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Production and Input-use Efficiency in the Sawmilling Industry of Peninsular Malaysia

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ABSTRAK

Fungsi-fungsi pengeluaran untuk industri papan gergaji di tiga buah negeri di Semenanjung Malaysia telah dianggarkan. Keluaran papan gergaji telah diregresikan dengan input-input modal dan buruh sebagai angkubah-angkubah bebas. Pulangan kepada skala untuk industri papan gergaji ini dianggarkan. Hasil kajian ini boleh memberi panduan terhadap kecekapan penggunaan input-input pengeluaran, tertakluk kepada beberapa sumber 'bias' yang diterangkan di dalam kertas ini.

ABSTRACT

Production functions for the sawmilling industry in three states of Peninsular Malaysia are estimated. Sawntimber output is regressed with gross capital and labour as independent variables. The returns to scale underlying the sawmilling industry are estimated. The findings of this study do provide useful indications on efficiency of input utilisation, subject to potential sources of bias noted in the paper.

INTRODUCTION

This study is an attempt to estimate the production functions of the sawntimber industry in three states of Peninsular Malaysia. The three states – Penang, Selangor and Trengganu – were chosen to compare probable different production characteristics arising from different sawlog endowments and production scales. Peninsular Malaysia's sawlog production in 1981 totalled 10.2 millon cubic metres, of which 17% came from Trengganu, 3% from Selangor and only 54 cubic metres from Penang. Structurally there are 73 mills in Trengganu, 58 mills in Selangor and 32 mills in Penang. Employment figures followed the same pattern of mill distribution above. Trengganu mills employed 4,275 workers with Selangor and Penang mills providing 1,692 and 436 jobs respectively. As a result of this distribution in number of mills and employment, Trengganu recorded the highest production figures of sawntimber at 693,440 cubic metres, followed by Selangor (221,738 cubic metres) and Penang (77,187 cubic metres).

Sawntimber output is regressed using two major inputs – gross capital and labour. This function allows us to understand the inter-relationships between these two factors in sawntimber production. An attempt is made to evaluate the efficiency with which these inputs are used in production. The returns to scale underlying this manufacturing industry are also estimated.

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MATERIALS AND METHODS

Specification of Production Function

The unrestricted Cobb-Douglas production function is used in this analysis. This form is used for four reasons:

a. it is simple to use because it is linear in logs

b. it provides useful information regarding economies of scale

c. it enables input factor productivity to be evaluated, and

d. other functions are not significantly better [1].

The form of the function is stated in the following equation:

$$Q = AK^{a}L^{b}e^{u}$$

The log transformation of this equation is:

where

$$\ln Q = \ln A + a \ln K + b \ln L + \mu$$

Q is output of sawntimber (in cubic metre)
K is gross value of capital (in Ringgit (1981))
L is number of labour (in man-hours)
A is a constant
e is a constant term that is approximately 2.718 ($\ln e = 1$)
μ is the disturbance term
a and b are the coefficients of capital and labour respectively

The production function selected and the choice of variables are dictated by the availability of data. Social inputs such as level of education, managerial-entrepreneurial quality, and research and development are excluded. Such inputs are known to increase the utilization of machine capacity and production of output, but are not readily quantified. The chosen inputs, capital and labour, are aggregated owing to difficulty of disaggregation. In using aggregated variables quality differences within inputs are ignored which may bias the results. This is particularly true in the case of labour, where data constraints prevent the division of the number of skilled and unskilled labour [2].

As far as possible, quantity data is preferred to value data as units for the variables. Thus, labour inputs are measured in man-hours. Unfortunately, for gross capital no quantity units of measure are available as a result of the aggregative nature of this variable. Gross capital, as used in this analysis, includes building and machinery, which are measured in value terms. The use of value rather than quantity data leads to little bias in the results, if cross-sectional relative prices are not too large (Griliches, 1963). Differences of relative prices of buildings and machinery between mills, although present, are limited to differences in transportation costs, which are considered relatively low within Peninsular Malaysia.

Stock values of capital inputs are used instead of service flow units which usually are measured by depreciations of capital stock values. Data on depreciations of each mill's machinery and building are not available. Furthermore, depreciation charges seldom measure the decrease in the efficiency of the capital stock (Banerji, 1974). The use of the gross values are justified, particularly in the context of the developing countries since the

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[1]Zvi Griliches (1963) applied several other forms, in particular the Transcendental and Constant Elasticity of Substitution functions, without any appreciable improvement in the results.
G.V.L. Narasimham and M.Z. Fabrycy (1974) applied Constant Elasticity of Substitution and Homothetic Isoquant, and concluded that these forms do not provide a significant improvement over the Cobb-Douglas functional form.

[2]In the case of Cobb-Douglas function the omission of quality is equivalent to leaving out a variable having a positive coefficient. High quality labour is usually associated with larger capital input and will increase marginal productivity of capital. On the other hand, quality is a substitute for quantity of labour. Holding capital constant, firms with high quality labour will use less gross labour man-hours. Hence, capital input coefficient may be overestimated and labour input coefficient underestimated. See Z. Griliches, (1957) pp. 12 – 20.

capital stocks are probably used at approximately constant levels of efficiency for a period far beyond the accounting life measured by normal depreciation. In Peninsular Malaysia, sawmill machinery is used for more than 8 years before it is discarded or sold for scrap[3]. This differs from the accounting life of 5 years as used in measuring depreciation. In many mills not all the machinery are discarded, instead certain items are replaced with new parts or whole machines. Thus, the declining value of the old machines need not lead to any decline in the current services of the capital stock. The same argument applies to building stock. For these reasons, Banerji (1974) used capital stock value as a variable in estimating production functions for selected industries in India. Radzuan (1975) in estimating the function for sawlog input capacity of sawmills in the state of Johore also used total fixed investment value as one of the independent variables.

The sawlog input is excluded in the estimation of the function because of its special relationship with the output. Sawntimber is the direct transformation of sawlogs; approximately 64 percent of the volume of logs is recovered as sawntimber. As a result, there is a very high correlation between sawntimber and sawlogs. Using sawlogs as an independent variable will distort the statistical relationship between sawntimber and the other independent variables.

Data on the quantity of sawntimber output, size of workforce and gross capital investment were obtained from a survey of the sawntimber manufacturing companies conducted by the Forest Research Institute[4]. The selection of the three states was based on their sawlog endowments. Penang has practically no domestic endowment and is thus almost totally dependent on other states for sawlog supplies. Selangor has a little domestic endowment equal to about 25 percent of its 1981 annual sawlog intake. Trengganu, in complete contrast to the above two states has an abundant domestic sawlog endowments.

RESULTS AND DISCUSSION

Estimation of Production Function

The main results of the estimation of production function are given in Table 1. The coefficient of multiple determination (R^2) for Penang is relatively high at 87 percent, but Selangor and Trengganu register lower R^2 values of 55 percent and 62 percent respectively. The lower R^2 values are acceptable since the production functions are estimated using cross-sectional data. Lower R^2 values indicate of course, that the independent variables have explained only part of the variations in the dependent variable and imply that other factors of production have not been included in the function[5].

It is felt, that the lower R^2 can be attributed to the omission of the sawlog input variable in the function. Prior trials, including sawlogs as a variable resulted in an R^2 above 99 percent. But the inclusion of sawlogs has resulted in high correlations between the independent variables and negative coefficients for capital and labour in the regression functions. For the above reasons it was necessary to omit sawlog input from the production function.

Estimation of production function from cross-sectional data often results in high correlation among some of the independent variables. Simple correlation coefficients between capital and labour inputs in our estimated functions

[3]Personal communication with Mr. Tee Choon Hwa, engineer in Forest Utilisation Unit of the Forest Department, Peninsular Malaysia.

[4]Personal communication with Mr. Abdul Raof Salim, formerly forest economist of Forest Research Institute, Kepong. He is now attached to the Institute of Strategic and International Studies Malaysia.

[5]Furthermore, R^2 is not the only indicator of a good regression function fit. Having slightly lower R^2 value in the absence of multicollinearity among the independent variables, and having coefficients that are significant with signs that are not contradicting economic relationships, would be more important.

TABLE 1
Coefficients of sawntimber production functions for the states of Penang, Selangor and Terengganu

State	Number of observation +	Constant Constant	Regression coefficients Gross capital (a)	Labour (b)	Coefficient of multiple determination (R^2)
Penang	18	− 6.6175	.4230* (.0851)	.8920* (.1526)	.87†
Selangor	35	− 1.2164	.1884** (.0977)	.6334* (.1487)	.55†
Terengganu	25	1.3964	.1776** (.1039)	.4569* (.1429)	.62†

+ Due to incompleteness of data from the survey records, not all of the sawmills in the three states could be included.

*Significant at 1 percent level.

**Significant at 10 percent level.

†Indicates that in the F test, the statistic for the respective regression turned out to be significant at 1 percent level.

Note: Figures in parentheses are standard errors.

TABLE 2
Simple correlation coefficients between variables (in logarithms) used for the estimation of production function in Table 1

State	Variables	Sawntimber output	Cross capital	Labour
Penang	Sawntimber output	1.000	—	—
	Cross capital	.8087	1.000	—
	Labour	.755	.409	1.000
Selangor	Sawntimber output	1.000	—	—
	Gross capital	.540	1.000	—
	Labour	.704	.482	1.000
Terengganu	Sawntimber output	1.000	—	—
	Gross capital	.665	1.000	—
	Labour	.754	.656	1.000

Coefficients of multiple correlation for the three production functions are: Penang (0.93), Selangor (0.74) and Terengganu (0.79).

however, are relatively low (Table 2). Among the three states, the correlation coefficient between these two inputs is highest in Trengganu (0.66) and may lead to multicollinearity problems. This is not necessarily a problem, as long as the correlation coefficient does not exceed 0.8[6] and provided that this correlation coefficient is not high relative to the overall degree of multiple correlation among all variables simultaneously[7].

[6]See E.O. Heady and J.L. Dillon: Agricultural Production Functions, Ames, Iowa, U.S.A. (1964) page 136.

[7]See L.R. Klein: An Introduction to Econometrics, Prentice-Hall, New Delhi (1965) page 101, as quoted by G.R. Saini (1969).

In the case of Trengganu the coefficient of multiple correlation is 0.79.

Another way of testing the existence of multicollinearity problem is by estimating the production function for various other data samples. Although this approach is not exact, it would allow for examination of variation in estimated regression coefficients — little variation indicating multicollinearity is not a problem. However, due to a lack of samples this test has not been carried out.

For Penang, coefficients for labour and gross capital are statistically significant at the 1 percent level. In the case of Selangor and Trengganu, only the coefficients for labour are statistically significant at the 1 percent level. The coefficients for gross capital in the two states are statistically significant at 10 percent level. The possibility of measurement error creating a lower confidence level for the coefficients of capital inputs, cannot be ruled out. Data for this input are based on sawmillers' estimates and it is not possible to ascertain their accuracy.

Given the regression results and caveats noted above, the regression equations appear to be linear and all coefficients are statistically significant. The coefficient of multiple correlations, R, are high in relation to the simple correlation coefficients between gross capital and labour thereby reducing multicollinearity problems. Furthermore, the coefficients of multiple determination are at acceptable levels, considering that the regressions are based on cross-sectional data. Thus, the regression equations provide reasonable approximations for the sawmilling production processes in Penang, Selangor and Trengganu.

The regression coefficients estimated for labour are consistently greater than those for gross capital. But, both these inputs are important factors in production of sawntimber since they are statistically significant. In the Cobb-Douglas production function, the coefficients of the independent variables are also their production elasticities. Judging from the high elasticities of output with respect to labour than to gross capital, it can be concluded that output is more responsive to percentage changes in labour than in capital.

Returns to Scale

The estimated unrestricted production function enables us to estimate the returns to scale that prevail in the sawmilling industry. The sum of the production elasticities indicates the returns to scale. The returns to scale are decreasing, constant or increasing, depending on whether the sum of the regression coefficients is less than, equal or greater than unity respectively. However, these interpretations should be exercised with a degree of reservation since this form of equation does not allow for certain important sources of economies of scale, notably indivisibilities and non-homogeneity of the production function (Griliches, 1960). The sum of the production elasticities derived from the estimated functions are given in Table 3.

TABLE 3
Indications of returns to scale of the sawmilling industry in Penang, Selangor and Terengganu

State	Sum of the production elasticities	Returns to scale
Penang	1.315**	Constant
Selangor	.822**	Constant
Terengganu	.635*	Decreasing

*Indicates that the sum of regression coefficients is significantly different from unity at 10 percent level.

**Indicates that the sum of regression coefficients is not significantly different from unity at 10 percent level.

The estimated functions indicate that the returns to scale is decreasing in Trengganu at 90 percent confidence level. The sawmilling industry in Penang and Selangor experience constant returns to scale. This finding in Penang and Selangor is similar to that of another recent study of sawmill input capacity (Radzuan, 1975) in the state of Johore where constant returns to scale was also observed. Radzuan (1975) estimated a Cobb-Douglas function regressing capital and labour as independent variables against sawlogs as the dependent variable. Although the study is not comparable to the present one in every respect, the very close correlation between sawlogs and sawntimber provides sufficient justification for the former to be used as a proxy for the latter, provided the recovery rate is constant for the mills of each of the two states.

The finding of a lack of scale economies in Trengganu mills is of interest. Table 4 provides information on the input-output relationships in mills of the three states. Trengganu mills produce 3.3 times more of sawntimber than Selangor mills while employing 2.6 times more of workers and 1.4 times more of fixed investment. Considering that Selangor mills register constant returns to scale, these may indicate substantial scale economies in Trengganu mills. However, such a suggestion may not be accurate since comparisons are based on average figures. A more diverse spread of production sizes with respect to sawntimber production and factor inputs of capital and labour as in the case of Trengganu mills, will result in average figures providing a poorer structural description than a more evenly distributed mill sizes occuring in Selangor. A cross-sectional comparison like the results obtained from the production functions estimated would be able to provide a more practical evaluation.

The declining returns to scale for mills in Trengganu implies of course that the mills are experiencing increasing cost conditions owing to an increase in output being lower than the proportionate change in all inputs. This phenomenon will occur when mill capacity is underutilised resulting in a higher average cost per unit of sawntimber produced. The figures on number of equipment (Table 5) indicates that Trengganu has more breakdown sawing and resawing machines than the other two states. The possibility that the capacity of these equipment is not utilised adequately may be a reason influencing the lack of economies of scale. The fact that only 48 out of 73 mills are in operation in the state provides further support to this underutilisation case.

The findings on returns to scale above are subject to several possible sources of bias. The use of values for gross capital rather than quantities could lead to biased estimates of the regression coefficients and their sums. The direction of the bias is likely to be downwards. This is probably the case in the state of Trengganu where machinery and buildings of the same size cost slightly more than in the other two states owing to transportation costs; since most of these inputs come from the west coast or are imported through Singapore. The omission of a variable (sawlogs) in the analysis is expected to bias the returns to scale estimate. The high correlation known to exist between sawlogs and the two included variables will influence the estimates of the coefficients for both capital and labour upwards. It is not certain if this is enough to compensate for the downward bias in the estimate of returns to scale due to the use of

TABLE 4
Input-output relationship in the sawmilling industry of Penang, Selangor and Terengganu

State	Number of mills	Average log intake per mill (m^3)	Average number of employees per mill	Average gross[1] capital per mill ($)	Average annual sawntimber produced per mill (m^3)	Recovery rate per mill (%)
Penang	29	4,220.76	15	281,579	2,661.62	63
Selangor	50	7,156.28	34	896,267	4,434.76	62
Terengganu	48	21,836.48	89	1,264,204	14,446.67	66

Calculated from Annual Report on Forestry in Peninsular Malaysia: 1981 Ministry of Primary Industries, Kuala Lumpur.

[1]Average gross capital per mill is calculated from the present study data.

TABLE 5
Machinery used by sawmills in Peninsular Malaysia

State	Total no. of mills licensed	No. of mills in operation	Breakdown Machines					Resaws	
			Circular saws 152 cm diameter and over	Bandsaws 122 cm pulley and over with automatic log carriage	Bandsaws 122 cm pulley and over without automatic log carriage	Horizontal handsaws	Others	Bandsaws	Circular saws
Johore	72	72	8	52	8	3	6	269	45
Kedah	34	30	—	13	—	—	30	93	—
Kelantan	42	42	5	7	3	—	—	129	
Malacca	15	14	—	—	—	—	—	58	—
Negeri Sembilan	48	48	3	18	1	2	5	185	
Pahang	124	113	10	57	17	19	39	388	44
Penang	32	29	—	2	—	—	22	65	7
Perak	101	97	4	14	11	9	13	252	19
Perlis	3	3	—	—	—	—	—	5	—
Selangor	58	50	2	19	—	5	1	136	7
Terengganu	73	48	1	24	8	1	—	239	13
Federal Territory	42	40	—	10	2	—	—	110	2
Total	644	586	33	216	50	50	116	1,929	97

Source: Annual Report on Forestry in Peninsular Malaysia: 1981, Ministry of Primary Industries, Kuala Lumpur.

values for gross capital. Likewise, neglecting quality differences in labour input will lead to overestimation of the returns to capital, underestimation of the returns to labour and thus biasing the returns to scale.

Efficiency of Input Utilisation

The production functions estimated enable us to develop estimates of input utilisation efficiency for the sawmilling industry in the three states.

An input factor is considered to be used optimally if its marginal value product equals its cost. Thus, the basic condition for efficient input factor utilisation is the equality of marginal value product and input factor cost. Marginal productivity of X_i, the i^{th} input is given by the following equation:

$$\frac{\delta \hat{Y}}{\delta X_i} = b_i \frac{\hat{Y}}{X_i}$$

where $\hat{Y}$ is the estimated sawntimber production in cubic metre
X_i is the i^{th} input factor
b_i is the coefficient of the i^{th} input factor

TABLE 6
Geometric means and coefficients of input factors, and the estimated production of sawntimber used in estimating the marginal products

State	Coefficients		Geometric means (X_i)		Estimated production of sawntimber (y) in cubic metres
	Gross capital (a)	Labour (b)	Gross capital ($)	Labour (man-hours)	
Penang	0.4230	0.8920	140029.75	29741.35	1963.63
Selangor	0.1884	0.6334	483485.08	64541.19	3880.19
Terengganu	0.1776	0.4569	933308.01	194243.32	12116.00

TABLE 7
Marginal value products of input factors at their geometric means

State	Sawntimber + export price ($/$m^3$)	Marginal product (m^3)		Marginal value product ($)	
		Capital	Labour	Capital	Labour
Penang	528.15	0.00593	0.05889	3.13	31.10
Selangor	498.29	0.00151	0.03808	0.75	18.97
Terengganu	379.29	0.00231	0.02850	0.87	10.81

"The most reliable, and perhaps the most useful, estimate of marginal productivity is obtained by using X_i at its geometric mean, i.e. at the value where log X_i assumes its arithmetic mean. Also, Y should be the estimated level of output when each input is held at its geometric mean" (Heady and Dillon 1964). Marginal value product for each of the individual input factors is obtained by multiplying each of their marginal products by the per unit price of the output from each state (Table 6). Export price of sawntimber is used in this analysis, although the proportion of production supplied to domestic and export markets are approximately equal. This is due to unavailability of domestic price data. For export price, f.o.b. price is used. Transportation costs to port of exit and handling costs are not deducted. This is an undoubted source of bias, especially against the states further away from their port. But exact knowledge on proportions of sawntimber exports through different ports is not known.

The marginal value products of the respective input factors are given in Table 7. Marginal value products for labour input are higher than for capital input in all states. Sawmills in Penang register higher marginal value products for both capital and labour than the other two states.

To evaluate the economic efficiency of sawntimber industry in utilising the factor inputs, the marginal value products of these input factors are divided by their acquisition costs[8]. Table 8 gives the ratios of marginal value product to input factor cost. The acquisition cost of labour for the sawmilling industry in the three states are obtained by weighting the national average wage rate for sawmill labour, obtained from the 1981 Industrial Survey of Peninsular Malaysia published by the Statistics Department. The weighted wage rate per man-hour are $2.29 for Penang, $2.92 for Selangor and $2.00 for Trengganu.

[8]Since the unit of fixed investment is in monetary value, therefore the marginal value product measures the marginal earnings obtained for a one Ringgit usage of fixed investment. This is unlike labour input where the marginal value product measures the marginal earnings from a one man-hour of labour used. Thus, in order to determine the efficiency of capital and labour their marginal value products need to be divided by one Ringgit of fixed investment value and by the labour wage for one man-hour respectively.

TABLE 8
Ratios of marginal value product to factor cost for the sawmilling industries in Penang, Selangor and Terengganu

State	Ratio of marginal value product to factor cost	
	Capital	Labour
Penang	3.13*	13.58*
Selangor	0.75**	6.50*
Terengganu	0.87**	5.41*

*Indicates that the ratio is significantly different from unity at 1 percent level.

**Indicates that the ratio is not significantly different from unity at 10 percent level.

The results show that labour gives higher ratios of marginal value product to factor cost as compared to gross capital in all three states. This indicates that labour input is insufficiently used in sawntimber production. Sawmills would be better off by employing more labour input until a point that marginal value product equals factor cost. At this point labour is efficiently used. In the case of gross capital, the use of this input is still insufficient for sawmills in Penang. However, in Selangor and Trengganu the ratios of marginal value product for capital to its factor cost of less than one, although not significant, may well indicate the presence of excess capacity, the underutilisation of the existing productive capacity of machinery. This excess capacity problem is exemplified by the low utilization rate of 41.7 percent obtained for the sawmilling industry in the state of Johore and is linked to a lack of sawlog supply (Radzuan 1975).

As indicated in Table 9, most of the sawlog supply for the sawmills in Penang comes from Kedah while Selangor obtains its sawlog requirement from Pahang, Trengganu and Kelantan. The average mill sawlog intake in the states of Penang and Selangor is very low (Table 4). For the mills in Penang, this low sawlog intake is not a problem as the labour and fixed investment employed are low. However, mills in Selangor are more seriously affected since their labour and fixed investment employed are higher. A higher sawlog intake is required to ensure better utilisation of the mill capacity. Since Selangor is not able to provide all its domestic sawlog requirements, millers will have to compete for supplies with the other states. As a consequent, most mills in the state do not have enough. The lack of sawlog supplies is the main reason for excess capacities in Selangor mills.

The case of mills in Trengganu is interesting. Trengganu is a sawlog surplus state with a consequent expectation that nearly all its mills should have enough sawlog input. But, this may not be the case; sawlogs flow freely between states depending on the prices offered by millers and the demand for the particular kinds of timber species, quantity, and products of the mills in question. Thus, mills in Trengganu may not have enough sawlogs owing to higher prices offered by millers in other states, who are more efficient in production, marketing or both of these functions. Another important factor for the existence of excess capacity in Trengganu mills is the fact that much of their fixed investments are idle and underutilised as reported earlier. This is the only state with 66 percent of the licensed mills in operation. Selangor mills also face such a situation but to a lesser extent (86 percent operational).

CONCLUSION

In this pioneer study, the variables used are aggregated and the resultant estimations are relatively reliable and wherever sources of bias might arise, their importance is explained. In this way the results can, with due caution, be interpreted, subject to the named potential sources of bias. The findings of this study should, of course, be rechecked as and when more comprehensive , more reliable and more disaggregated data based on survey questionnaires become available.

Data on quality of labour, notably skilled versus unskilled labour, managerial-entrepreneurial quality and depreciation on machinery instead of gross fixed investment should be used in future studies to avoid some of the biases explained in the paper. An attempt should be

TABLE 9

Movement of sawlogs between state and export overseas (m^3)

Annual 1981

	DESTINATION												OVERSEAS	
Origin	Johore	Kedah	Kelantan	Malacca	Negeri Sembilan	Pahang	Penang	Perak	Selangor	Federal** Territory	Terengganu	Perlis	Singapore	Others
Johore	1,259,357	–	–	6,961	20,891	5,242	–	356	14,127	–	–	–	21,846	2,635
Kedah	–	211,171	–	–	–	–	21,585	1,506	–	–	–	378	–	–
Kelantan	16,070	–	516,442	–	18,603	373,430	3,661	7,066	31,587	1,812	72,203	–	2,628	–
Malacca	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Negeri Sembilan	886	–	–	19,597	388,822	973	–	33	37,540	2,867	–	–	556	–
Pahang	356,456	–	–	34,366	188,972	731,946	28	14,076	193,321	–	3,992	–	4,083	–
Penang	–	–	–	–	–	–	54	–	–	–	–	–	–	–
Perak*	–	–	–	–	–	–	94,216	699,283	–	–	–	–	–	–
Selangor	–	–	–	–	–	84	–	10,759	44,518	223,678	–	–	–	–
Federal Territory	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tereng-ganu	22,029	287	15,429	3,172	1,668	289,674	1	12,646	36,721	–	971,956	–	–	–
Perlis	–	2,520	–	–	–	–	2,857	–	–	–	–	10,421	–	–
TOTAL	1,463,798	213,978	516,442	64,096	618,956	1,401,349	122,402	745,725	357,814	331,208	104,815	10,801	29,113	2,635

Source: 1981 Forestry Statistic Bulletin, Volume 7, Number 5. Forest Department Headquarters, Kuala Lumpur.

*For Perak complete figures are not available.

**For Federal Territory the remaining 102,851 m^3 comes from Pahang and Terengganu.

made to deflate the cross-sectional value data for regional price differences such as one due to transportation costs. Using of value-added (value of output substract value of sawlog input) instead of output quantity as dependent variable would eliminate the problems of omitting sawlog variable from the equation.

The findings, of this study are not adequate to provide a reliable basis for policy decisions at the macro or micro level. Nevertheless, they do provide useful indications for efficient input factors utilisations. For mills in all three states, increasing labour inputs are very likely to increase production. In the case of Penang an increased capital investment, especially in machinery would also increase production. Determining the incremental quantities of both these inputs for efficient input use, are beyond this study.

The findings on returns to scale is a tenuous one since the Cobb-Douglas type of production function does not allow for sources of economies of scale such as indivisibilities and disproportionalities by its assumption of homogeneity. To study the subject of economies of scale adequately will require the use of a production function that is not homogeneous over at least some range of the inputs. Despite that, the presence of substantial excess capacity problem notably in Selangor and Trengganu mills are noted. The main causes are related to insufficient sawlog inputs and underutilisation of mill capacities partly due to a number of mills being unoperational. It appears that states with sawlog endowments do not necessarily ensure efficient utilisation of factor inputs since the problem of insufficient sawlog input stretches beyond the states without sawlog endowments.

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