

LONG-TERM TIMBER HARVESTING IN BORNEAN FORESTS: THE YONG KHOW CASE

Richard B. Primack

Biology Department, Boston University, 5 Cummington Street, Boston, MA 02215, U.S.A.

&

Frankie Tieh

Silvicultural Research Office, Sarawak Forest Department, Sibul, Sarawak, Malaysia

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PRIMACK, R. & TIEH, F. 1994. Long-term timber harvesting in Bornean forests: the Yong Khaw case. Timber production has increased dramatically over the last 20 years from Sarawak's hill forest, but an international controversy has developed over whether these forestry practices are sustainable. Yong Khaw (YK) and Sons, the oldest timber concession operating in the hill dipterocarp forest of Sarawak, can give insight into the feasibility of sustained yield harvesting in Sarawak's forests. The forests in the YK concession area appear to be in good condition as of 1990 despite three to four cutting cycles starting in 1938. Key elements in the long-term success of the YK concession which are often missing in other concession areas are the direct involvement of the licensee in day-to-day operations, an efficient containment of costs, no local farming population competing for the land, steady sales for sawn timber to the local Miri market, and minimal damage to the forest during logging operations. More recently, the extent of forest area has been drastically reduced from the concession area, as by farmers cutting down trees for shifting cultivation along the logging roads. Consequently, YK will probably soon cease its operations.

Key words: Timber harvesting - sustainability - concession - long-term success

PRIMACK, R. & TIEH, F. 1994. Penuaian jangka panjang balak di hutan-hutan Borneo: kes Yong Khaw. Pengeluaran balak telah meningkat secara dramatik sejak 20 tahun yang lalu daripada hutan bukit Sarawak tetapi kontroversi antarabangsa sama ada amalan-amalan perhutanan ini dapat berkekalan atau tidak telah berkembang. Yong Khaw (YK) and Sons, konsesi hutan yang paling tua beroperasi di hutan bukit dipterokarpa Sarawak, boleh memberi pengertian terhadap kebolehlaksanaan hasil penuaian yang berkekalan di hutan-hutan Sarawak. Mulai tahun 1990, hutan-hutan di kawasan konsesi YK berada dalam keadaan yang baik walaupun telah mengalami tiga hingga empat pusingan tebangan semenjak 1938. Asas-asas penting dalam kejayaan jangka panjang konsesi YK yang biasanya tidak ada pada kawasan-kawasan konsesi yang lain adalah seperti berikut: penglibatan langsung pemegang lesen dalam operasi hari ke hari, penyekatan cekap kos, tiada peladang/pekebun setempat yang bersaing untuk tanah, jualan stabil untuk kayu gergaji kepada pasar Miri setempat dan kerosakan yang minimum pada hutan semasa operasi pembalakan. Sejak akhir-akhir ini, takat kawasan hutan telah dikurangkan secara drastik daripada kawasan konsesi seperti penebangan pokok-pokok di sepanjang jalan pembalakan oleh peladang-peladang untuk pertanian pindah. Akibatnya, YK mungkin akan segera menamatkan operasinya.

Introduction

A major controversy in tropical forestry is the feasibility of long-term sustained yield logging in mixed tropical forests. Reviews of tropical forestry by Baur (1965) and Whitmore (1984) were able to describe only a few cases of sustained yield forestry, and many of these production forests were later felled for agricultural plantations. Present attempts at sustained yield tropical forestry often fail after only a few decades when the first crop of trees, initial investments and subsidies run out. Because Sarawak, on the northwest coast of Borneo, is presently one of the world's leading suppliers of tropical hard woods, the feasibility of sustained yield forestry is an important consideration. The purpose of this paper is to describe the oldest timber company in Sarawak's mixed dipterocarp hill forests, Yong Khaw and Sons, which has been in continuous operation since 1938. Analysis of this timber operation might give some insight into the current problems of forestry activities in the region.

Historical background

Prior to 1975, selective logging in Sarawak was mainly conducted in the coastal peat swamp forests using labour-intensive extraction methods (Kavanagh *et al.* 1989). However, as the surrounding areas of the Philippines, Indonesia and Peninsular Malaysia exhausted their timber supply or restricted the export of logs, the world timber market turned to new suppliers, such as Sarawak, for sources of inexpensive tropical hardwood. Selective logging began on a large scale in the mixed dipterocarp hill forests of Sarawak in the 1970s (Lee 1981, Kavanagh *et al.* 1989). Since that time the area under license and the amount of log exports have increased dramatically. Recent studies by the Sarawak Forest Department and the International Tropical Timber Organization (ITTO 1990) suggest that the current rate of selective logging cannot be sustained indefinitely, even though the policy of the Sarawak government is that timber harvesting will be done on a sustained yield basis. The long-term supply of timber is further threatened by indigenous people cutting down the remaining forest for shifting agriculture. The conflicts between the logging industry and the native peoples of Sarawak have received widespread international attention (Colchester 1990, Sesser 1991). At the present rate of harvesting, the timber industry of Sarawak will begin to run out of timber in about twelve years (ITTO 1990, Primack 1991, Primack & Hall 1992). These predictions are not simply abstract speculations, because such a decrease of timber supplies due to overharvesting and land-conversion has already occurred in Peninsular Malaysia and the Philippines. Since the timber industry is vital to the economy of Sarawak, providing about half of the state's revenues and 60 000 jobs in the rural economy (ITTO 1990), the long-term health of the industry is of central concern to the government.

The current practices of selective logging in Sarawak's hill forest in theory should provide a sustainable timber industry, since small timber trees are left to form the next crop (Hutchinson 1980, Korsgaard 1985, Primack *et al.* 1989). However, in practice the policy is not working, due to excessive damage to small trees during timber extraction and local people cutting down the forest for shifting agriculture (ITTO 1990). As a result, most of Sarawak's timber concessions are unable to run their operations on a sustained yield basis, and many have already exhausted or will soon exhaust their timber supplies after only 10 to 20 years. Why has Yong Khaw and Sons been able to keep harvesting timber profitably in the same concession area for over 50 years, when most modern concessions are so short-lived?

Yong Khaw and Sons

The oldest timber company operating in the hill forests of Sarawak is Yong Khaw and Sons (YK). YK has been harvesting timber continuously from the same forest south of Miri since 1938, working successively under the British Rajah, the Japanese Army, the Australian Military Authority, the British Colonial Rule and now the Malaysian government. A visit to the site in August 1990 showed that the area is still mostly forested and employs about sixty men in felling operations and sawmilling. At a time when forestry practices in Sarawak are being questioned both within Sarawak and by the international community, an examination of the reasons for the long-term success of YK, as well as its current problems, can provide valuable insight. The information in this report comes from a site visit in August 1990, interviews with Dr. Yong Chong Ping, Yong Khaw's son and the current manager, as well as with Forest Department officials, shifting cultivators, workers and industry representatives. In addition all relevant Sarawak Forest Department files were examined. Unfortunately much of the information that one would like to know on past management plans, accounting practices, employment figures, the numbers of shifting cultivators, and the original condition of the forests does not exist, as far as we know. Even the limited data available are rapidly disappearing as memories fade, people die and move, and forest records are discarded.

The Yong Khaw concession area lies about 20 km south of the oil town of Miri and currently has a total area of 8500 ha (Figure 1). The concession is roughly square, bordered on the west by the South China Sea, on the south by Sungei (= Stream) Jakang, the Antulang Foot Track and Lambir Hills National Park, on the east by Sungei Padang Liku along the Riam Road and on the north by a survey line just south of Tunku Abdul Rahman Village. The area is about 10 km across and contains the Tukau area and Kampong (= Village) Bakam. The area is easy, undulating countryside in the west, and hilly with cliffs and steep slopes in the east and south.

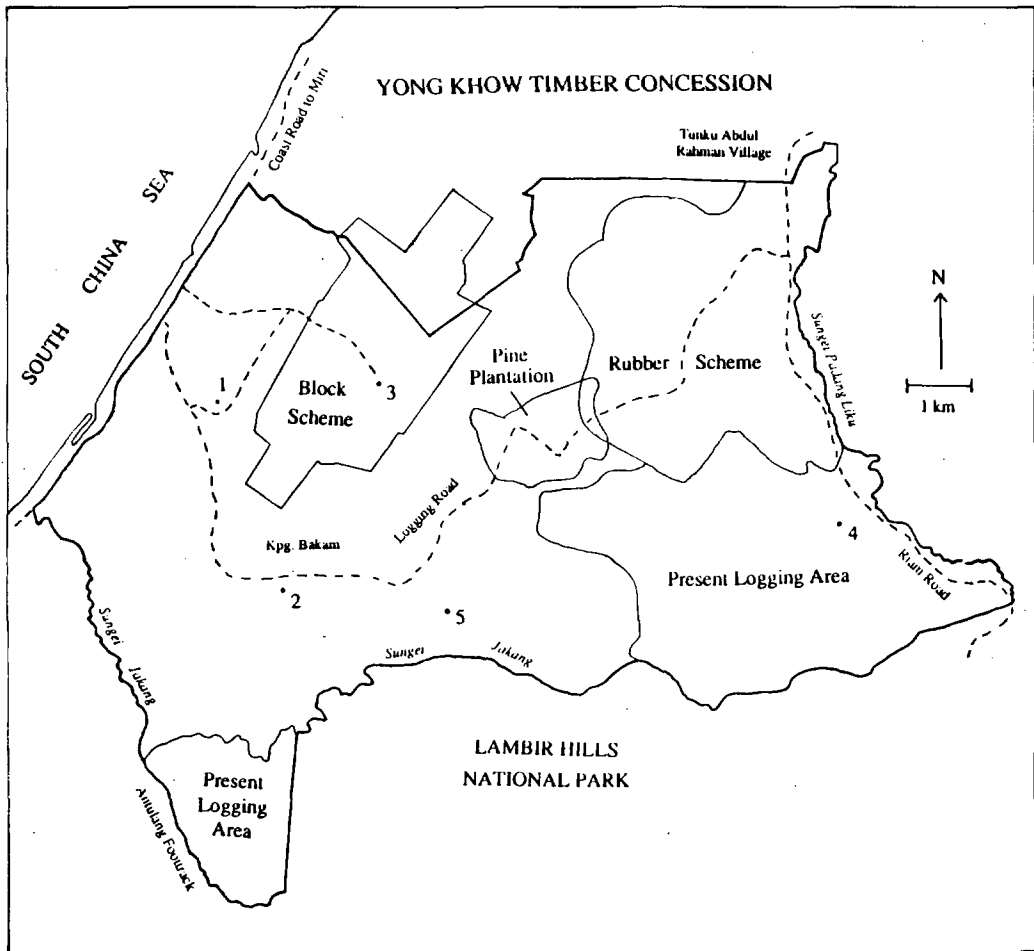


Figure 1. Map of the Yong Khow concession area. Only major logging roads are shown; there are other smaller logging roads

The key figures in YK are Yong Khow himself and his son Dr. Yong Chong Ping, (Figure 2), who took over the concession in 1972, at the request of his father, on his return from England where he had been practising as a dentist. Dr. Yong has continued to run YK since that time and has trained his younger son in the timber business.

The YK concession can be viewed historically in several distinct phases.



Figure 2. Yong Khaw, with three of his sons, February 1963

The early years (1938-1941)

Prior to 1938, Shell Oil Company conducted logging and sawmilling in Miri itself, using the timber for construction of buildings, wharves and oil rigs. In 1938, Shell decided to close their own sawmill at Sungei Bakong and rely on Yong Khaw to be their main supplier of sawn timber. Yong Khaw assured Shell that he could supply them with timber cheaply and reliably. In 1938 Yong Khaw entered the second phase of his business career as a timber tycoon by obtaining a timber licence for the entire area between the crest of the Lambir Hills and the South China Sea. This was a huge area of primary forest, with no human settlements. The area was not suitable for cultivation due to the sandy soil associated with low kerangas forest (= low forest with many small trees) in the west and the steep slopes to the south and east.

Yong Khaw established his first sawmill in 1938 along the Sungei Rahan and built the Bakam Road along the coast from there to Miri for transporting sawn timber. The circular saw was powered by a steam engine using wood waste as a fuel source. The principal woods processed were heavy hardwood species such as kapur (*Dryobalanops* spp.), keruing (*Dipterocarpus* spp.), meranti (*Shorea* spp.) and selangan batu (*Shorea* sections *Shorea* and *Neohopea*), needed for construction of oil rigs in Miri by Shell. Some bindang (*Agathis alba*) was cut, above the minimum four-foot (122 cm) circumference. Unsurfaced roads extended at most several kilometers into the surrounding forests, mainly along the bottoms of valleys. Logs

were dragged to the roads mainly using human labour in the "Kuda-kuda" system, whereby medium-size logs were pulled downslope on greased tracks of wooden poles. Experiments using water buffalo were unsuccessful as the logs often slid forward going downslope and injured the animals. Only medium-size trees were removed during this logging operation since big trees were impossible to haul out using human labour. When logs reached the road, they were transported to the sawmill on Ford and Chevrolet trucks. At this time the area was largely uninhabited except for the quarters of the timber workers. While this first sawmill is now abandoned, bits of old machinery and truck parts still stick out of the ground. The mill site itself is hidden by a grove of chempedak trees that Yong Khaw had planted in 1938 when the mill was established.

War years 1942-45

In 1942 the concession area was taken over by the Japanese under whose supervision Yong Khaw was allowed to continue running the sawmill. Conditions in the mill were difficult, but the sawmill ran at a high level of production with over 300 workers. A 62-inch breakdown saw was added to the mill to increase output. Production was over 200 tons of heavy timber per month, for use by the Japanese Navy and in the maintenance of oil field facilities. In addition, quantities of *bindang* were cut for export to Japan. Under the Japanese the logging roads were extended many kilometers southward to the Sungei Jakang area and northward to the Sungei Buloh area. A narrow-gauge railroad for log transport was built along the valley to the east of the sawmill using equipment removed from the Shell Oil Company facilities in Miri. The railroad and captured British Army trucks were used to carry logs from the forest to the sawmill. During this period, the sawmill and logging trucks were strafed several times by American aircraft but were never damaged beyond repair.

Post-war years

The Australian military authority took over Miri after World War II and primarily relied on YK for the timber needed to rebuild Miri and the Shell facilities. During the early 1950's a second sawmill was established near the Sungei Bakam, with the surrounding village of Kampong Bakam built by sawmill workers. The logs were still removed from the forest mainly by human labour. YK also began to use second-hand U.S. Army D4 crawler tractors and winches. Logs were removed from the area east of the second sawmill, and logs were transported along the old rail network. The concession employed about 150-200 men to produce about 200 t of timber per month, mainly *meranti*, *keruing*, *kapur* and *selangan batu*. The timber was mainly sold to Shell to build houses in Piasau and for construction of shops and houses in Miri town. Attempts were made to ship logs to Australia, and a jetty was constructed for this purpose on the beach. However, the attempt was not profitable and the operation discontinued.

After 1955 a decline in both world demand and local demand for timber led to a slump in the industry that continued through the 1960's. During this phase a third sawmill was used to saw logs harvested from the northern and central areas of the concession (Figures 3, 4). The sawmill used two diesel-powered circular saws, cutting dipterocarp hardwood for sale to Shell and for maintenance activities in Miri. Sawn timber was also exported to Sabah, where there were no sawmills. Large numbers of *bindang* logs and also *jankong* (*Diospyros* spp.) were cut from the forest for export to Australia (Figure 5). The number of workers declined to about sixty since most of the timber extraction was being done by crawler tractors (Figure 6). Also, chainsaws were utilised starting in 1957, further decreasing the need for workers. Large logs in addition to medium-size logs could now be cut and removed from the forest.

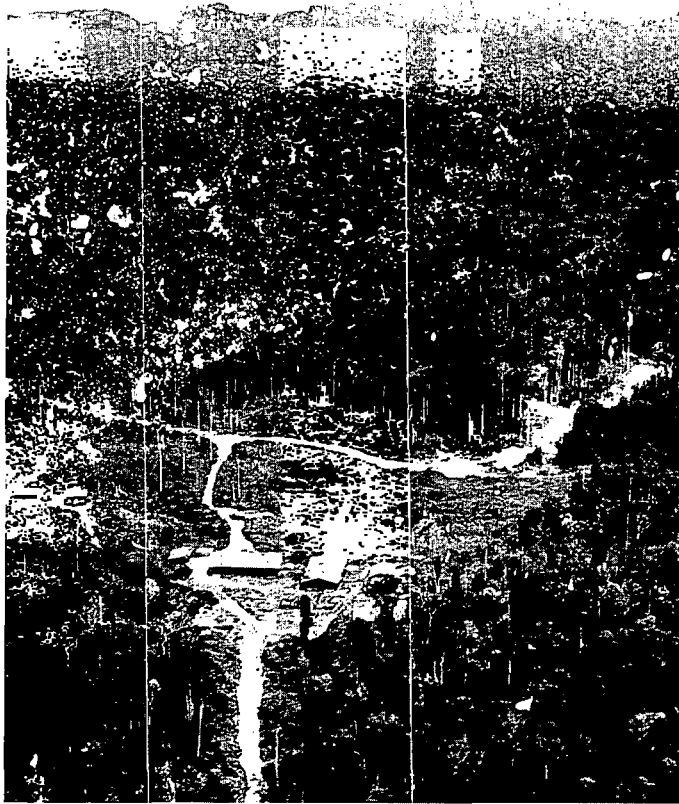


Figure 3. Third sawmill at Tukai, approximately 1963, surrounded by forest with Lambir Hills in the background



Figure 4. The appearance in 1990 of the abandoned third mill, with the surrounding area taken over by grasslands

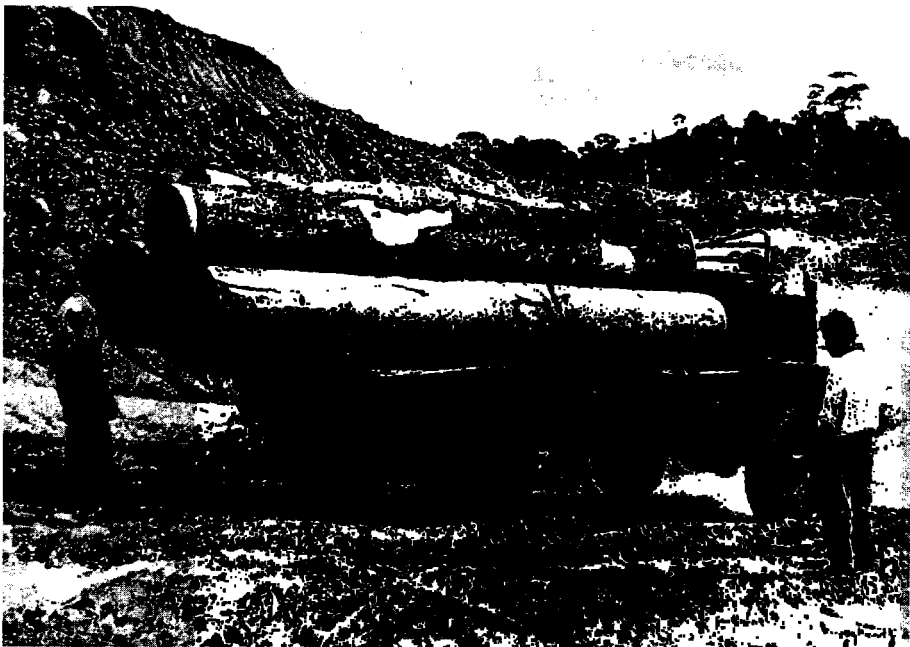


Figure 5. Old British Army Bedford truck being used to transport bindang logs in about 1955

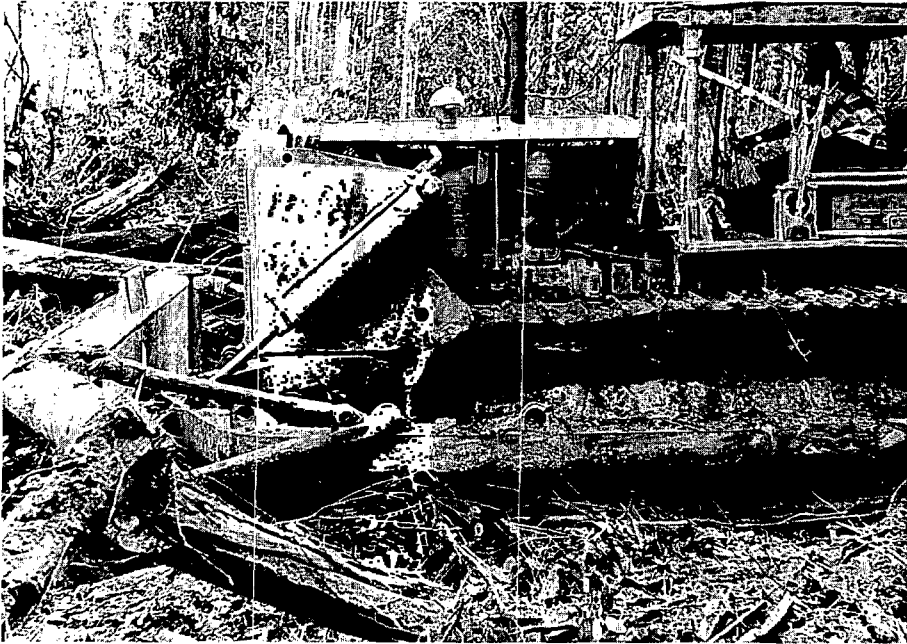


Figure 6. Caterpillar D8 tractor being used by one of Yong Khow's sons in road construction in about 1963

During the 1960's timber was still being removed from the Western cutting blocks that were first established in 1938 by YK near the third sawmill (Figure 3). However, as a result of cutting down the surrounding forest by shifting cultivators and lack of nearby timber, this sawmill was closed in 1969. All that is left today of the third sawmill is a large clearing along the road (Figure 4). The surrounding area that was once heavily forested is now grassland in all directions. On the hill above the site is the old water tank for the mill and a clump of rubber trees planted by Yong Khow.

The fourth sawmill was established in the eastern part of the concession along the Riam Road in 1963 with two bandsaws. The fifth sawmill was established in the southern part of the concession in 1973. Both sawmills are still in operation, using timber from the southern, central and eastern sections of the concession area. During these three decades, the Asian market for Sarawak's tropical hardwoods has been steadily increasing.

Sawmill operations

The fourth sawmill currently has two bandsaw benches. The main bandsaw was produced in 1961 by the Flywheel Machine Company and is powered by a diesel truck engine manufactured by Rolls Royce and obtained in the 1950's from the Shell Company (Figures 7, 8). The sawmill cuts logs mainly from 36 to 60 inches (91 to 152 cm) in girth, producing timber for the Miri market. The main sizes

produced (in inches) are 2×3 , 2×4 , 1×2 , $1/2 \times 2$, 2×6 , 2×8 and 4×4 . The recovery rate is roughly 50%. The best logs are for export, but this is only a small part of the YK operation. Royalty marking is only done once a month due to the small volume (Figure 9).



Figure 7. The main bandsaw of the fourth sawmill, manufactured in 1961 by the Flywheel Machine Company, and still in operation

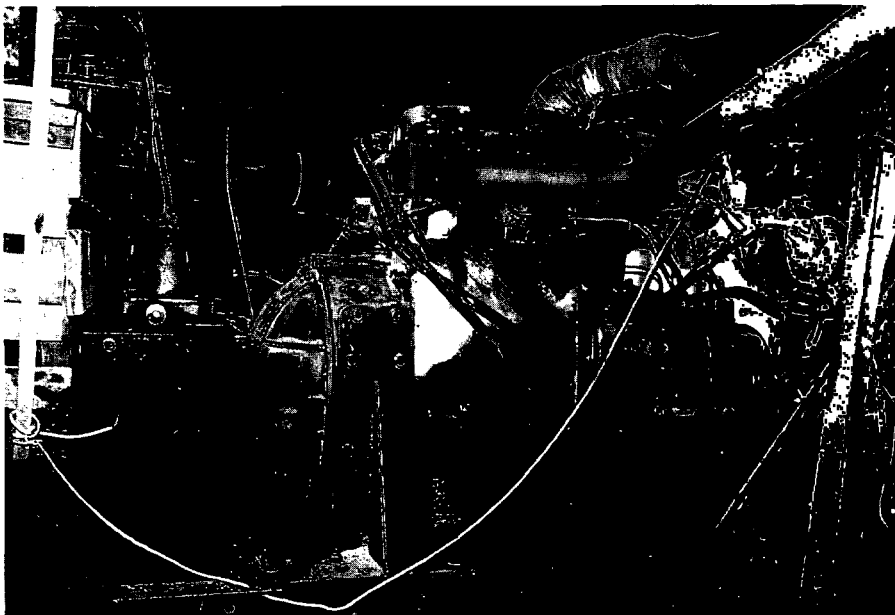


Figure 8. Rolls Royce diesel truck engine for powering the bandsaw at the fourth sawmill. The engine is over thirty years old

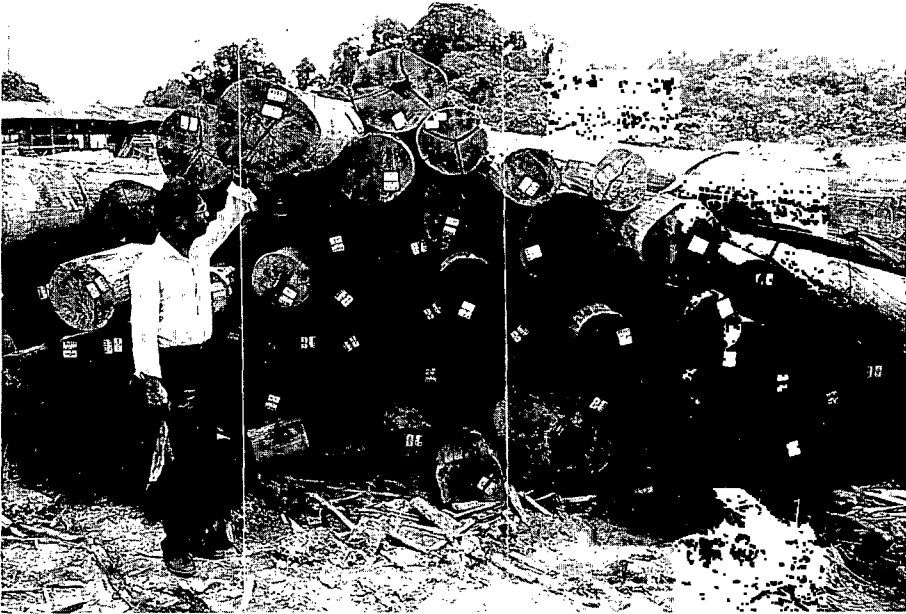


Figure 9. Logs with royalty stamps being readied for export in 1990

The company currently employs about fifteen workers in each sawmill. Six tractors work in the forest. Each tractor has a driver and assistant, a feller and assistant, and a debarker. Three trucks haul the logs out of the forest. Three people handle the office work in Miri. The total work force is about fifty people. In 1986, when the level of harvesting was somewhat greater, YK employed sixty workers, with eleven tractors and four trucks.

The present sawmills are clearly old fashioned, but the concession area is still profitable as it is presently operating. Rebuilding the sawmill would be prohibitively expensive. Also, a modern sawmill would not employ as many workers, and Dr. Yong feels an obligation to his workers, many of whom are the sons of the original workers hired by his father. The key to the profitability of the sawmill is that it is linked to a concession area and close to Miri, a major market for its timber.

Shrinkage of the concession

The history of the YK concession during the last thirty years has been one of steadily shrinking boundaries as a result of government policy, and reduced forest cover due to shifting cultivation. In 1955 the area north of Sungei Buloh was excised from the concession area and given to another licensee (Figure 1). This area was particularly rich in *bindang*. In 1963 approximately 2000 ha of land in the northeast part of the concession was removed from the concession in order to establish rubber gardens for local villagers. The land was distributed after it was cleared and planted with rubber trees. The trees did not grow well, in part because the heavy rains in 1964 washed away much of the topsoil. Also, farmers could

make more money working in Miri and consequently neglected the plots. As a result, the rubber gardens are presently overgrown and unproductive.

Starting in 1967 the Sarawak government began efforts to expand the boundaries of Lambir National Park. Prior to 1967 YK held the license to log up to the top of Lambir Hills. Actually, this was never technically feasible due to the steep terrain. In 1967 the boundary was established as an east-west line south of Sungai Jakang. However, in 1975 the boundary was moved north slightly to follow the stream itself. Although the boundary was officially shifted northward, YK still retained rights for timber extraction up the 1967 border of the National Park.

In 1970 the Forest Department cleared 282 ha in the middle of the concession area for an experimental pine plantation. The resulting performance of the pine trees was so poor that the plantation was soon abandoned. When we examined the site in 1990, we could not locate even one of the pine seedlings. The area of the plantation and the surrounding forest has now been completely cut down by shifting cultivators.

In 1979 the Block Alienation scheme in the Tukai area was proposed as a way of giving land to landless people. YK was given one year's notice to extract all saleable timber from the Block. During this year, shifting cultivators moved onto the land to establish land claims and burned the remaining forest. Since the area has sandy soils, agriculture has been unsuccessful.

Unsecured land claims were sold to other farmers, who built homes and gardens on the land. At the present time this area is mainly unproductive grassland with some degraded patches of forest and scattered houses of people without land titles. This area was logged continuously from 1938 through 1980. The final logs were taken out of the area in 1984. Before 1984 the area still contained harvestable logs of *bindang* and *nyatoh* (Sapotaceae). Patches of the original forest can be seen on the ridge running along the beach road.

Shifting cultivators

One of the principal problems faced in 1990 by YK was controlling shifting cultivators, who entered selectively logged forest, cut down the remaining trees, burned them and cultivated hill padi and vegetables. Dr. Yong attempted to prevent shifting cultivation by destroying access to all logging roads after timber harvesting. Protests to the Forest Department Section Office in Miri proved to be ineffective as cultivators returned even after being told to leave by Forest Department staff. These farmers were aggressive in asserting land claims as Native Customary Rights. Such claims were groundless under existing laws since the land had to have been cultivated prior to 1958 for a claim to be recognized. Farmers told workers from YK not to come back to certain areas and threatened to burn logging equipment.

Much of the shifting cultivation in 1990 was apparently being done by people living and working in Miri, who drove out to the concession area on weekends. These "weekend shifting cultivators" were often workers seeking to supplement their meagre wages by growing rice and vegetables and cutting fallen timber

using chain saws (Figure 10). The yield from this land was so poor that establishing a land claim was probably the main driving force behind this activity.



Figure 10. An area of selectively logged forest on steep slopes, parts of which were cut down and burned in 1990 by shifting cultivators. Note the good canopy structure in the selectively logged forests

Timber production

The area around the center of the concession was selectively logged by YK for the Japanese during WWII, again for large trees in the 1960's, a third time in the early 1980's, and was being worked for the fourth time in 1990 (Figures 11, 12). The harvesting by YK was particularly thorough this time because of rumours that the land was going to be alienated from the concession and the inability of the Forest Department to stop the shifting cultivators. This area, which has been selectively logged three times already, still has large trees in the three- to four-foot (91 to 122 cm) girth range of meranti bulu merah (*Shorea pubistyla*), yellow meranti (*Shorea* section *Richetioides*) and kapur. We measured one large meranti tree of 75 inches (190 cm) girth and an engkabang of 90 inches (228 cm) girth. The forest had abundant seedlings and saplings of selangan batu, urat mata (*Parashorea* sp.) and belian (*Eusideroxylon zwageri*), as well as abundant rattan vines.

The good health of the YK concession area as of 1985 is independently supported by a technical timber assessment prepared by a professional timber consultant (R & G Consultants 1985). This report was required as part of a license renewal procedure and part of a request to re-enter logging blocks. The timber



Figure 11. An isolated, massive tree stump cut with a saw above the buttresses about thirty years ago. The surrounding area was cut down by shifting cultivators in 1990

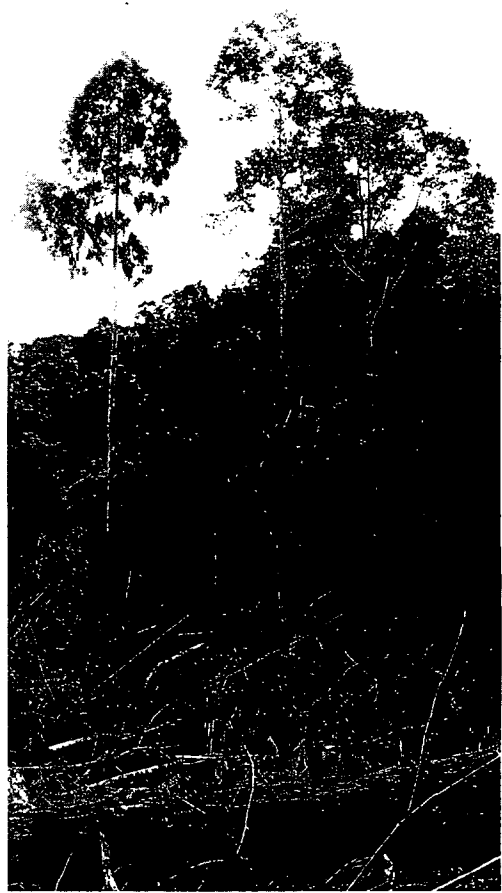


Figure 12. Large dipterocarp trees remaining in forests that have been selectively logged at least twice in the past. Area in the foreground was destroyed by shifting cultivators in 1990

volume had to be sufficient to re-enter the blocks. The method of assessment involved 53 transects, each 400×10 m, through selectively logged forest. The survey showed that the stocking of trees over 30 cm DBH was $129 \text{ m}^3 \text{ ha}^{-1}$, with trees over 45 cm DBH at $114 \text{ m}^3 \text{ ha}^{-1}$. The total for all dipterocarps was $60 \text{ m}^3 \text{ ha}^{-1}$, with meranti (*Shorea* sp.) constituting $14 \text{ m}^3 \text{ ha}^{-1}$ of this exploited forest, with up to $70 \text{ m}^3 \text{ ha}^{-1}$ of timber available for harvesting in good market conditions. Even though the original condition of the primary forest is not known, these present figures indicate that the forest still has numerous trees of good size. One of the most surprising aspects of this report was that R & G Consultants specifically excluded certain forest areas from their survey, which they said were unlogged, primary forest. Yet Dr. Yong claims that they were logged several times in the past.

If Dr. Yong is correct then the average stocking of the forest, the number and size of the trees, would be even higher.

Exact timber production figures are unavailable prior to 1976. However, according to Dr. Yong, production has been variable, depending on the market. Peak times for log sales were the late 1960's through 1973, during the Vietnam War. The mid-1970's was a period of depression for the industry. The late 1970's was a very profitable time for selling logs, in particular 1979-82 to Japan. However, in the 1980's the main business was selling sawn timber in the local market. For the nine years from 1976 through 1984, annual timber production, based on Forest Department records, varied from around 10 000 m³ in 1981 and 1983 up to 20 000 m³ in 1979 and 1982 (Figure 13). Production figures in 1985, 1988 and 1989 were lower than in any previous year, indicating an operation in a transitional and probably declining phase.

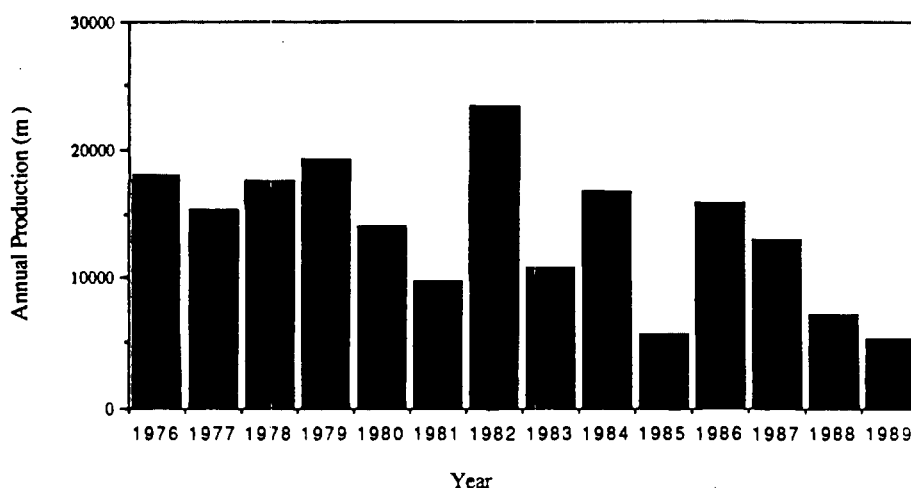


Figure 13. Annual timber production (m³) at Yong Khaw from 1976 to 1989.
Data from Sarawak Forest Department

The concession area has undergone considerable changes over time in the processing of wood. Before 1960 most of the logs were sawn for the local market. In the 1960's most logs were exported. Now most wood is processed locally and sold in Miri. Much of the YK timber is sold to the Mirsama Company, a Miri company that builds furniture and houses, employing more than sixty workers. This company built many of the buildings at Lambir and Mulu National Parks.

Sustained yield at Yong Khow & Sons

Yong Khow & Sons has had many unique features that allowed it to continue harvesting the same concession area for over fifty years. Even after four cutting cycles, the basic forest structure is intact and regeneration is excellent. How can YK continue to harvest trees for 50 years while most of the large concession areas in Sabah and Sarawak are completely exhausted within ten to twenty years of harvesting? Certain elements are worth considering.

At YK, the concession holder (or licensee) also acts as the contractor involved in the timber harvesting and the sawmill operator cutting timber. This means that there is a close integration between all phases of the operation. In most timber harvesting operations in Sarawak, the licensee simply signs a contract with a timber company, which does all of the actual timber removal. In such cases, the licensee does no actual work and may never have even visited the concession area. Similarly, the logs are often sold to sawmills for processing. This means that profits are split several ways, and the operation is not viable unless it is excessively profitable. In the case of YK the operation can continue even with a small profit margin since all operations are in one company.

The concession holder, Dr. Yong, is physically on the concession area most days and is actively patrolling the boundaries. This has the effect of minimizing forest destruction by shifting cultivators, stopping timber theft and minimizing delays in decision-making in matters relating to labour disputes and equipment repair. In many other concession areas, a subcontractor does most of the logging and has little long-term interest in the concession.

The concession is run in a low-cost, efficient manner. At YK the wages paid are the standard Miri wages, the transportation costs from the forest to the sawmill and from the sawmill to the town are low, and the equipment is old but reliable. In contrast, most large, interior concession areas are very expensive to operate due to very high wages, high transportation costs and expensive modern equipment. In these concession areas there is a frantic race to cut timber when the timber prices are high. As long as the timber prices are high and the royalty rates are low, these timber companies can still be very profitable. However, when timber prices fall, these companies either stop harvesting trees or even go out of business. In contrast, YK has been capable of cutting timber profitably almost without interruption for 52 years. As long as its costs are low, it can continue to make a profit.

YK is being managed on a long-term basis. Trees are not cut unless they have reached a large size. Attempts are made to avoid damaging small trees of commercial species, which will form the future timber crops. Roads are similarly kept narrow to minimize damage. The net result is that forests can be re-entered every twenty or so years. Many blocks have been logged two or three times already and still contain good quantities of saleable timber.

The YK concession area had no inhabitants when YK began operations there in 1938 and no farming activity until the 1970's. According to the 1958 Land Code, this means that no land claims can be made for land in the concession area. The

land is generally unsuited for agriculture in the undulating northwestern half due to the sandy, kerangas soils, while the topography in the hilly southeastern half is too steep for agriculture. The result is that shifting cultivators did not begin to encroach on the land until the late 1970's.

YK has a steady demand for its sawn timber in the local Miri market. This market has allowed YK to continue its operation, even when the export market is very poor. The YK concession area was among the nearest forest areas to Miri in 1938 when it was established, and it continues to enjoy that position. As a result, sawn timber can be brought into Miri with the lowest transportation costs. During its decades of operation, YK has established close business connections with leading companies in Miri, such as Shell Oil Company in the past and the Mirsama Company now, which buy most of its sawn timber.

Even though YK has been in operation for 52 years, the first 20 years of the concession involved manual removal of only medium-sized logs. As a result the forest structure of large trees and the soil were left mostly undisturbed. Consequently, natural regeneration was sufficient to produce the next tree crop. No post-harvest silvicultural treatments were needed or carried out. Intensive harvesting with machines has only occurred within the last 30 years, with the 1960's being a period of low log production. Consequently, the experience of the YK concession does not represent a half-century of selective logging using methods comparable to those used today. In many ways YK is a special case, and a unique set of circumstances.

Conclusion

Despite these very strong factors which have allowed YK to practise long-term timber extraction for the last 52 years, there is a very real possibility that YK will cease operations in the near future. The main factor is that shifting cultivators are moving onto the land in increasing numbers, and cutting down and burning the forest. At the present rate of activity, very little commercial forest may be left in five years.

In the place of these productive forests will be extensive, unproductive grasslands and patches of degraded forest and secondary forest. At the five sawmill locations will be scattered pieces of rusting machinery. Trees will only slowly colonize these old mill sites and the system of logging roads. At these places the ground has been severely compacted by thousands of passes by trunks and tractors and much of the soil and nutrients have been washed away. Many things will be lost when YK leaves. First, the sixty YK workers will have lost steady, long-term jobs. Second, the Miri factories and construction companies will no longer have one of their reliable suppliers of inexpensive sawn timber. Third, one of the last connections linking Yong Khow to Miri will be severed. When Yong Khow arrived in Miri, it was a little village. Yong Khow was one of the key figures who worked with the Sarawak Shell Company to transform Miri into the modern, industrial town it is today. And fourth, the knowledge of long-term timber management in hill forests, that YK could have supplied to Sarawak will be permanently lost.

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