

FOREST RESOURCE EXPLOITATION IN MALAYSIA

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[Malaysia's forest ecosystem has been undergoing rapid changes in the past twenty five years both in terms of depletion of total acreage due to large scale land development and deterioration of its quality due to extensive logging activities in lowland and upland areas. Such rapid changes have brought about serious implications on the ecosystem as well as on the timber industry in light of the fact that rapid exploitation of the resource has not been accompanied by a satisfactory rate of regeneration. This paper examines these changes as a result of land use policy, technological improvements in timber extraction and market trends of timber products; the biological implications on the forest ecosystem and the future commercial implications on the timber industry and export.

Ekosistem hutan rimba di Malaysia sedang mengalami perubahan yang pesat dalam jangka masa dua puluh lima tahun ini dari segi pengurangan jumlah kawasan akibat dari penerokaan tanah secara besar-besaran dan dari segi kemerosotan kualiti hasil dari aktiviti membalak yang dijalankan secara meluas di kawasan dataran dan bukit. Perubahan-perubahan yang pesat ini telah mendatangkan implikasi-implikasi yang serius bukan sahaja kepada ekosistem itu sendiri bahkan kepada industri balak lebih-lebih lagi memandangkan bahawa eksploitasi kayuan yang pesat tidak diikuti dengan kadar tanaman semula yang memuaskan. Kertas ini akan mengkaji perubahan-perubahan yang berlaku hasil dari dasar penggunaan tanah, kemajuan teknologi membalak dan aliran pemasaran bahan-bahan kayuan; juga implikasi biologis terhadap ekosistem hutan dan implikasi ekonomi terhadap industri dan eksport bahan kayuan pada masa depan.]

Introduction

Environmental problems and conservation issues in Malaysia take several forms (Hamzah, 1979; Goh, 1982) not least among them concerns the rainforest ecosystem of the country. In recent years much fear and anxiety have been expressed regarding the rapid depletion of the forest resources and the overall management of those that remain. There has been a general neglect of the importance of the forest ecosystem in the process of economic development. This neglect over the years has manifested itself in many serious implications. These implications are not necessarily confined to the biological components within the forest ecosystem but economic as well, since wood-based industries, exports of timber and timber products play an important role in the country's economic well being. There is, therefore, an urgent need to review the problem of forest resource exploitation and what the future of the Malaysian tropical rainforest will be. This paper seeks to examine two main issues; the biological implications and the

effects on the timber industry.

The Equatorial Rainforest Ecosystem of Malaysia

By virtue of its nearness to the Equator, the climate of Malaysia is generally hot and moist throughout the year. Mean annual temperature is 26°C and the annual range of temperature is about 2°C while the diurnal range may be higher at about 6°C. Soil temperatures at varying depths show a 24-hour yearly mean of 29°C. Most areas of the country receive not less than 2000 mm per year with certain localities experiencing more than 4500 mm.

Such a climate condition has been generally stable since geologic times and there is certainly no evidence of catastrophic changes of climate in the Quaternary period. Such an unchanging climate coupled with a tectonically stable landmass have produced a rainforest ecosystem that can be considered as the oldest forest ecosystem in the world and that has been able to sustain its climatic climax over millions of years (Richards, 1964, p. 14). Much of the land surface of Malaysia has probably been covered continually with vegetation since it rose above the sea, some of it as long as the Jurassic (Poore, 1964, p. 46).

Because of the favourable climatic and tectonic factors, the nature of the forest is also different from those of higher latitudes, in terms of its richness and diversity of its floristic and faunal composition. Peninsular Malaysia and Singapore alone have an estimated 7900 species and 1500 genera of seed plants (Whitmore, 1975, p. 5) and for the whole of Malaysia the total number of species of flowering plants can be anywhere between 9000 and 10000 (Dunn, 1975, p. 38). For mosses alone several hundred species have been identified.

Another interesting feature of this great diversity in plant species is the actual scarcity of individuals per species per unit area. In about two hectares of primary lowland dipterocarp forest at Sungei Menyala (Negeri Sembilan) for example, are found 210 different species and the ratio of individuals to species varies from 3.8 to 2.8. In terms of natural distribution this means that individual plants of a given species may be far apart from one another (Jong, *et al*, 1973, p. 114).

The above two characteristics of diversity and paucity of individuals per species in the rainforest must be borne in mind when the detrimental effects of uncontrolled exploitation and depletion of this resource base is discussed subsequently.

The great floral diversity is equally matched by the abundance of

faunal life, ranging from organisms to large animals. The birds in particular are especially diverse in variety and out of the total of about 800 species found in the Sunda Shelf area, 575 are found in the peninsular and perhaps 75 per cent of these are resident in or migrant visitors to the Malaysian jungle (Medway, 1969).

In Selangor, a minimum of 400 bird population is found within a forested area of 40 hectares (McClure, 1969, p. 180) while in the hilly forested area a bird population of between 1500-2500 is found within an area of 25 hectares. Wells (1974, p. 4) in his study of the lowland Pasoh Forest Reserve discovered that out of 207 species of forest-inhabiting birds in the peninsular, 202 were found in that area and 116 were breeding residents. Birds are not only confined to the trees but large numbers are also found on the canopy as well as on the ground.

As regards land mammals in the Malaysian forest, Medway (1969, Intro. p. XII) has shown that there are about 199 known species. Other animals found in wet and low-lying environment include 129 species of snakes (Tweedie, 1957), 100 species of other reptiles, probably 50 amphibians and about 200 fresh-water fishes (Tweedie and Harrison, 1954). A study in Sarawak concerning reptiles and amphibia in an area of 520 hectares for a period of one year revealed 135 species comprising 48 species of amphibians, 40 of lizards and 47 snakes (Lloyd, *et al*, 1968, pp. 498-499). Dunn (1975, p. 40) after adding up all these species obtained from the various studies shows a total of 1253 species of invertebrate animals. Including insects and fresh-water invertebrates, the total might well swell to several thousand species.

These inhabitants of the forest exist not to adorn the ecosystem but to serve a symbiotic function with the other components of the ecosystem; a function which is not as yet fully understood (Furtado, 1979, p. 89). They are in a state of interdependence and symbiotic relationship with the vegetation and other components within the forest environment, thereby maintaining the ecosystem in a delicate equilibrium.

Effects of Land Policy, Technological Changes and Market Trends on Forest Resources

Due to widespread poverty and unemployment particularly among the rural population, the government just prior to Independence in 1957 set up a Working Party to assess the need of the various states for assistance from the Federal Government in the development of new areas for land settlement. The Working Party recommended that land settlement in economic-sized holdings, planned and coordinated by a suitable organization with the Federal Government's aid was timely and recognised that it had the poten-

tial of alleviating some of the socio-economic ills of the rural people. After Independence, the National Land Council was set up to look into the various land policies of the country and it fully endorsed the previous findings that land should be considered as a primary source of wealth which must not be permitted to deteriorate but allowed to improve and increase where possible. Several basic principles were laid down by the National Land Council. These were:

- i) to increase the total yield from present resources,
- ii) to increase and improve the resources themselves, and
- iii) to ensure wherever possible, that land is put to use for which it is best suited in order to maintain a maximum yield over as long a period as possible (Bahrain, *et al*, 1979, pp. 36-37).

The adoption of the above recommendations represented the birth of a new era in landuse and landuse management in this country. For, consonant with the above principles and as a direct consequence of their promulgation, a policy of vast rural development programmes was initiated and these development programmes were intensified in subsequent years at both the Federal and state levels. As early as 1957, a federal agency, the Federal Land Development Authority (FELDA) was set up to implement federal land development schemes on a large scale. In fact its function was:

"To promote and assist the investigation, formulation and carrying out of projects for development and settlement of land in the Federation" (Bahrain *et al*, 1979, p. 50).

By the end of the First Malaysia Plan in 1970, roughly about 123,000 hectares of new land were opened up by FELDA and, to a smaller extent, by state agencies (Second Malaysia Plan, 1971-75, p. 125). With just over two decades of its establishment, FELDA has successfully developed and planted nearly 400,000 hectares of new land and resettled 41,288 families and has now evolved to become the biggest and most significant land development agency in the country. Under the New Economic Policy (NEP) started in the Second Malaysia Plan 1971-75, agricultural expansion and land settlement continued to be a major tool in achieving the two-pronged objectives of the NEP — eradication of poverty among all Malaysians and restructuring the Malaysian society so that identification of race with economic function and geographical location is reduced and eventually eliminated.

During the Second Malaysia Plan alone which ended in 1975, almost 323,000 hectares of forest lands were cleared for land development and another 240,000 hectares were then expected to be developed by the end of the Third Malaysia Plan in 1980 (Third Malaysia Plan 1976-80, p. 302). This was for Peninsular Malaysia. For the whole of Malaysia the target by

1980 was 400,000 hectares. Land development is by no means going to cease in the near future. In fact, as long as there is still land available and suitable for agriculture, and the need for resettlement is great, it is going to continue well beyond the 1990s (Table 1).

TABLE 1: Rate of conversion of forested land for agricultural use for the period 1971 to 1990 in Peninsular Malaysia

Period	Hectares
1971 - 1975	203,000
1976 - 1980	304,000
1981 - 1985	405,000
1986 - 1990	506,000

(SOURCE: Sulaiman Hj. Noordin, 1977, p. 177)

The effect of such vast development programme has been the rapid depletion of virgin land and forest acreage. At the turn of the century, apart from small enclaves of human settlements and small urban and mining areas in the two valleys of Klang and Kinta, the whole of the peninsular was covered by rainforest vegetation. By 1958, subsequent to the planting of rubber, 74 per cent of the peninsula was under forest. This figure dwindled to 61 per cent by 1971. By 1975 an estimated one million hectares have already been cleared or ear-marked for felling. It was further estimated that a total of approximately 40,000 to 80,000 hectares of forest land will be cleared annually between 1976 and 1995 to give way to agriculture (Asri, 1977, p. 6).

For the whole of Malaysia inclusive of Sabah and Sarawak, out of the total land of 32.8 million hectares, 15.3 million hectares (46%) are suitable for agriculture and out of this total, only 3.4 million hectares (21%) have so far been developed. It is apparent from Table 2 that the potential for further development in Sabah and Sarawak is greater than in Peninsular Malaysia.

TABLE 2: Agricultural land use and future potential in Malaysia (million hectares)

Types of land	P. Malaysia	Sabah	Sarawak	Total
Total area	13.16	7.45	12.51	33.12
Total land suitable for agriculture	6.04	3.56	5.34	14.94
Area under agricultural uses	2.84	0.20	0.28	3.32
Area available for development	3.68	3.36	5.06	12.00

(SOURCE: Second Malaysia Plan 1971-75, p. 131)

The Malaysian forests have traditionally produced various items that are of commercial value. In Sarawak for example, as early as 1841 when

James Brooke took over the Raj, barter trade with China in jungle produce such as rhinoceros horns, kingfisher feathers, damar, camphor and horn-bill ivory had taken place. Towards the end of the nineteenth century, forest produce such as jelutong, rattans, cutch and a few other minor items were produced for export in Sarawak. In Peninsular Malaysia too, trade in jungle products was started well before World War II. Trade in jungle products such as damar or resins, wood oil, barks, fruits, seeds and other associate items was in the hands of the Chinese while the aborigines were the gatherers of those items. The damar (*damar penak*) was obtained from wood of the Dipterocarpaceae variety, the best damar coming from *Neobalanicarpus heimii* (*chengal*) and was used by the Europeans in making spirit varnishes. Locally, such produce was used for caulking boats. Wood oil was used for caulking the inside of boats, for torches and for medicinal purposes. Timber was mainly used for housing construction, boats and buildings generally.

Mangrove forests along the coasts, however, were exploited for different purposes and such activities were undertaken by private concerns. Licences to work the forest on small plots of land were granted by the British Government to individuals who cut the trees for firewood, charcoal and for poles and fishing stakes (Cobban, 1968, p. 14). Another product was tannin which is obtained from the bark of Rhizophoraceae and was used as a preservative for fishing nets and the clothing of fishermen.

In these early days of simple tool, poor transportation networks, unsophisticated organizational structures and low demand for jungle products, the effects of such exploitation on the forest habitat were negligible.

For the past twenty five years, the forests of Malaysia have played a significant role in the socio-economic development of the country and will continue to play that role in the future. Before World War II, logging was not carried out extensively mainly because the techniques used were unsophisticated such as hand sawing for tree felling and pit sawing for breaking of logs and the use of buffalo labour; all these factors made felling of trees far away from logging tracks difficult and uneconomical. Besides, power acted as a serious constraint in most sawmills. As electric power supply was generally not available and diesel engines were unheard of, steam power became the only energy form to drive machines.

After the war and especially after the Emergency in 1960, the introduction of mechanical tractors and the fact that they could be left overnight in the jungle without fear of destruction by insurgents and the introduction of one-man chain saws in the early sixties and band-sawing mills with automatic carriages, powered rollers and pony rigsaws have revolutionised logging activity in this country, and have made possible extensive felling of trees further inland from logging tracks. As a result of such tremendous im-

provements in the logging industry corresponding to a great increase in world and domestic demand for wood, sawmills have increased in number. The growth of the saw milling industry in Peninsular Malaysia has been such that it is out of proportion to the available forest working areas, many mills having insufficient working areas thus becoming dependent on independent logging contractors, while some others are completely without any working area. More than 500 sawmills and about 30 plymills are found in the peninsula and their distribution as shown in Figure 1, indicates that very few regions of the country are not covered by these factories, except in the interior parts of Pahang, Kelantan and Perak. In some areas, large excess capacity exists (Radzuan, 1977, p. 131) where the industry was allowed to expand without reference to the extent of resource base which reflects the lack of control and planning in the timber industry. For such factories, their continued operation is dependent on log flows over long distances from other states.

Timber production and exports have increased tremendously over the years. In 1960, for the whole of the peninsula, exports of timber and timber products totalled 0.5 million cubic tonnes but in 1969 the volume has risen to about 1.9 million cubic tonnes. For the whole of Malaysia, the trend in timber exports in the form of sawlogs, sawn timber, plywood and veneer indicated a rapid growth, particularly with regard to the volume of export. For sawlogs, the volume of export has risen by 100 per cent in the decade 1965-1974, sawn timber by 133 per cent, plywood 2,368 per cent and veneer 502 per cent for the same period and total export earnings have more than trebled. The trend in the future is one of rapid increase in demand and consumption both internally and externally of wood and wood products (Table 3).

TABLE 3: Projected domestic consumption of wood products in Peninsular Malaysia (Million cubic tonnes)

Year	Log	Sawn-wood	Plywood
1976 - 80	1.7	7.9	0.35
1981 - 85	2.8	10.0	0.52
1986 - 90	2.8	13.0	0.74
1991 - 95	3.7	17.2	1.04

(SOURCE: Arshad Ayub, 1979, p. 352)

Increasing demand will result in increased logging and under the present circumstances not only do logging practices leave much to be desired, factory efficiency is still low in spite of modernisation. The overall average wastage for both state land forests and forest reserves has been relatively high. This wastage was not confined to factory wastage but takes the form of trees or logs left unutilized because they are unpopular species, of small diameters, short lengths or defective. At the factory stage, the recovery

rates are as low as 35 per cent to 79 per cent (Lee, 1976, p. 16). Another form of wastage is mill residue after processing has been completed. These chips, slabs, etc. amounted to about 4.47 million M³ per year for the period 1976-1980.

In terms of employment forestry in Peninsular Malaysia alone provides more than 30,000 jobs as direct employment (Salleh and Tang, 1973, p. 103) while over 120,000 were employed in wood-related industries.

IMPLICATIONS OF RAINFOREST DISTURBANCES AND DEPLETION

Biological implications

The abundance of plant species and at the same time the scarcity of individuals per species means that only a small proportion reach utilizable size at any one time and any felling of these large trees would mean the destruction of the smaller trees and plants in the immediate surrounding and such damage is considerable. Burgess (1971, p. 232) in his study of logging in lowland mixed dipterocarp rainforest of Gunung Tebu noted that only 10 per cent of the basal area was removed for timber, 55 per cent was destroyed during logging operation and only 35 per cent remained intact.

Wasteful logging practices are not only evident in felling of large trees having little regard for other smaller plants, but also in harvesting of trees itself and subsequent utilization. Also the process of harvesting of trees is governed by quick profits rather than by conservation principles such that a high proportion of the trees felled have diameters below the desired size (46 cm).

Wasteful logging practices have caused some of the lowland forests to be occupied by poorer timber species, weed species and bamboos. There are many potential species of fruit trees within the forests which remain as yet a rich under-exploited resource. The same applies to many other species that may be useful for medicinal purposes. In view of the extensive logging and forest clearance, some of these species might be lost altogether before any study is conducted on them.

In terms of animal life, there has been no full study of the consequences of logging on the rain forest faune. In Peninsular Malaysia, the dwindling forest acreage in certain localities has resulted in elephants encroaching on areas of human habitation and causing considerable damage to rubber and oil palm plants, estimated to be \$250 million ringgit over the past few years. Logging of the core area of the Endau-Rompin forest reserve recently has created serious concern about the last community of the

Sumatran Rhinoceros known to survive in this locality. Birds are more upset by logging especially those that survive on top of the canopy. Canopy-top birds such as hornbills and eagles need large areas of forest for the maintenance of breeding stock to prevent extinction. There is no doubt that the disturbance of the forest environment reduces the species diversity of animals. Progressive destruction of the rainforest results in progressive elimination of the native mammal fauna while selective felling of primary forest with a serious attempt to maintain the forest as a productive one, does not seriously deplete the number of species, at least of the smaller mammals.

Effects on the timber industry

Changing land use from forest to agriculture on a massive scale leads to a reduction in total forest acreage while indiscriminate logging leads to the actual deterioration of the remaining forest areas. For the period 1971-1976, the average area of forest logged has been about 86,000 hectares per year (Anon, 1979, p. 337). About 26 per cent of this activity took place within the forest reserves while the balance was in state forest lands. Much of this activity has also been conducted in lowland areas, some a couple of times over.

At the present rate of timber exploitation and with the absence of successful conservation and reafforestation measures, the timber industry will face a bleak future. Such a concern about the future of the industry in Peninsular Malaysia in particular and in Malaysia in general was expressed by some Malaysian leaders who stressed that uncontrolled felling would deplete the nation's timber resources in a matter of 12 years in state land forests and 13 years in all productive virgin forests in the Permanent Forest Estate after which Peninsular Malaysia would be a net importer of tropical hardwoods. By 1990 the rate of timber export industry and the operation of timber factories will be badly affected. The industry is already facing an overall reduction in both quantity and quality of raw materials production in the peninsula. This can be attributed to the depletion of high grade logs and the increasing costs of raw materials as less accessible resources have to be drawn upon. Already there is a shortage of the Dark Red Meranti in the peninsula (Abdul Razak Majid, 1977, p. 197).

As pressures on the lowland forests are being greatly felt, exploitation will invariably turn towards hill forests. The 330 metre contour which formerly marked the boundary between lowland and hill forests has been pushed to the 1000 metre level. It is recognised that the rough and hilly areas of the peninsula will ultimately be the exclusive venue for logging in the

near future. Although under such circumstances, logging operations can still be carried out by the application of a different system of extraction and technological know-how already available in many countries abroad, the introduction of such technology to Malaysia may be slow and may lag behind actual hill forest exploitation. In the absence of better methods than those currently available in the country which incidentally are more suited to lowland terrain, logging operations in these upland areas may be very destructive and may severely curtail the regeneration of trees. The construction of roads into these hitherto inaccessible areas to facilitate log removal will further contribute to the damage.

The shortage of logs currently experienced is not being helped either by present silvicultural practices which tend to increase the production of rapid growing low grade logs mainly from unpopular species and smaller trees which are difficult to sell. Domestic demand for such low quality timber is poor and there is also resistance from industries which have been accustomed to prime logs. These are further compounded by the existence of surplus low grade timber during extraction from forest reserves as well as from forest areas designated for land development schemes.

The rate of reforestation does not auger well for the timber industry as estimates show that out of an annual exploitation of about 90,000 hectares in Peninsular Malaysia, only 10,000 hectares are reforested annually; a value of just over 10 per cent. Because of the long period for trees to reach exploitable dimensions — about 70 years to reach 60 cm diameter under the Malaysian Uniform system — the poor rate of reforestation will cause a serious shortage at some stage in the near future. The wood-based industry, which is already experiencing log shortage will continue to face this problem with an annual shortage of 410,000 cubic tonnes starting from the year 1986. Although such shortages can be temporarily overcome by log imports from East Malaysia and the neighbouring countries, the problem will remain in the long term unless intense regeneration and reforestation programmes are carried out.

The future prospect for the timber industry in Peninsular Malaysia in the light of the above problems, is dim indeed. The economic implications of this rather gloomy future are extensive. Already the mills are working below capacity which indicates a waste of capital and resources. More factories will be shut down and retrenchment of workers in this sector as well as in logging will be experienced. Loss of revenue will become real as exports of wood dwindle and hardwoods may be imported from abroad. The demand for wood may increase but due to serious shortage of supply, wood products will cost more. The impact of such increases in domestic costs of wood will be greatly felt, especially among the lower-income groups whose houses depend almost entirely on timber.

Forestry management

There is yet no formal landuse policy in Peninsular Malaysia and only broad land capability classification has been undertaken in 1965. The need to have a National Forest Policy was recognised and a policy was endorsed by the National Land Council in 1978. The policy among other things advocated the need to have a sufficient acreage of Permanent Forest Estate to fulfill the three-fold functions of protective forests, productive forests and amenity forests; taking both the interests of the environment and economics into account. It also made provisions for the efficient utilization of forest resources on land not included in the permanent forest estate and this entails proper planning and coordination especially with departments dealing with land development. Together with the above objectives there is the need to improve the utilization of wood by industries, manpower training in both industry and forestry and research in forest development and use of wood.

While the national forest policy is commendable in its intentions for the long term interests of the forest resources of the country, the fact that land, and therefore the crucial resource base, is a state matter poses problems to the overall implementation of the policy. The legislative and executive authority over forest is a state responsibility and this right is enshrined in the country's constitution; a provision that may create a lot of problems regarding the implementation of any policy that originates at the federal level, because of the state's fear of federal domination and possible eventual loss of constitutional sovereignty over their valuable forest resources. The potential source of conflict in such an arrangement was evident in the Endau-Rompin issue when the Federal Government was helpless in dealing with the Pahang State Government.

Silvicultural practices in the country at present involves the improvement of stand composition by release treatment and regeneration of the desired species by enrichment planting. To improve the practice, a Selective Management System was introduced where each logging area has a floating girth limit and felling limit is based on a pre-felling inventory of the forest and the assessment of what constitutes an economic volume extractable from the forests. However, such a system is more appropriate to hill forests, although it could apply to lowland forests as well.

Efforts at regeneration by enrichment planting have also proved unsuccessful due to the administrative and technical problems. Not only are costs involved prohibitive as more and more remote areas of steeper topography have to be regenerated, but the rate at which timber is extracted has far outstripped the rate of regeneration. Under the present circumstances of inadequate knowledge and expertise of forest regeneration coupled with the prevailing economic condition, artificial regeneration on a large scale by the

public sector is an unacceptable and impracticable proposition (Mok, 1979, p. 30). As a result of such constraints, up to March 1979, regeneration of forest trees covered an area of about 220,000 hectares i.e., 10.8 per cent of total productive logged-over forest in the so-called permanent forest estate. The principle of sustained yield from forests currently advocated may remain an ideal in view of such a negligible rate of forest regeneration. The only solutions are to speed up this process and to explore other options of producing wood.

In this connection, attempts have been made to establish integrated timber complexes where state agencies together with private sector participation are given concessions from which all wood required for the complex is obtained on a long term basis. These complexes which will number more than twenty throughout Malaysia by 1985, are envisioned to replace current saw milling establishments dominated mainly by small family enterprises. Because these complexes are expected to produce more refined products, wastage will be cut to the minimum. However, the success of such a system will depend very much on the managerial skills and trained manpower available and these are currently lacking. Should this system prove successful, then regeneration of forests so that sustained yield over a long term basis is possible, can be carried out by such large agencies and options such as plantation forestry aimed at producing short-term varieties of trees for products such as paper can be considered. Other options such as plantation of trees on FELDA schemes to complement the government's effort at helping the rural population could provide a lucrative alternative.

Conclusion

The above discussion shows the nature of the problem faced by the forestry sector due to excessive logging and acreage reduction concomitant with economic development. It has been emphasised that there has been a neglect of the principles of good logging practices and conservation measures. Although efforts have been made to consciously curb some of the indiscriminate and excessive logging practices, much more remains to be done towards the end. The problem is further compounded by conflicting objectives and policies with regard to land use, and the priorities have often been in favour of massive land clearance for agricultural and land resettlement programmes rather than for forestry.

As mentioned above, the future of the Malaysian rainforest goes further than forestry management for the timber industry alone. This is just one of the objectives. Other goals must also be taken into consideration which include non-economic considerations such as water catchment areas for water supply, forest ecosystems for research and education, wildlife sanctuaries and national parks and recreation. The success of forest

management and conservation must take into consideration all these needs so that no one priority must be allowed to outweigh the others to such an extent that forest development may contain serious long-term shortcomings and therefore prove self-defeating.

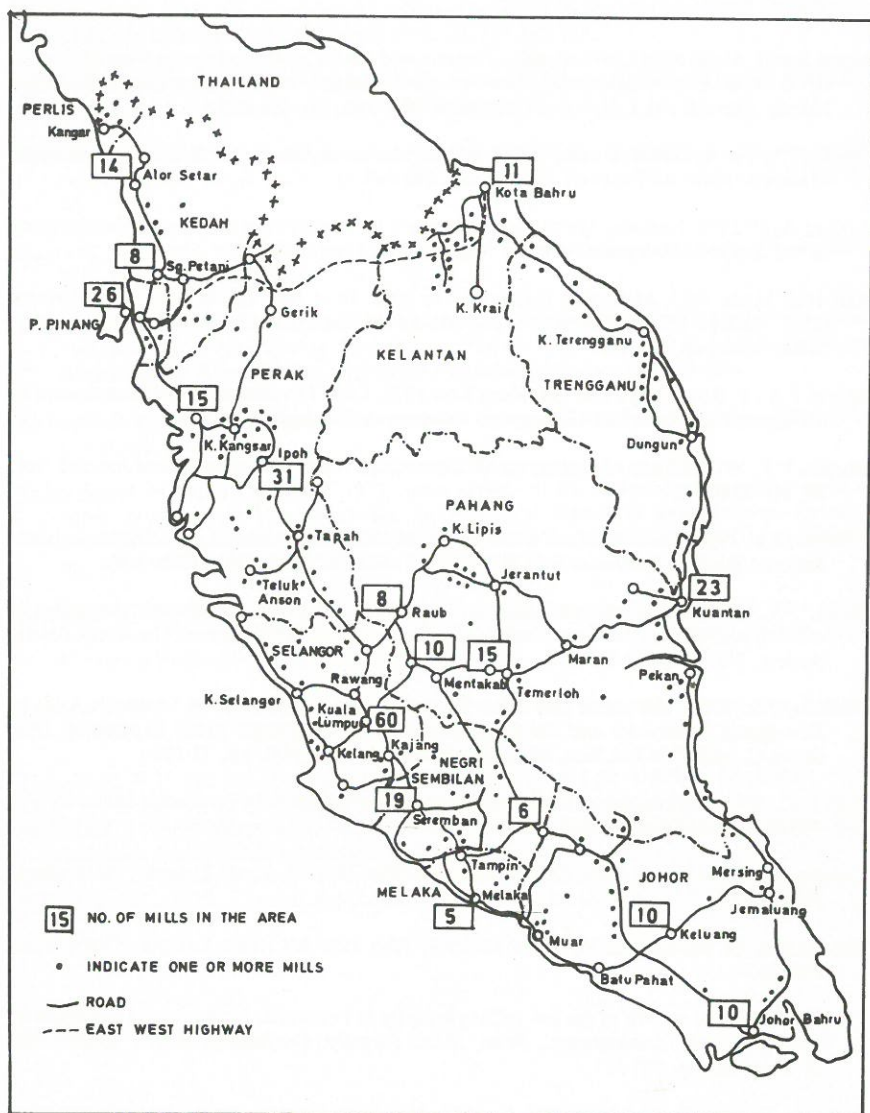


Figure 1: SAWMILL DISTRIBUTION (Source: Ho K.S. 1976, p. 211)

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