 shows the premium rates in various states of Peninsular Malaysia.

The standard premium applies to all concessions; the rate is set by the EXCO or the SFO. Thus, the standard premium varies according to forest type, administrative structure of the forest where the concession is located, condition and status of forest, length of agreement,

and type of concession contract. The rate can be reviewed from time to time by the EXCO or SFO in the respective state. The basis for establishing the rate varies. More recently, some states have adopted tendering as the method of timber sale to concessionaires.

Volume-based timber fees include royalty, silvicultural cess, and tribute. Royalties are calculated and charged based on the actual volume of logs extracted from the forest. The rates vary by species, but they are uniform within each state (Table 10). For a given species, royalties are not differentiated according to stumpage value. The royalty is independent of diameter class, quality of logs, terrain, location of forest, and type of forest concession. Thus, royalties in Peninsular Malaysia are closer to uniform royalties[6] than to differentiated royalties. The basis for setting royalty rates was originally 10% of the market price of logs.[7] Royalties tend to be higher for heavy hardwood and lower for lesser-known species (grouped under the category of other species).

Another volume-based charge, known as silvicultural cess, has been collected in all states since 1973; the revenues are to be used solely for forest rehabilitation and development (Forest Resource 1979). Specific flat rates are charged on each cubic meter of timber extracted, but these rates vary among states, from MYR 0.60 (USD 0.16) to MYR 2.80 (USD 0.74) per m^3. Some states have increased the rate to MYR 10.00 (USD 2.63) per m^3. The tribute is a special payment made by ITCs in certain states. The tribute rates vary among states.[8]

The forest revenue system in Sabah is quite different from the one practiced in Peninsular Malaysia in terms of rate charges and methods of log disposal. The royalty rates in Sabah are much higher compared to that of Peninsular Malaysia. The royalty of timber in Sabah varies depending on what the timber is intended for (example: export or domestic processing), the log diameter class and where the logs are sourced from. The royalty rates for selected species in 1999 are shown in Table 10.

There is no premium charged to concessionaires for timber harvesting in Sabah. At present, the Sabah Forestry Department has adopted an open auction for selling the "eco-friendly" harvested logs from the Deramakot Forest Reserve since 1995. This is part of the efforts to improve the economic feasibility of Sustainable Forest Management (SFM) in Sabah. Under this system, logs are sorted according to species, species group or its utilisation aspect. This method provides the opportunity for potential buyers to bid only for timber they are interested in and at a very much higher price. The bid price offered under this system is slightly higher compared to that of market price. This method has yet to be applied to other concession areas in Sabah.

[6]This is equivalent to the specific uniform royalty used by Gillis (1980).

[7]In this sense, the rate can be considered as *ad valorem*. However, the rates are fixed by the EXCO, and in practice they do not reflect the prices of logs.

[8]Cess and tribute are not explicitly specified in the theoretical and empirical models. "Royalty" in these empirical analyses implicitly includes these fees.

Table 10. Royalty Rates for Sabah

Category	*Class*	*Species*	*Rate (MYR/m^3)*
(a) Export Logs	A	Belian	600
	B	Merbau	500
	C	Kapur Keruing Selangan Batu	150
	D	Any other species not listed in Class A, B and C	100
(b) Domestic Processing	Logs from Forest Reserve	All species, except Macaranga	70
	Log from State Land: -above 41 cm -below 41 cm		 70 45

Source: Sabah Forestry Department (2002)

Note: 3.80 MYR = 1 USD

The revenue collection from these charges provides substantial and significant source of public funds to some of the states. The value of this revenue rose steadily from 1971 to 1986 but it experienced a drastic increase in 1987 due to increased competition and demand for logs (Table 11)**.** In 1997, the total revenue collection from the forest amounted to MYR 352 million (USD 93 million) .Premium collection was the highest, as it contributed about 52% of the total revenue collection. Its contribution has increased compared to the 1970s and 1980s. This was because of the tendering systems adopted by some states in disposing the concession areas. However, the fees charged on forest concessionaires by state governments are generally low and below the true market value of the trees at the stump (i.e. their stumpage value). As a result, the actual returns from timber extraction earned by state governments are lower than they should be, whilst concessionaires earn a higher share of timber rent.

2.4 Forest Management

Forest management and harvesting practices in Malaysia vary with regards to the status of forest lands. In State Land Forests (Conversion Forests), clear felling is practiced and there is no minimum-diameter cutting limit. Timber with a diameter as low as 27 cm dbh (diameter at breast height) is commonly sold in the market. Selective felling is implemented in production forests of the PFEs. Strict rules and regulations are imposed on timber harvesting. The cutting cycle is determined first. Then the minimum-diameter cutting limits are decided.[9] Only trees above the minimum-diameter cutting limits are harvested.

[9]This differs from forest management in even-aged forests with single species, in which case a forest owner need only decide when to harvest. Most problems associated with even-aged forest management involve determining optimal rotation and subsequently estimating optimal harvest volume. Optimal rotation varies with respect to factor ownership and economic and other policy variables.

Table 11 Revenue Collection from Forest, Peninsular Malaysia, 1971-98 (Real Price, 1994=100)

Year	*Premium*	*Royalty*	*Silvicultural Cess*	*Other*[1]	*Total*
	MYR '000				
1971	957	47,057	-	1,281	49,294
1972	12,496	56,365	-	1,959	70,821
1973	18,899	55,167	4,394	4,007	82,467
1974	13,704	51,161	4,528	3,356	72,750
1975	22,706	47,240	4,254	3,068	77,268
1976	32,440	64,930	6,060	4,179	107,609
1977	n.a.	n.a.	13,211	n.a.	n.a.
1978	33,072	67,885	18,277	6,092	125,326
1979	37,475	66,806	19,987	37,844	162,113
1980	37,315	76,389	18,718	16,785	149,207
1981	52,363	67,277	18,094	7,632	145,365
1982	41,752	84,743	17,848	5,921	150,263
1983	86,188	85,726	19,922	10,192	202,027
1984	60,764	77,374	17,824	7,151	163,113
1985	65,434	76,401	16,646	9,773	168,253
1986	73,148	84,201	20,167	9,580	187,095
1987	67,474	101,868	24,411	31,039	224,792
1988	110,285	113,187	27,573	17,412	268,457
1989	114,331	127,172	33,461	19,982	294,946
1990	109,372	123,708	31,898	17,572	282,551
1991	132,591	110,198	28,412	28,261	299,463
1992	145,026	122,037	29,437	24,397	320,898
1993	174,335	100,364	25,376	39,289	339,625
1994	223,756	96,132	25,176	26,776	376,414
1995	207,255	90,292	22,204	36,600	361,724
1996	156,829	91,239	22,569	67,827	347,256
1997	154,784	110,360	44,212	24,085	343,047

Source: Forestry Statistics Peninsular Malaysia (various issues).

[1] includes the collection of minor forest products, compensation and fines.

Note: n.a.– not available

3.80 MYR = 1 USD

Increasing the cutting limits affects the amount of stumpage value, and hence the distribution of resource rent and efficient harvest level. The economics of cutting regimes have been analyzed by Mohd. Shahwahid (1985) and Vincent et al. (1993). However, the methods used in their studies were different. The findings suggest that the cutting limits are not economically justified under the current SMS because of low rates of return, relative to the opportunity cost of capital (if non-timber benefits are not taken into account). Higher cutting limits may be economically justified if non-timber benefits are considered.

It should be noted that forest management in the natural lowland and natural hill dipterocarp forests are entirely different because of variations in forest structures and the ability of seedlings to regenerate after harvest. The management system developed for natural lowland forests rich in meranti (a group of *Shorea* spp.) is known as the Malayan Uniform System (MUS). This management system has been found to be very effective in regenerating such forests (Tang 1987). The cutting cycle under the MUS is 70 years.

The current management practice in the natural hill forests of PFEs is based on the Selective Management System (SMS). This system attempts to prescribe cutting regimes that yield an economically viable harvest volume while leaving sufficient residual trees of advanced regeneration to ensure future harvests at intervals of 30 years (Tang 1987; Thang 1986). The SMS is designed to optimize the management objectives of the economic and better harvesting practices, sustainability of the forest and timber supply, and minimum forest development costs under prevailing socioeconomic conditions.

In practice, under the SMS when the next cut is expected in 25 - 30 years after the first logging with an expected net economic outturn of 30 – 40 m^3/ha enriched with dipterocarp species, the following prescriptions are generally followed:-

1. The cutting limit prescribed for the group of dipterocarp species should not be less than 50 cm dbh, except for *Neobalanocarpus heimii* (chengal) where the cutting limit prescribed should not be less than 60 cm dbh;

2. The cutting limit prescribed for the group of non-dipterocarp species should not be less than 45 cm dbh;

3. The residual stocking should have at least 32 sound commercial trees per hectare for diameter class 30 cm - 45 cm or its equivalence;

4. The difference in the cutting limits prescribed between the dipterocarp species and that of the non-dipterocarp species should be at least 5 cm; and

5. The percentage of dipterocarp species in the residual stand for trees having 30 cm dbh and above should not be less than that in the original stand.

Moreover, the current situation in Peninsular Malaysia favors the implementation of the SMS as this type of forest management would require concentration of operations on a large-scale using mechanized equipment and providing higher employment and jobs diversification. These operations will become increasingly sophisticated and the aspects of transferring technical and organizational skills especially to the rural people would be enhanced. The sequence of operations under the SMS is shown in Table 12.

Table 12. Sequence of the SMS Operations

Year	*Operation*
n-2 to n-1	Pre-felling forest inventory of 10% sampling intensity using systematic-line-plots to determine appropriate cutting regimes (limits)
n-1 to n	Tree marking incorporating directional felling. No marking of residual trees for retention.
N	Felling of all trees as prescribed
N+1/4 to n+1/2	Forest survey to determine fines on trees uncut and damage to residuals; and royalty on short logs and tops
N+2 to n+5	Post-felling forest inventory of 10% sampling intensity using systematic-line-plots to determine residual stocking and appropriate silvicultural treatments
N+10	Forest inventory of regenerated forest to determine status of the forest

Source: Forestry Department (undated).

All logging operations in a concession (managed under the SMS or the MUS) are under the general supervision of the SFO. Logging must be carried out during the period when the permit or license is valid. Normally, a concessionaire submits an application for permission to terminate the logging operations when almost all of the sound marked trees have been harvested. However, in some cases, concessionaires will leave marked trees because they are difficult to extract and are likely to be defective (for instance, hollow trunks). The government allows concessionaires to leave as many as 20% marked trees. Concessionaires are subject to fines if they do not continue logging. They can also be fined for felling unmarked trees (trees that are below the cutting limits) or felling trees in other compartments (timber trespass or illegal felling).

3.0 RESEARCH METHODS

3.1 General Approach

The general approach in this study was to select the most recently logged areas that show variations in terms of forest types, accessibility, distance to sawmill, forest productivity, and terrain condition. Data on pre-felling was combined with data on log prices and logging costs to calculate stumpage value. The study focused on forest areas allocated with those only under administered fees (i.e. fixed royalty and premium).

3.2 Quantitative Estimates of Timber Rent (or Stumpage Value)

Various methods can be used to estimate the stumpage value from a logging compartment. There are generally two methods of stumpage valuation (Davis and Johnson 2000; Duerr

1993; Klemperer 1996): (i) market evidence (direct method or transaction evidence method), and (ii) analytical method. The market evidence method is done by setting the stumpage value of subject stand through comparison with the prices of stumpage received for stumpage recently sold from stands with similar characteristics as the subject stand. There are two problems related to this method: (a) location, and (b) species composition. An adjustment is needed if the valuer wants a reliable estimate. This can be done in two ways: (a) regression analysis - to estimate the appraised value by examining hundreds of actual sales and to fit a regression equation to these sales data which relate some factors that cause differences in the sale price. (b) Another technique is known as regionalized harvest value tables or comparable sales - the state can be divided into several timber value areas and within each area, all timber sales are reported and empirical tabulations of market stumpage prices by forest types and logging costs are made. The transaction data is then smoothed and processed into a standard set of tables showing the average current market price of stumpage for each timber value area. In developing countries, these methods are not applicable due to uncertainties in market structure and the absence of complete information.

The widely used technique in determining the stumpage value is the analytical method, which requires detailed analysis on logging and timber harvesting, processing, and marketing of forest products from a particular logging compartment. This method consists of two techniques: (a) investment method - this calculates the capital, logging, and processing costs for a given product derived from log (timber intended for sale as sawlog or veneer log). It also requires the calculation of margin for profit and risk. Using this method, the net present value (NPV) of its most likely future cash flow is estimated. However, the method has been largely ignored because of the difficulty in getting accurate information on investment and working capital, changes in technology over time, and variation of timber harvesting operation under different environments.

(b) The most feasible method that can be applied to tropical countries is the residual value or conversion approach. The value of standing timber is calculated as the difference between the selling value of the products made from it and the stump-to-market processing costs (including margin for profit and risk). Parameters required to calculate stumpage include selling price, timber volume, conversion cost, and profit margin. This method starts with estimating the market prices of the end product made from standing timber. The market price is the first point of sale where the product is sold freely in the competitive market. From the market price, the stumpage value is residually determined by subtracting all costs involved in processing and harvesting, including profit margin.

The following formula was used to calculate the stumpage value for each species and diameter class in a logging compartment.

$$sv_{i,j} = v_{i,j} * (p_{i,j} - c - m_{i,j})$$

where:

sv = stumpage value, (MYR/ha)

v = volume, (m^3/ha)

p = price, (MYR/m^3)

c = average logging cost, (MYR/m^3)

m = profit margin, (MYR/m^3)

i,j are index for species and diameter class, respectively.

Note: 3.80 MYR = 1 USD

The profit margin, m is obtained as follows:

$$m_{i,j} = \frac{p_{i,j} * PR}{(1+PR)}$$

where PR is the profit ratio. The profit ratio, PR is the margin for profit and risk, calculated as a proportion of production cost and stumpage price.[10] It is based on industry average or organizational average or is set arbitrarily as a target (Leushner 1984). The subscripts i and j indicate that stumpage value (sv_{ij}) varies due to variations in log price (p_{ij}) in each diameter class j. Since average cost is constant, it is not subscripted. Thus, the formula for calculating the stumpage value for a logging compartment is given as:

$$S = \sum_{i=1,j=1}^{n\,k} V_{ij}\left(P_{ij} - c - m_{ij}\right)$$

S is the average stumpage value per hectare. Thus, it is expected that variation in stumpage values within a compartment will result mainly from differences in forest characteristics and log prices across species and diameter classes. For a given forest concession, the average total cost, *c* is assumed to be constant within a concession. In reality, this might not be the case since logging operations depend on many factors such as stand density, species composition, soil condition, slope, logging method, distance of forest road to the main road and the skills of forest workers. These factors were not taken into account because of the difficulties in tracking the concessionaires who carried out timber harvesting activities in the selected compartments. Based on discussions with timber operators in the field, the average logging cost is slightly higher when the slope is high, there is less timber stocking, long distance between the forest road and the main road and the workers are not skilled. However, the average cost used in the study is relatively comparable under the normal logging condition.

The individual components of stumpage value or timber rent are estimated as follows:

- Potential stumpage value or potential rent – is calculated from pre-felling inventory data, which allows estimation of potential harvest volume. The log price of this volume minus logging costs and profit margins provides an estimate of potential stumpage value. Under the SMS, this is also stumpage value above the cutting limit as specified in the SMS regulations.

- Realized rent – is the actual rent generated by the government through actual timber harvest.

[10]By definition: PR=m/(C+S), and S=P-C-m. Substitute S in the formula, we obtain: PR=m/(C+P-C-m). Thus, PR=m/(P-m). Solving for m, we have: m=PR*(P-m). Consequently, m=PR*P – PR*m. Thus, m+PR*m=PR*P, and m(1+PR)=PR*P. Therefore m is obtained as: m=PR*P/(1+PR)

- Forest revenue (i.e. government revenue) was obtained directly from the data on royalty, silvicultural cess, and premiums. The rent captured by the concessionaire is calculated by deducting forest revenue from realized rent or hypothetical timber rent.

- Silvicultural rent was calculated based on the stumpage value below the cutting limit from the inventory data.

3.3 Research Sites

All the research sites are located in the states of Pahang and Terengganu. These states were chosen for several reasons: their importance as log producers; their broadly similar forests; their proximity to each other; and a history of cooperation between their state forest offices and researchers. The forest revenue systems in the state of Pahang and Terengganu can be characterized as follows:

Pahang: High royalty, high premium, royalty and premium comprise almost equal shares of forest revenue, and some forest reserves are allocated through tendering.

Terengganu: Moderate royalty, moderate premium, royalty comprises *lare sae* (large sums) of forest revenue than premium, and tendering is recently introduced by the new ruling state government. The characteristics of research sites are presented in Tables 13a and 13b. Due to data inavailability, some parameters in each compartment were not reported.

The selection of logging compartments within each state was influenced by the availability of pre-felling (pre-F) inventory data. We had to rely on existing pre-F inventories for information on the composition of the compartments before logging. Through consultation with the state forest offices, research sites were chosen in 27 compartments in Pahang and 25 compartments in Terengganu. Since the compartments were not chosen randomly based on sound statistical technique, we make no claim that they are representative of virgin forests in the two states. We did work with the state forest offices, however, to select compartments where logging practices were thought to be neither markedly better nor markedly worse than the norm in forest reserves.

The concessionaire in each compartment differs in forest allocation. Each compartment was allocated either through short-term logging license or a long-term agreement. In all the compartments, all logging activities were carried out by independent logging contractors. Even though there are differences in forest allocation in the study sites, we regard the stumpage value to be the same regardless of the differences in the allocations systems. This is because we used the same logging cost in each compartment within the state. The same logging cost was used in each compartment because it is difficult to trace the logging contractors who had actually carried out the operation in the last few years. The duration of logging ranged from four months to three years, with the average duration of logging being 12 months. The average area of logging compartment is 222 ha, with the average production of 42.5 m^3 per ha.

3.4 Data Source

Information from pre-F inventories was available at the compartment level. Altogether, 52 pre-F inventory data was collected in the two states. This enabled us to calculate the stumpage value before logging (i.e. the potential stumpage value or rent and other rents). The inventories record stocking (number of trees) per diameter class (12 classes, in 5-15 cm increments) by species group (the same groups are used in recording data on revenue and log prices). Estimates of standing timber volumes for each species and/or species group are created as part of this process. In this study, all species reported from the pre-F inventory data were divided into 21 groups based on the average domestic log price.

Data on log prices were based on ASPA (Amanah Saham Pahang – a state-based economic development agency). The log prices were reported for each species or species group. The prices of timber in smaller trees were calculated using the reduction factors. The reduction factors used were 0.025% for trees with 50 to 55 cm dbh, 15% for 45 to 50 cm dbh and 30% for trees between 30 and 40 cm dbh. The use of reduction factors is important because logs with smaller diameters sell at lower prices, with the price discount becoming steeper as the diameter decreases. The logging costs used in the study was taken at MYR 100 (USD 26.3) per m^3 in Pahang and MYR 120 (USD 31.6) m^3 in Terengganu. The constant logging costs were used within the state because previous studies have shown that it is generally constant within the state. Table 14 shows the average harvesting cost per cubic meter in Terengganu based on the International Tropical Timber Organization (ITTO) study in the long-term concession area in Terengganu. The average harvesting cost was MYR 117.05 (USD 30.8)/m^3 under the current conventional practice. This cost includes the cost of royalty, premium and cess paid to the state government. However, if we were to include the opportunity cost of unearned timber income from buffer areas due to logging regulations, the average harvesting cost would be MYR 123.46 (USD 32.5)/m^3. Under the SMS, certain areas were prohibited from being harvested. These areas are classified as riparian buffers and areas with steep slopes. Normally, 20 m buffer strips along second order streams and land with slopes exceeding 40^o are set aside for buffer zones. Timber above the cutting limits were not harvested in these areas and leaving the trees uncut would have incurred a higher opportunity cost .

A 30% normal profit margin was used in the analysis. This was based on a survey carried out by two Malaysian researchers with logging operators in Pahang and some other states.

4.0 RESULTS AND DISCUSSION

4.1 Estimates of Stumpage Value: Prescribed Silvicultural and Prescribed Realized

Table 15 presents our estimates of the components of stumpage value on a per hectare basis. All values are in Malaysian Ringgit (3.80 MYR = 1 USD). The estimated stumpage value was disaggregated by species groups and diameter classes for each compartment. The potential stumpage value indicates the total stumpage value that would be realized if the area is logged through clear felling. In reality, timber harvesting in the permanent forest reserve would not occur. Therefore, this value can be considered a hypothetical maximum stumpage value. The results show that the potential stumpage value that could be captured by the government (as owner of the resource) ranges from MYR 7,078 (USD 1,863) to MYR 42,532 (USD 11,193) per hectare. The estimates of potential stumpage value vary by a factor of six.

The average potential stumpage values for all trees 30 cm and above in the two states are not significantly different. The variation between sites is due to species composition because in this analysis the price and logging cost as well as other factors are the same within the state. Had we used different logging costs and log prices, the variation in stumpage value between sites would have differed greatly.

Table 14 Average Total Cost of Harvesting Activities per Cubic Meter Timber Production

Activity	*Conventional Practice*	
	MYR/m^3	*Percent*
Management Plan	0.24	0.21
Pre-felling Inventory	0.88	0.75
Compartment Boundary Demarcation	0.87	0.74
Proposed Road Alignment	0.52	0.45
Tree Marking and Mapping	2.40	2.05
Road Construction	3.86	3.30
Felling and Bucking	5.52	4.71
Skidding	20.71	17.69
Log Loading	2.02	1.73
Short Distance Haulage	10.98	9.38
Monitoring and Control (Supervision/Inspection)	2.51	2.15
Other Expenditures	13.26	11.33
Closing report	0.10	0.08
Additional Training on MC&I Compliance	0.00	0.00
Total	63.87	54.57
Taxation (Royalty, Premium)	53.18	45.43
Total (Including Tax)	117.05	100.00

Source: Abd. Rahim et al. (2001)

Note: The average production cost only increased by 5.19% to MYR 123.46/ m^3 when the foregone revenue from buffer areas was included.

3.80 MYR = 1 USD

However, logging in Malaysia is based on a sustained yield management under the SMS. Thus the amount of potential stumpage value is split between prescribed silvicultural rent (stumpage value of trees below the cutting limit) and prescribed realized rent (stumpage value of trees above the cutting limits). From the table, much of the stumpage value comprise prescribed realized rent and the average is estimated at 85% in Pahang and 65% in Terengganu.

Table 15 Estimates of Stumpage Value before Logging in Logging Compartments

(a) Pahang

Logging Compartment	*Prescribed Silvicultural (Trees below cutting limit)*		*Prescribed Realized (Trees above cutting limit)*		*Potential (all trees 30 cm dbh and above)*
	Total (MYR/ha)	*Percent*	*Total (MYR/ha)*	*Percent*	*MYR/ha*
1	798	11.27	6,280	88.73	7,078
2	810	9.54	7,685	90.46	8,495
3	1,264	9.03	12,728	90.97	13,992
4	738	2.72	26,406	97.28	27,144
5	868	3.42	24,476	96.58	25,344
6	1,611	3.79	40,920	96.21	42,532
7	1,050	4.22	23,800	95.78	24,850
8	1,590	13.26	10,398	86.74	11,988
9	842	6.07	13,044	93.93	13,886
10	5,065	32.01	10,758	67.99	15,823
11	1,265	10.12	11,229	89.88	12,494
12	,968	8.78	10,059	91.22	11,027
13	5,642	24.8	17,075	75.2	22,718
14	9,399	44.7	11,637	55.3	21,036
15	9,957	28.0	25,649	72.0	35,606
16	3,964	11.7	29,857	88.3	33,821
17	5,371	18.7	23,306	81.3	28,677
18	5,126	20.7	19,612	79.3	24,738
19	5,742	21.5	21,024	78.5	26,766
20	5,532	19.7	22,614	80.3	28,147
21	6,073	18.3	27,155	81.7	33,228
22	4,938	16.5	25,058	83.5	29,997
23	4,864	14.6	28,449	85.4	33,313
24	3,973	16.2	20,602	83.8	24,575
25	2,284	7.6	27,902	92.4	30,186
26	5,610	16.2	29,059	83.8	34,670
27	4,352	14.4	25,849	85.6	30,202
Average	3,692	15.28	20,468	84.90	24,161

Note: 3.80 MYR = 1 USD

In Pahang, the amount of prescribed silvicultural rent ranges from MYR 738 (USD 194) per hectare to MYR 9,957 (USD 2,620) per hectare, while for prescribed realized rent the values range from MYR 6,280 (USD 1,653) per hectare to MYR 40,920 (USD 10,768) per hectare. It can be concluded that the amount of forgone timber benefits due to logging regulation is low. On average, the forgone timber benefits is estimated at 15%. Only one site shows that the forgone timber benefits are as high as as 40%. Whereas in Terengganu, the amount of prescribed silvicultural rent ranges from MYR 239 (USD 63) per hectare to MYR 15,735 (USD 4,141) per hectare, while the values for prescribed realized rent range from MYR 1,259 (USD 331) per hectare to MYR 53,606 (USD 14,107) per hectare.

(b) Terengganu

Logging Compartment	*Prescribed Silvicultural (Trees below cutting limit)*		*Prescribed Realized Trees above cutting limit)*		*Potential (all trees 15cm dbh and above) MYR/ha*
	Total (MYR/ha)	*Percent*	*Total (MYR/ha)*	*Percent*	
1	9,607	29	23,278	71	32,884
2	7,758	22	28,318	79	36,075
3	2,938	20	11,920	80	14,858
4	4,671	30	11,148	70	15,819
5	11,356	19	48,884	81	60,240
6	6,978	22	24,134	78	31,111
7	9,708	40	14,782	60	24,490
8	3,353	51	3,229	49	6,582
9	4,368	52	3,960	48	8,327
10	4,414	78	1,259	22	5,673
11	239	2	13,682	98	13,921
12	11,687	23	38,715	77	50,402
13	11,879	76	3,694	24	15,573
14	3,679	53	3,223	47	6,903
15	15,735	58	11,385	42	27,120
16	4,810	43	6,501	57	11,310
17	3,955	24	12,438	76	16,392
18	10,760	26	29,857	74	40,618
19	7,040	12	53,606	88	60,646
20	5,405	39	8,455	61	13,860
21	10,377	30	24,016	70	34,393
22	8,046	24	25,287	76	33,333
23	6,665	37	11,361	63	18,025
24	5,127	28	12,869	72	17,996
25	4,519	28	11,515	72	16,034
Average	7,003	35	17,501	65	24,503

Note: 3.80 MYR = 1 USD

The prescribed realized rent indicates the maximum amount that the government would have received by logging the area given the prescribed cutting limit. It also indicates the maximum amount that the concessionaire would be willing to pay to obtain harvesting rights at the assumed profit margin (30%), harvesting cost and log price under the competitive bidding (Table 16). The estimated value could also be used to set the premium price (per hectare) if the revenue system comprises the volume-based (royalty) and area-based timber fees (premium). The value of premium is obtained by deducting the total royalty payment from the total prescribed realized rent.

Table 16 Distribution of Prescribed Realized Rent between the Government and Concessionaire

(a) Pahang

Logging Compartment	*Expected Gov. Revenue*		*Profit Margin*		*Prescribed Realized Rent*
	Total (MYR/ha)	*Percent*	*Total (MYR/ha)*	*Percent*	*(MYR/ha)*
1	6,280	58.25	4,502	41.75	10,782
2	7,685	61.85	4,741	38.15	12,426
3	12,728	64.47	7,013	35.53	19,741
4	26,406	67.40	12,773	32.60	39,179
5	24,476	66.57	12,289	33.43	36,765
6	40,920	67.68	19,543	32.32	60,463
7	23,800	66.70	11,882	33.30	35,682
8	10,398	63.01	6,105	36.99	16,503
9	13,044	65.09	6,997	34.91	20,041
10	10,758	64.55	5,907	35.45	16,665
11	11,229	65.26	5,977	34.74	17,206
12	10,059	63.64	5,746	36.36	15,805
13	43,485	71.72	17,146	28.28	60,631
14	39,677	71.50	15,815	28.50	55,492
15	70,935	76.34	21,984	23.66	92,919
16	57,844	71.80	22,714	28.20	80,558
17	50,679	71.84	19,865	28.16	70,544
18	42,148	70.75	17,428	29.25	59,576
19	46,194	70.39	19,428	29.61	65,622
20	48,617	70.37	20,469	29.63	69,086
21	58,456	70.61	24,334	29.39	82,790
22	50,557	71.09	20,560	28.91	71,117
23	55,999	71.17	22,685	28.83	78,684
24	41,821	70.80	17,246	29.20	59,067
25	52,362	70.25	22,177	29.75	74,539
26	58,968	70.82	24,298	29.18	83,266
27	50,823	71.14	20,621	28.86	71,444
Average	35,791	70.20	15,194	29.80	50,985

Note: 3.80 MYR = 1 USD

(b) Terengganu

Logging Compartment	*Expected Gov. Revenue*		*Profit Margin*		*Prescribed Realized Rent*
	Total (MYR/ha)	*Percent*	*Total (MYR/ha)*	*Percent*	*(MYR/ha)*
1	34,358	75.62	11,080	24.38	45,438
2	42,410	75.06	14,092	24.94	56,502
3	18,077	74.59	6,158	25.41	24,235
4	16,688	75.08	5,540	24.92	22,228
5	71,843	75.78	22,959	24.22	94,803
6	35,334	75.93	11,200	24.07	46,534
7	21,815	75.62	7,034	24.38	28,849
8	4,956	74.15	1,727	25.85	6,684
9	5,980	74.74	2,021	25.26	8,001
10	1,969	73.49	710	26.51	2,679
11	20,736	74.62	7,053	25.38	27,789
12	56,475	76.08	17,760	23.92	74,234
13	5,333	76.49	1,639	23.51	6,972
14	4,936	74.24	1,713	25.76	6,649
15	16,637	76.01	5,252	23.99	21,889
16	9,817	74.75	3,316	25.25	13,134
17	18,198	75.96	5,761	24.04	23,959
18	44,859	74.94	15,002	25.06	59,860
19	80,041	75.17	26,434	24.83	106,475
20	12,338	76.06	3,882	23.94	16,220
21	35,921	75.11	11,905	24.89	47,826
22	37,902	75.03	12,615	24.97	50,517
23	16,531	76.17	5,171	23.83	21,702
24	19,404	74.81	6,535	25.19	25,939
25	17,460	74.60	5,946	25.40	23,406
Average	26,001	75.00	8,500	25.00	34,501

Note: 3.80 MYR = 1 USD

It is interesting to see how logging regulation makes economic sense from the financial perspective. Theoretically, timber should be left in the forest to grow rather than be harvested, only if its stumpage value at the time of the next harvest is larger than the accumulated returns from investing the revenue from timber harvest at an appropriate rate of interest. We assume that we would have avoided all opportunity costs involved in timber harvesting activities due to logging regulations (for example, revenue forgone from harvesting timber in the buffer zone area). Therefore, the stumpage value of trees below the cutting limit can be used as a measure of financial viability by compounding for 30 years at selected interest rates. The results are presented in Table 17.

Almost all sites show that the compounded value of the prescribed silvicultural rent is greater than the original value when the interest rate is between 4 and 6%. However, the second growth of forest is unlikely to show a higher stumpage value than the stumpage value of virgin forest. The sustained yield management under the current SMS is therefore financially feasible at a lower discount rate. If we take into account the benefits of non-timber forest

products, then the SMS is financially feasible by prescribing high cutting limits. It should be noted that the cutting cycle adopted in each compartment will affect the future growth of the forest in the second cycle. The future stumpage value is therefore dependent very much on the physical growth of the forest under various environmental condition. Detailed growth and yield studies are required to predict future timber yields for a given logging compartment.

Table 17 Compounded Values of Prescribed Silvicultural Rent.

(a) Pahang

Logging Compartment	*Prescribed Silvicultural* (MYR/ha)	*Interest rate (%)* 4	6	8	10	12	*Potential* Rent (MYR/ha)
1	9,607	31,159	55,178	96,672	167,636	287,825	7,078
2	7,758	25,162	44,558	78,066	135,372	232,429	8,495
3	2,938	9,529	16,874	29,564	51,266	88,022	13,992
4	4,671	15,150	26,828	47,003	81,506	139,943	27,144
5	11,356	36,832	65,223	114,272	198,155	340,225	25,344
6	6,978	22,632	40,078	70,217	121,762	209,060	42,532
7	9,708	31,487	55,758	97,688	169,399	290,851	24,850
8	3,353	10,875	19,258	33,740	58,508	100,456	11,988
9	4,368	14,167	25,088	43,954	76,219	130,865	13,886
10	4,414	14,316	25,352	44,417	77,022	132,243	15,823
11	239	775	1,373	2,405	4,170	7,160	12,494
12	11,687	37,906	67,124	117,602	203,931	350,142	11,027
13	11,879	38,528	68,227	119,534	207,281	355,894	22,718
14	3,679	11,932	21,130	37,021	64,196	110,223	21,036
15	15,735	51,035	90,374	158,336	274,566	471,419	35,606
16	4,810	15,601	27,626	48,401	83,932	144,107	33,821
17	3,955	12,828	22,716	39,798	69,012	118,491	28,677
18	10,760	34,899	61,800	108,274	187,756	322,369	24,738
19	7,040	22,834	40,434	70,841	122,844	210,918	26,766
20	5,405	17,531	31,044	54,389	94,314	161,933	28,147
21	10,377	33,657	59,600	104,420	181,072	310,894	33,228
22	8,046	26,096	46,212	80,964	140,398	241,058	29,997
23	6,665	21,617	38,280	67,068	116,300	199,683	33,313
24	5,127	16,629	29,447	51,591	89,463	153,605	24,575
25	4,519	14,657	25,955	45,473	78,854	135,389	30,186
26	9,607	31,159	55,178	96,672	167,636	287,825	34,670
27	9,607	31,159	55,178	96,672	167,636	287,825	30,202

3.80 MYR= 1 USD

(a) Terengganu

Logging Compartment	*Prescribed Silvicultural (MYR/ha)*	*Interest rate (%)*					*Potential Rent (all trees 30cm dbh and above) (MYR/ha)*
		4	*6*	*8*	*10*	*12*	
1	9,607	31,158	55,176	96,668	167,630	287,815	32,884
2	7,758	25,161	44,555	78,061	135,364	232,415	36,075
3	2,938	9,530	16,875	29,566	51,269	88,027	14,858
4	4,671	15,151	26,830	47,007	81,514	139,956	15,819
5	11,356	36,831	65,221	114,268	198,150	340,215	60,240
6	6,978	22,631	40,076	70,213	121,755	209,049	31,111
7	9,708	31,487	55,759	97,690	169,402	290,856	24,490
8	3,353	10,876	19,259	33,742	58,512	100,462	6,582
9	4,368	14,166	25,086	43,951	76,214	130,856	8,327
10	4,414	14,316	25,352	44,417	77,022	132,243	5,673
11	239	775	1,372	2,403	4,168	7,156	13,921
12	11,687	37,904	67,122	117,598	203,924	350,129	50,402
13	11,879	38,527	68,225	119,531	207,276	355,884	15,573
14	3,679	11,934	21,133	37,025	64,203	110,234	6,903
15	15,735	51,034	90,372	158,333	274,562	471,411	27,120
16	4,810	15,599	27,623	48,397	83,923	144,093	11,310
17	3,955	12,828	22,715	39,797	69,012	118,490	16,392
18	10,760	34,901	61,803	108,279	187,764	322,383	40,618
19	7,040	22,834	40,435	70,843	122,846	210,922	60,646
20	5,405	17,530	31,043	54,387	94,312	161,929	13,860
21	10,377	33,656	59,598	104,417	181,067	310,885	34,393
22	8,046	26,097	46,213	80,966	140,401	241,063	33,333
23	6,665	21,617	38,279	67,066	116,297	199,677	18,025
24	5,127	16,630	29,448	51,594	89,467	153,612	17,996
25	4,519	14,657	25,955	45,473	78,853	135,387	16,034

3.80 MYR=1 USD

4.2 Estimates of Stumpage Value by Major Groups and DBH Class

All timber species in the logging compartment is divided into two major groups, namely dipterocarp and non-dipterocarp. Dipterocarp group is normally dominated by species from Dipterocarpaceae family such as *Anisoptera, Dipterocarpus, Dryobalanops, Hopea, Parashorea* and *Shorea*. The results of the estimated stumpage value are presented in Table 18. The results show that the contribution of stumpage value in natural forest is largely dependent on the composition of dipterocarp timber species. However, the results in Pahang indicate that the stumpage value of the dipterocarp species contributes about 47% compared to that of the non-dipterocarp. This may be due to a higher timber volume of the non-dipterocarp species in the logging compartment. This is not true in all sites, where the dipterocarp species contribute as much as 96% of the total potential stumpage value. In Terengganu, a higher stumpage value for dipterocarp was observed (i.e., about 66% of the total stumpage). This may be due to a higher composition of timber volume from the dipterocarp species in the compartment, which also fetches a higher log price compared to

that of the non-dipterocarp species.

Table 18 Stumpage Value by Major Species Groups (Potential Stumpage Value, All Trees 30 cm and Above).

(a) Pahang

Logging compartment	*Dipterocarp*		*Non-Dipterocarp*		*Total (MYR/ha)*
	Total (MYR/ha)	*Percent*	*Total (MYR/ha)*	*Percent*	
1	4,738	66.9	2,340	33.1	7,078
2	6,196	73.0	2,294	27.0	8,491
3	10,497	75.0	3,495	25.0	13,992
4	26,089	96.1	1,055	3.9	27,144
5	20,855	82.3	4,489	17.7	25,344
6	39,750	93.5	2,781	6.5	42,532
7	23,047	92.7	1,803	7.3	24,850
8	9,368	78.1	2,620	21.9	11,988
9	13,114	94.4	772	5.6	13,886
10	11,144	70.4	4,678	29.6	15,823
11	10,628	85.1	1,866	14.9	12,494
12	9,129	82.8	1,898	17.2	11,027
13	3,318	14.6	19,400	85.4	22,718
14	5,793	27.5	15,243	72.5	21,036
15	16,644	46.7	18,962	53.3	35,606
16	7,130	21.1	26,691	78.9	33,821
17	5,599	19.5	23,078	80.5	28,677
18	4,548	18.4	20,191	81.6	24,738
19	3,384	12.6	23,382	87.4	26,766
20	3,666	13.0	24,481	87.0	28,147
21	5,040	15.2	28,187	84.8	33,228
22	6,124	20.4	23,873	79.6	29,997
23	7,429	22.3	25,884	77.7	33,313
24	3,880	15.8	20,696	84.2	24,575
25	3,672	12.2	26,514	87.8	30,186
26	5,040	14.5	29,630	85.5	34,670
27	5,542	18.3	24,659	81.6	30,202

Note: 3.80 MYR = 1 USD

The distribution of stumpage values (potential rent) by diameter class are presented in Table 19**.** As can be seen from the table the estimated stumpage values (potential rent) with regards to the diameter class, vary considerably in each compartment. It can be observed that the estimated stumpage value is concentrated in the 55 to 75 cm dbh class. This is because a major proportion of timber volume is within this diameter class and this phenomenon is quite obvious for the dipterocarp forest.

(b) Terengganu

Logging	*Dipterocarp*		*Non-Dipterocarp*		*Total*
Compartment	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*(MYR/ha)*
1	19,597	59.59	13,287	40.41	32,884
2	23,766	65.88	12,309	34.12	36,075
3	7,986	53.75	6,872	46.25	14,858
4	9,394	59.38	6,425	40.62	15,819
5	47,002	78.02	13,238	21.98	60,240
6	24,594	79.05	6,517	20.95	31,111
7	19,346	79.00	5,144	21.00	24,490
8	3,706	56.31	2,876	43.69	6,582
9	5,104	61.29	3,223	38.71	8,327
10	3,703	65.27	1,970	34.73	5,673
11	5,792	41.61	8,129	58.39	13,921
12	45,318	89.91	5,084	10.09	50,402
13	15,118	97.08	455	2.92	15,573
14	4,170	60.41	2,733	39.59	6,903
15	16,000	59.00	11,120	41.00	27,120
16	7,851	69.41	3,460	30.59	11,310
17	10,633	64.86	5,760	35.14	16,392
18	27,453	67.59	13,165	32.41	40,618
19	32,522	53.63	28,124	46.37	60,646
20	7,955	57.40	5,905	42.60	13,860
21	22,724	66.07	11,669	33.93	34,393
22	21,024	63.07	12,309	36.93	33,333
23	15,578	86.43	2,447	13.57	18,025
24	11,453	63.64	6,544	36.36	17,996
25	8,527	53.18	7,507	46.82	16,034

Note: 3.80 MYR = 1 USD

Table 19 Stumpage Value (Potential Rent) by Diameter Class.

(a) Pahang

Logging compartment	*1*		*2*		*3*		*4*	
Diameter class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	-25.78	-0.36	47.32	0.56	220.79	1.58	-11.07	-0.04
30-45	41.13	0.58	464.85	5.47	708.00	5.06	325.15	1.20
45-50	450.69	6.37	516.04	6.07	732.28	5.23	537.66	1.98
50-55	608.82	8.60	810.22	9.54	656.88	4.69	703.19	2.59
55-60	724.58	10.24	641.29	7.55	584.50	4.18	1,495.42	5.51
60-65	1,401.32	19.80	1,260.00	14.83	1,747.79	12.49	2,255.22	8.31
65-70	314.70	4.45	774.89	9.12	1,140.22	8.15	1,515.27	5.58
70-75	393.14	5.55	625.35	7.36	2,056.09	14.70	1,163.12	4.28
75-80	924.95	13.07	456.04	5.37	2,809.71	20.08	4,379.15	16.13
80-85	603.48	8.53	984.75	11.59	1,777.78	12.71	6,244.40	23.00
85-90	382.36	5.40	314.71	3.70	232.88	1.66	3,140.10	11.57
90	1,258.59	17.78	1,599.67	18.83	1,324.77	9.47	5,396.68	19.88
Total	7,077.98	100.00	8,495.11	100.00	13,991.71	100.00	27,144.30	100.00

Logging compartment	*5*		*6*		*7*		*8*	
Diameter class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	288.30	1.14	168.77	0.40	34.20	0.14	60.98	0.51
30-45	194.65	0.77	1,237.10	2.91	429.67	1.73	689.59	5.75
45-50	546.98	2.16	211.13	0.50	735.38	2.96	605.85	5.05
50-55	426.32	1.68	377.90	0.89	885.45	3.56	735.28	6.13
55-60	396.08	1.56	456.47	1.07	766.48	3.08	890.26	7.43
60-65	1,139.15	4.49	1,512.78	3.56	685.62	2.76	973.75	8.12
65-70	765.38	3.02	2,487.37	5.85	672.55	2.71	1,487.38	12.41
70-75	1,928.94	7.61	4,852.90	11.41	741.90	2.99	1,388.25	11.58
75-80	3,206.80	12.65	5828.30	13.70	742.20	2.99	1,107.95	9.24
80-85	3,031.22	11.96	8672.31	20.39	498.36	2.01	1,727.46	14.41
85-90	166.68	0.66	653.08	1.54	759.22	3.06	839.92	7.01
90	13,253.25	52.29	16,073.42	37.79	17,898.97	72.03	1,481.62	12.36
Total	25,343.75	100.00	42,531.52	100.00	24,850.00	100.00	11,988.28	100.00

Logging compartment	*9*		*10*		*11*		*12*	
Diameter class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	-38.56	-0.28	218.96	1.38	69.20	0.55	27.94	0.25
30-45	219.46	1.58	262.68	1.66	461.76	3.70	240.45	2.18
45-50	266.40	1.92	209.79	1.33	351.24	2.81	311.26	2.82
50-55	619.47	4.46	505.43	3.19	542.91	4.35	241.95	2.19
55-60	460.83	3.32	302.68	1.91	604.31	4.84	544.79	4.94
60-65	1,691.45	12.18	1,803.58	11.40	1,490.17	11.93	1,070.82	9.71
65-70	1,316.97	9.48	809.48	5.12	1,237.18	9.90	1,881.09	17.06
70-75	1,765.56	12.71	2,325.25	14.70	1,187.78	9.51	1,214.88	11.02

75-80	1,508.62	10.86	1,918.72	12.13	1,385.98	11.09	1,227.59	11.13
80-85	3,485.49	25.10	3,462.31	21.88	1,990.98	15.94	791.68	7.18
85-90	936.38	6.74	315.73	2.00	668.25	5.35	784.34	7.11
90	1,653.93	11.91	3,687.90	23.31	2,504.07	20.04	2,689.84	24.39
Total	13,886.01	100.00	15,822.50	100.00	12,493.83	100.00	11,026.64	100.00

Logging compartment	*13*		*14*		*15*		*16*	
Diameter Class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	-217	-0.96	-116	-0.55	-125	-0.35	-153	-0.45
30-45	2,562	11.28	2,905	13.81	2,544	7.15	1,416	4.19
45-50	1,967	8.66	1,849	8.79	2,161	6.07	868	2.57
50-55	983	4.33	2,332	11.09	1,711	4.81	1,461	4.32
55-60	2,225	9.80	1,246	5.92	1,629	4.57	1,418	4.19
60-65	1,396	6.15	2,106	10.01	3,017	8.47	3,363	9.94
65-70	2,311	10.17	2,272	10.80	3,359	9.43	2,349	6.95
70-75	1,781	7.84	1,145	5.44	3,469	9.74	2,534	7.49
75-80	3,603	15.86	833	3.96	5,026	14.12	2,795	8.26
80-85	862	3.80	1,940	9.22	2,357	6.62	2,173	6.43
85-90	1,805	7.94	2,340	11.13	3,076	8.64	2,451	7.25
90	3,439	15.14	2,183	10.38	7,381	20.73	13,146	38.87
Total	22,718	100	21,036	100	35,606	100	33,821	100

Logging compartment	*17*		*18*		*19*		*20*	
Diameter Class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	-133.54	-0.47	-171.25	-0.69	-155.08	-0.58	-248.95	-0.88
30-45	1429.20	4.98	1150.27	4.65	2016.25	7.53	1492.35	5.30
45-50	2417.70	8.43	1507.95	6.10	1842.16	6.88	1215.64	4.32
50-55	1207.30	4.21	1314.88	5.32	1785.95	6.67	2517.14	8.94
55-60	1121.85	3.91	1636.38	6.61	1178.18	4.40	2402.48	8.54
60-65	2196.48	7.66	3553.38	14.36	2448.69	9.15	5116.32	18.18
65-70	3711.02	12.94	3195.75	12.92	1738.27	6.49	1742.09	6.19
70-75	1491.68	5.20	2260.78	9.14	1976.05	7.38	4696.45	16.69
75-80	2962.59	10.33	1120.85	4.53	2014.55	7.53	2383.05	8.47
80-85	1278.46	4.46	2598.86	10.51	1207.49	4.51	2286.21	8.12
85-90	2337.07	8.15	2306.77	9.32	2426.67	9.07	1709.61	6.07
90	8657.27	30.19	4263.77	17.24	8286.69	30.96	2834.92	10.07
Total	-133.54	-0.47	-171.25	-0.69	-155.08	-0.58	-248.95	-0.88

Logging compartment	*21*		*22*		*23*		*24*	
Diameter Class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	(251.84)	-0.76	(174.96)	-0.58	(191.77)	-0.58	(91.43)	-0.37
30-45	1,203.75	3.62	1,406.31	4.69	1,597.09	4.79	1,579.95	6.43
45-50	932.33	2.81	879.91	2.93	1,405.77	4.22	879.24	3.58
50-55	2,627.29	7.91	1,523.62	5.08	1,668.94	5.01	1,289.03	5.25
55-60	2,228.26	6.71	1,597.15	5.32	1,621.92	4.87	597.96	2.43

60-65	4,940.15	14.87	4,761.60	15.87	2,398.86	7.2	1,798.18	7.32
65-70	2,787.83	8.39	3,756.02	12.52	1,696.25	5.09	1,232.84	5.02
70-75	2,415.14	7.27	809.39	2.7	2,362.27	7.09	2,061.40	8.39
75-80	3,802.91	11.44	3,025.21	10.09	2,996.75	9	1,389.28	5.65
80-85	990.20	2.98	2,420.94	8.07	2,302.23	6.91	2,805.27	11.41
85-90	1,100.26	3.31	4,486.47	14.96	1,886.98	5.66	2,774.77	11.29
90	10,451.52	31.45	5,505.21	18.35	13,568.19	40.73	8,258.89	33.61
	33,228	100	29,997	100	33,313	100	24,575	100

Logging Compartment	*25*		*26*		*27*	
Diameter Class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	(280.55)	-0.93	(239.69)	-0.69	(170.72)	-0.57
30-45	690.64	2.29	1,349.16	3.89	1,445.59	4.79
45-50	874.54	2.9	1,047.00	3.02	897.01	2.97
50-55	876.44	2.9	2,777.52	8.01	1,535.86	5.09
55-60	1,031.61	3.42	2,560.26	7.38	1,612.10	5.34
60-65	1,299.13	4.3	5,444.02	15.7	4,807.02	15.92
65-70	4,654.24	15.42	2,814.78	8.12	3,795.72	12.57
70-75	1,144.84	3.79	2,424.92	6.99	817.70	2.71
75-80	5,041.12	16.7	3,928.68	11.33	3,025.21	10.02
80-85	1,214.18	4.02	990.20	2.86	2,420.94	8.02
85-90	4,375.28	14.49	1,100.26	3.17	4,509.92	14.93
90	9,264.31	30.69	10,472.93	30.21	5,505.21	18.23
	30,186	100	34,670	100	30,202	100

(b) Terengganu

Logging Compartment	*1*		*2*		*3*		*4*	
Diameter Class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	723	2.20	1,060	2.94	273	1.84	253	1.60
30-45	3,432	10.44	2,773	7.69	1,561	10.51	1,673	10.58
45-50	1,751	5.32	540	1.50	783	5.27	763	4.83
50-55	1,921	5.84	2,138	5.93	636	4.28	1,169	7.39
55-60	1,707	5.19	1,681	4.66	616	4.15	952	6.02
60-65	3,893	11.84	2,662	7.38	1,578	10.62	2,237	14.14
65-70	2,670	8.12	3,357	9.31	1,053	7.08	2,942	18.60
70-75	3,104	9.44	2,933	8.13	1,319	8.88	1,472	9.31
75-80	2,937	8.93	2,965	8.22	1,107	7.45	1,997	12.62
80-85	3,371	10.25	2,301	6.38	1,391	9.36	1,045	6.60
85-90	2,687	8.17	2,492	6.91	811	5.46	623	3.94
90+	4,689	14.26	11,174	30.97	3,731	25.11	692	4.37
Total	32,884	100	36,075	100	14,858	100	15,819	100

Logging Compartment	*5*		*6*		*7*		*8*	
Diameter Class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	1,470	2.44	540	1.74	536	2.19	318	4.83
30-45	3,785	6.28	2,547	8.19	1,669	6.82	909	13.81
45-50	2,550	4.23	920	2.96	1,512	6.18	1,122	17.05
50-55	3,022	5.02	1,156	3.71	2,222	9.07	1,028	15.62
55-60	1,978	3.28	1,718	5.52	2,708	11.06	723	10.98
60-65	3,319	5.51	2,317	7.45	4,023	16.43	903	13.72
65-70	3,676	6.10	2,388	7.68	2,256	9.21	1,121	17.04
70-75	3,933	6.53	2,019	6.49	1,661	6.78	166	2.52
75-80	4,185	6.95	2,490	8.00	1,841	7.52	161	2.44
80-85	7,005	11.63	2,518	8.09	1,506	6.15	52	0.78
85-90	4,284	7.11	3,251	10.45	1,568	6.40	79	1.20
90+	21,034	34.92	9,247	29.72	2,988	12.20	0	0.00
Total	60,240	100	31,111	100	24,490	100	6,582	100

Logging Compartment	*9*		*10*		*11*		*12*	
Diameter Class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	516	6.19	637	11.23	42	0.30	348	0.69
30-45	1,124	13.49	1,588	28.00	81	0.58	1,783	3.54
45-50	778	9.34	1,197	21.10	62	0.44	2,173	4.31
50-55	1,592	19.12	936	16.49	87	0.62	3,156	6.26
55-60	873	10.49	598	10.55	13	0.09	3,278	6.50
60-65	1,164	13.98	382	6.73	14	0.10	4,464	8.86
65-70	595	7.15	184	3.24	6,869	49.34	4,288	8.51
70-75	373	4.48	58	1.03	4,007	28.79	4,782	9.49
75-80	318	3.82	35	0.61	1,682	12.08	3,457	6.86
80-85	206	2.48	28	0.50	1,025	7.36	4,673	9.27
85-90	327	3.93	16	0.28	39	0.28	8,400	16.67
90+	460	5.53	13	0.24	0	0.00	9,601	19.05
Total	8,327	100	5,673	100	13,921	100	50,402	100

Logging Compartment	*13*		*14*		*15*		*16*	
Diameter Class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	1,312	8.42	342	4.96	1,526	5.63	323	2.86
30-45	2,126	13.65	711	10.29	6,153	22.69	1,643	14.53
45-50	2,241	14.39	521	7.55	2,631	9.70	1,198	10.60
50-55	2,460	15.80	1,429	20.70	3,993	14.72	1,430	12.64
55-60	2,213	14.21	1,216	17.62	3,472	12.80	938	8.29
60-65	1,742	11.18	1,047	15.16	2,462	9.08	896	7.92
65-70	1,123	7.21	448	6.49	1,886	6.95	1,215	10.74

70-75	824	5.29	99	1.44	1,658	6.11	819	7.24
75-80	623	4.00	267	3.86	498	1.83	1,222	10.81
80-85	434	2.79	191	2.77	99	0.37	353	3.12
85-90	300	1.93	154	2.24	336	1.24	265	2.35
90+	177	1.13	478	6.92	2,404	8.87	1,007	8.90
Total	15,573	100	6,903	100	27,120	100	11,310	100

Logging Compartment	*17*		*18*		*19*		*20*	
Diameter Class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	336	2.05	1,096	2.70	837	1.38	301	2.17
30-45	1,910	11.65	2,673	6.58	2,223	3.67	1,783	12.86
45-50	406	2.48	1,847	4.55	427	0.70	1,997	14.41
50-55	887	5.41	4,000	9.85	2,153	3.55	1,468	10.59
55-60	995	6.07	3,466	8.53	1,832	3.02	1,150	8.30
60-65	2,108	12.86	3,469	8.54	2,777	4.58	2,108	15.21
65-70	1,834	11.19	3,384	8.33	3,221	5.31	1,189	8.58
70-75	1,376	8.39	2,865	7.05	2,664	4.39	735	5.30
75-80	703	4.29	2,911	7.17	2,928	4.83	878	6.34
80-85	1,640	10.01	4,938	12.16	2,804	4.62	775	5.59
85-90	1,683	10.26	2,216	5.46	10,282	16.95	880	6.35
90+	2,514	15.33	7,753	19.09	28,497	46.99	596	4.30
Total	16,392	100	40,618	100	60,646	100	13,860	100

Logging Compartment	*21*		*22*		*23*		*24*	
Diameter Class	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*	*Total (MYR/ha)*	*Percent*
15-30	2,176	6.33	1,056	3.17	456	2.53	481	2.67
30-45	3,272	9.51	2,900	8.70	1,030	5.72	1,817	10.10
45-50	1,754	5.10	696	2.09	722	4.00	1,207	6.71
50-55	2,304	6.70	2,080	6.24	1,388	7.70	1,134	6.30
55-60	1,516	4.41	1,621	4.86	1,884	10.45	1,198	6.66
60-65	2,586	7.52	2,788	8.36	2,465	13.67	1,993	11.08
65-70	2,384	6.93	3,107	9.32	925	5.13	1,406	7.81
70-75	2,890	8.40	2,655	7.97	1,356	7.52	1,096	6.09
75-80	1,898	5.52	3,217	9.65	1,926	10.68	1,482	8.23
80-85	2,663	7.74	2,729	8.19	924	5.12	1,422	7.90
85-90	2,317	6.74	2,159	6.48	1,648	9.14	1,134	6.30
90+	8,633	25.10	8,322	24.97	3,303	18.32	3,626	20.15
Total	34,393	100	33,333	100	18,025	100.00	17,996	100

Logging Compartment	*25*	
Diameter Class	*Total (MYR/ha)*	*Percent*
15-30	494	3.08
30-45	2,079	12.96
45-50	1,057	6.59
50-55	976	6.09
55-60	821	5.12
60-65	1,225	7.64
65-70	702	4.38
70-75	843	5.26
75-80	900	5.61
80-85	919	5.73
85-90	1,167	7.28
90+	4,852	30.26
Total	16,034	100

4.3 Hypothetical Rent Capture under Different Royalty Systems

The estimates of stumpage value, government revenue, and concessionaire‘s rent under different revenue systems are presented in Table 20**.** Under competitive bidding, it is assumed that all the concessionaires would bid for the concession based on prevailing market price and harvesting technique. The profit ratio is taken as 30%. This is a target profit ratio used by concessionaires in evaluating their timber harvesting activities. This figure was obtained based on discussions with forest practitioners (concessionaires) in the field. It should be noted that under this system, the sole source of revenue is the tender price, without charging the royalty. From the table, the average bid price for getting the concession right is estimated at MYR 19,100 (USD 5,026) per hectare (Column 5). The average bid price for Pahang is MYR 20,468 (USD 5,386) per hectare and MYR 17,501 (USD 4,606) for Terengganu. With this bid price, the government can capture full stumpage value and the concessionaire‘s rent would be zero. The efficient concessionaires with lower logging cost would be willing to bid at a lower price and they will obtain normal profit margin.

If the revenue system is implemented through fixed royalty on volume of timber harvested and the premium is set equal to the estimated prescribed realized rent (i.e. stumpage value above the cutting limit), the table indicates that the average premium or tender price that would be offered by the concessionaire is MYR 16,278 (USD 4,284) per hectare (Column 6). The hypothetical average tender price in Pahang is MYR 17,069 (USD 4,492) per hectare, while in Terengganu the hypothetical average tender price is MYR 15,424 (USD 4,059) per hectare. Under this revenue system, the state government can also obtain full stumpage value.

Purely on the basis of fixed revenue system (royalty and premium), the table indicates that the average rent that could be captured is estimated at MYR 3,168 (USD 834) per hectare or 19.3% of the potential rent or stumpage value. In Pahang, the average rent that could be captured by the government is MYR 3,899 (USD 1,026) and in Terengganu, it is estimated at MYR 2,376 (USD 625) per hectare. The results of this study indicate that the fixed revenue

system would provide low rent capture to the government and they are comparable to the previous studies conducted by Vincent (1990) and Awang Noor et al. (1992). Compared to other tropical countries, the low rent capture obtained in this study is also comparable to the value estimated in the Philippines and Indonesia as shown in Table 21.

4.4 Realized Rent

Table 22 presents our estimates for realized rent components for selected logging compartments. Since we were unable to obtain government revenue data from all logging compartments, only selected compartments are reported. The most striking result is the small size of government revenue relative to actual realized rent in most compartments. The estimated realized rent ranges from 0.1 to 35.4% with an average of about 10%. The average realized rent in Pahang is higher than that of Terengganu. A higher percentage of realized rent found in Pahang is due to the higher premium charged for forest concession. The rates vary between MYR 500 (USD 132) and MYR 1,550 (USD 408) per hectare depending on the type of the forest and the type of agreement area. In Terengganu, the premium is MYR 300 (USD 79) per hectare. The low realized rent capture by the government in some compartments may be due to a high estimate of timber volume, which might be too high for the average compartment. This alerts us to possible problems with the pre-F data for some compartments, where the discrepancy is quite large. Leaving out some compartments with less than 5% for government rent capture based on potential rent, the average realized rent is estimated at 15.1%, which is even less that Vincent‘s (1990) median estimate of government rent capture in Peninsular Malaysia as a whole during the years 1966-86, at 21.8%. It should be noted that direct comparison might be biased since the method used by Vincent is based on aggregate data for the timber harvest and revenue collected in Peninsular Malaysia. The important finding is that the concessionaire could capture higher proportion of potential rent from timber harvesting activities and this may lead to _rent-seeking‘ behavior among them. The results from this study do not indicate the government‘s target share of resource rent because the optimal distribution of this rent between the government and the concessionaire was not carried out. It emphasizes that the government‘s share in capturing resource rent is low.

Table 20 Determination of Premium under Competitive Bidding and Comparison with Fixed Revenue System

State	*Compartment*	*Area (ha)*	*Potential Rent (Stumpage value above the Cutting Limit) (MYR/ha)*	*Competitive Bidding through Tendering (MYR/ha)*	*Premium Price Based on Competitive Bidding (MYR/ha) (Col. 4-Royalty – Cess)*	*Fixed Revenue System (Royalty and Premium) (MYR/ha)*	*Rent Capture Under Fixed Revenue System (Percent) (Col. 7/Col.4)*
Pahang	1	296.2	6,280	6,280	4,233	2,547	40.6
	2	40.5	7,685	7,685	3,710	4,475	58.2
	3	369.0	12,728	12,728	10,506	2,722	21.4
	4	121.4	26,406	26,406	24,759	2,147	8.1
	5	95.5	24,476	24,476	21,920	3,056	12.5
	6	176.4	40,920	40,920	38,796	2,624	6.4
	7	153.8	23,800	23,800	22,516	1,784	7.5
	8	110.9	10,398	10,398	7,029	3,869	37.2
	9	402.3	13,044	13,044	10,658	2,886	22.1
	10	294.6	10,758	10,758	8,240	3,018	28.1
	11	104.5	11,229	11,229	9,688	2,041	18.2
	12	93.8	10,059	10,059	6,775	3,784	37.6
	13	60.7	17,075	17,075	13,554	4,021	23.5
	14	32.4	11,637	11,637	9,008	3,129	26.9
	15	40.5	25,649	25,649	21,435	4,714	18.4
	16	57.1	29,857	29,857	24,757	5,600	18.8
	17	52.6	23,306	23,306	19,218	4,588	19.7
	18	82.4	19,612	19,612	16,132	3,980	20.3
	19	103.2	21,024	21,024	17,225	4,299	20.4
	20	60.7	22,614	22,614	18,605	4,509	19.9
	21	60.7	27,155	27,155	22,261	5,394	19.9

State	*Compartment*	*Area (ha)*	*Potential Rent (Stumpage value above the Cutting Limit) (MYR/ha)*	*Competitive Bidding through Tendering (MYR/ha)*	*Premium Price Based on Competitive Bidding (MYR/ha) (Col. 4-Royalty – Cess)*	*Fixed Revenue System (Royalty and Premium) (MYR/ha)*	*Rent Capture Under Fixed Revenue System (Percent) (Col. 7/Col.4)*
	22	60.7	25,058	25,058	20,859	4,699	18.8
	23	58.2	28,449	28,449	23,755	5,194	18.3
	24	111.3	20,602	20,602	17,016	4,086	19.8
	25	80.9	27,902	27,902	22,539	5,863	21.0
	26	60.7	29,059	29,059	24,098	5,461	18.8
	27	60.7	25,849	25,849	21,570	4,779	18.5
Terengganu	1	392.2	23,278	23,278	20,661	2,917	12.5
	2	402.0	28,318	28,318	24,742	3,876	13.7
	3	374.0	11,920	11,920	10,270	1,949	16.4
	4	422.5	11,148	11,148	9,745	1,703	15.3
	5	121.0	48,884	48,884	43,585	5,599	11.5
	6	121.0	24,134	24,134	21,604	2,830	11.7
	7	121.0	14,782	14,782	13,121	1,960	13.3
	8	444.0	3,229	3,229	2,744	785	24.3
	9	383.0	3,960	3,960	3,427	832	21.0
	10	342.0	1,259	1,259	1,046	513	40.7
	11	162.0	13,682	13,682	11,798	2,184	16.0
	12	162.0	38,715	38,715	34,789	4,226	10.9
	13	282.0	3,694	3,694	3,355	639	17.3
	13	400.0	3,223	3,223	2,747	776	24.1
	15	170.0	11,385	11,385	10,212	1,473	12.9
	16	417.0	6,501	6,501	5,628	1,173	18.0
	17	462.0	12,438	12,438	11,141	1,597	12.8
	18	405.0	29,857	29,857	25,996	4,162	13.9

State	*Compartment*	*Area (ha)*	*Potential Rent (Stumpage value above the Cutting Limit) (MYR/ha)*	*Competitive Bidding through Tendering (MYR/ha)*	*Premium Price Based on Competitive Bidding (MYR/ha) (Col. 4-Royalty – Cess)*	*Fixed Revenue System (Royalty and Premium) (MYR/ha)*	*Rent Capture Under Fixed Revenue System (Percent) (Col. 7/Col.4)*
	19	405.0	53,606	53,606	46,992	6,914	12.9
	20	420.0	8,455	8,455	7,595	1,160	13.7
	21	413.0	24,016	24,016	21,013	3,303	13.8
	22	412.0	25,287	25,287	22,073	3,513	13.9
	23	370.7	11,361	11,361	10,234	1,426	12.6
	24	421.0	12,869	12,869	11,161	2,009	15.6
	25	310.0	11,515	11,515	9,923	1,892	16.4
Average			19,041	19,041	16,278	3,167	19.3

Note: 3.80 MYR = 1 USD

Table 21 Rent Capture from Previous Studies: Malaysia and Some Selected Countries

State/Forest Reserve	*Potential rent (above cutting limits)* 1	*Rent based on actual log extracted* 2	*Government revenue collection* 3	*Percent* (3/1)	*Percent* (3/2)
Pahang: (1989-90)[1] (MYR)					
Lesong (C386/387)	12,804	9,809	1,887	14.7	19.2
Lesong (C388/389)	23,542	19,619	1,738	7.4	8.8
Bencah (C15)	8,044	7,592	3,750	46.6	49.4
Bencah (C16)	6,802	5,941	2,747	40.4	46.2
Terengganu: (1988-89)[1] (MYR)					
Jengai (C86)	12,850	12,327	1,674	13.2	13.6
Jengai (C87)	10,087	10,763	1,791	17.7	16.6
Kelantan: (1989-90)[1] (MYR)					
Berangkat (C13)	4,870	2,057	406	8.3	19.7
Berangkat (C14)	5,261	2,318	547	23.6	23.4
Peninsular Malaysia[2] (MYR)					21.3
Sabah[2] (MYR)					46.2
Sarawak[2] (MYR)					18.4
Sabah: (1979-82) (Billion US)[3]	2,198	2094	1703	81.3	77.5
Other tropical countries (Billion US):					
Indonesia (1979-82)[3]	4,954	4,409	1,644	37.3	33.2
Philippines (1979-82)[4]	1,505	1,033	171	16.5	11.4
Philippines (1987)	256	68	39	57.1	15.3

Source:

1 Awang Noor et al. (1992)

2 Vincent (1990)

3 Gillis (1988a)

4 Boado (1988)

Note: 3.80 MYR= 1 USD

Table 22 Realized Rent Component by Compartment.

State	*Compartment*	*Potential Realized Rent (MYR/ha)*	*Government Revenue (Actual) (MYR/ha)*	*Windfall Profits (MYR/ha)*	*Government revenue*	*Concessionaire's rent*
					As Percentage of Potential rent	
Pahang[1]	13	17,075	2,727	14,348	16.0	84.0
	14	11,637	3,386	8,251	29.1	70.9
	15	25,649	2,944	22,705	11.5	88.5
	16	29,857	21	29,836	0.1	99.9
	17	23,306	2,471	20,835	10.6	89.4
	18	19,612	1,821	17,791	9.3	90.7
	19	21,024	2,665	18,359	12.7	87.3
	21	27,155	4,249	22,906	15.6	84.4
	22	25,058	3,295	21,763	13.1	86.9
	23	28,449	3,832	24,617	13.5	86.5
	24	20,602	571	20,031	2.8	97.2
	25	27,902	9,885	18,017	35.4	64.6
	27	25,849	2,257	23,592	8.7	91.3
Terengganu	1	23,278	453	22,824	1.9	98.1
	2	28,318	610	27,707	2.2	97.8
	5	48,884	950	47,934	1.9	98.1
	6	24,134	977	23,156	4.0	96.0
	7	14,782	1,032	13,750	7.0	93.0
	8	3,229	51	3,177	1.6	98.4
	9	3,960	320	3,640	8.1	91.9
	10	1,259	401	858	31.9	68.1
	11	13,682	1,178	12,504	8.6	91.4
	13	3,694	721	2,973	19.5	80.5
	14	3,223	83	3,140	2.6	97.4
	18	29,857	750	29,107	2.5	97.5
	19	53,606	757	52,850	1.4	98.6
	21	24,016	754	23,262	3.1	96.9
	23	11,361	338	11,023	3.0	97.0
	24	12,869	718	12,151	5.6	94.4
Average		20,804	1,732	19,073	9.8	90.2

Note: [1] Data were not available for compartments 1 to 12.

5.0 POLICY IMPLICATIONS

Based on the results of the study, it appears that the government is collecting a relatively small share of the total possible rents using their existing administratively fixed revenue system (fixed royalty, premium and silvicultural cess). It also appears that the government is collecting a larger share of the potential rents through tendering, although these may still be less than hypothetical maximum prescribed resource rent. Therefore, if the government wants to increase its share of the rents, it can do so by either increasing the royalty rates or by tendering out the concession. The analysis suggests that tendering would be preferred over a fixed premium system since government revenue from concessions could be increased many times over by reducing the potential rent captured by the concessionaires. This would not totally eliminate normal profit margin for logging contractors because the bid price offered by the concessionaires is reflected in their true willingness to pay to obtain the concession rights. The risk and

uncertainties in timber harvesting activities have also been taken into account in the bidding process. The level of premium could be set based on the average prescribed realized rent per hectare, after deducting the royalty payments, as we did in the analysis. This value needs to be adjusted by a certain margin to reduce the likelihood of overcharge. The method of tendering system (sealed tender or open tender) would depend on the type of forest concession, the number of expected bidders, and the scale of operation.

For the long-term concession agreement, tendering might not be suitable because of the established long-term contract between the state government and the concessionaire. The conditions of the concession contract cover, among others, the concessionaire‘s rights and obligations, along with the conditions for the management and operation of the production forest areas within the concession, and sales of forest concessions. The conditions also provide for the protection and management of other forest goods and services. The short-term concession is suitable for tendering because the market for stumpage is competitive. The number of potential short-term concessionaires are quite large and they can be invited to indicate their interest and submit information for tendering. Tendering also eliminates problems of having accurate pre-F data because the tender price offered by concessionaires reflects the full value of the timber in a competitive market.

On the other hand, other methods of forest charges could be considered such as the calculation of prescribed rent based on the final product (i.e., sawntimber, plywood, furniture, etc.). Many developed countries, such as the United States, Canada and Australia used this method to calculate the stumpage value or resource rent. This will ensure that the estimated stumpage value is a reflection of true market transaction under competitive market structure.

The estimated prescribed stumpage value depends on the cutting limit regulation under the SMS. Using a lower discount rate, the present cutting limit is financially feasible because the second growth forest would produce more or less the same timber value compared to the original condition. However, if we take into account the benefits of non-timber forest products, then the SMS is financially feasible by prescribing high cutting limits. Thus, the government can have different cutting limits under different management regimes, whether for timber production or multiple use objectives. The current cutting limit can be maintained if the forest is used for timber production and higher cutting limit may be required if the forest is to be used in relation to a combination of timber production and non-timber forest products.

Another implication of the study is that there is a very large difference in the shares of the rent collected by the government in some compartments. It is hard to see why the government would want to collect such different amounts for a given compartment. If this happens, it could create perverse incentives in harvesting activities. The large share of rent collected by the government could also be due to data problems, especially the pre-F data. Therefore, there is a need to evaluate and assess the factors that lead to such differences.

6.0 CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

6.1 Conclusion

The findings of the study confirm some of the findings of previous studies on stumpage value and variations between compartments as well as rent capture by the government. However, in some cases it contradicts other studies. Our principle conclusions with regards to forest pricing and rent distribution are as follows:

1. Potential stumpage value—The minimum commercial log diameters in the states are as low as 30 cm. Even if it is based on authors' study on other areas in the state of Pahang, the commercial log diameters can be up to 15 cm. It is important to note that the tropical rain forest has a very high commercial value with high commercial species. In some compartments, this reflects the dominance of species in the dipterocarp family. This results in most of the sites having a substantial stumpage value of MYR 42,000 (USD 11,053) per hectare. The analysis also indicates that a large portion of potential stumpage value comprises prescribed realized rent (trees with above cutting limits). The Selective Management System's (SMS) cutting limits may be economically justified only if one assumes either that discount rates are very low or the value of non-timber benefits protected by high cutting limits is very large. A purely financially motivated forest owner would probably find it profitable to harvest all timber down to the minimum commercial log diameter. If he does this, then it is like he is clear felling the forest.

2. Rent capture by the government—Based on actual revenue collected by the government in some compartments, only a small share of the stumpage value was captured by the state via royalty, premium, and silvicultural cess under the fixed forest revenue system (i.e. royalty, premium and silvicultural cess are administratively fixed by the government). Other forms of tax could also be captured in terms of company's tax or indirect tax enjoyed by forestry workers and through timber harvesting activities. Most of the rent is captured by concessionaires through the prescribed resource rent which are not captured by the government, in excess of their normal profit margin.

3. Revenue system—The results indicate that the government's rent capture could be increased through tendering either based on pure tender system (without royalty charge) or a mixture of fixed royalty and competitive tender (premium) price system. This system will reflect a "fair market" value of a logging compartment by the concessionaires bidding for concession rights. Administratively fixed royalty and premium system would provide low rent capture and this may result in "below cost timber sales" if other non-revenue forest products are taken into account in the total fund allocated for forest management.

6.2 Future Research

Critical issues remain unanswered due to the limitations of the study. These include the estimation of logging cost data across states under different forest conditions, analysis of tendering system and comparison with the fixed royalty system, assessment of the

accuracy of pre-F data and impacts of different forest revenue systems on timber harvest behavior. Future studies should incorporate all these factors.

The logging cost may vary from site to site depending on the slope of the forest, species composition, harvesting method, skilled workers employed in timber harvesting, road distance, and other environmental factors. The use of different logging cost to reflect these differences may provide different stumpage value for different sites. The use of the tendering system in allocating forest concessions to concessionaires will result in higher stumpage value and rent capture to different stakeholders. Differences in tendering system and fixed royalty would provide a clear picture of the divergence in rent capture compared to the market transaction. Stumpage values can be estimated or derived in several ways:

a. Stumpage values from sales of standing timber – computed based on the price paid in a competitive market to forest owners for standing timber (through tendering system).

b. Prices paid for felled trees and logs at road-side – computed from prices of felled trees by deducting logging cost.

c. Prices paid for logs delivered to the mill – computed from prices of logs delivered to the mill by deducting transportation and logging costs.

d. Domestic and export prices of forest products – computed from prices of the processed or final products (sawn wood, plywood, veneer) by deducting processing costs, log transport costs and logging costs from the FOB (free on board) prices of the processed forest products.

In this study, method (b) was used. This study suggests a comparison between method (b) and (d). We felt that method (b) would underestimate the stumpage value compared to method (d). Method (d) involves more steps and is more complicated, but the estimated stumpage value is much closer to a competitive market.

The study also found out that there are large variations of stumpage values across compartments in both states. This may be due to data reliability from the pre-F inventory. The use of one-way volume formula in calculating timber volume in the pre-F inventory may also need to be reviewed. Different forest revenue systems would result in different harvest behavior in terms of how loggers would respond to reducing the logging damage and environmental conservation. Further research in these areas will provide a greater understanding of forest pricing policies and its link with logging behavior and environmental conservation.

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