論　文

Rubberwood: Characteristics of its supply and development of its utilization

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ラバーウッド：その供給特性と利用の発展

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While the sustainability of timber production in natural forests in Southeast Asia has seemed to be in peril, rubberwood, a by-product of natural rubber production, has attracted more interest and its utilization steadily developed through the 1980's. In the 1990's, however, especially in countries like Malaysia where utilization expanded intensively, a shortage problem has emerged and prices have increased. Since rubberwood production is a secondary concern for farmers, even when there is increased demand the supply doesn't respond to it. This is a problem for rubberwood supply as an industrial resource, differing from other timbers.
Key words: rubberwood, agricultural plantation, by-product, furniture industry,

天然林からの持続的な木材生産が危ぶまれている東南アジアにおいて、天然ゴム（ラテックス）を産出するパラゴムノキの木部ラバーウッドが、1980年代から着実に需要を伸ばしている。資源量が豊富で価格が安いことに加え、あくまでもラテックスを採取した後の廃材を有効に利用しているがゆえに、ラバーウッドは理想的な木材として期待を集め、特に木製家具産業において大量に利用されている。ところが、ラバーウッドは、現時点では価格が低すぎ、生産者は積極的な生産意欲を持たないため、廃材として供給される以上の量が市場に出てこない。つまり、ラバーウッドの供給は、需要の増減に弾力的に反応しないという特性を持つために、需要が拡大したマレーシアでは不足状況が生じ、利用者にとって価格上昇が深刻な問題となりつつある。
キーワード：ラバーウッド、農業プランテーション、副産物、家具産業、マレーシア

1 Background and Objectives

In Southeast Asia, as the deforestation problem has been watched with keen interest and the sustainability of timber production in natural forests has seemed to be in peril, alternative timber resources have been anticipated.

Para rubber trees (*Hevea brasiliensis*) are widely planted in Southeast Asia to produce natural rubber, or latex, and its timber, so called "rubberwood", is popularly utilized for industrial purposes. While the development of industrial tree plantations has made little progress, this rubberwood, a by-product of natural rubber production, has attracted much interest as a substitute helping to relieve the pressure on tropical forests since the 1980's.

In this paper, we use rubberwood as the subject matter, firstly examining the development process of its utilization, and then analyzing the current situation in order to understand the characteristics of its supply as an industrial resource. Discussion is based on information both in existing publications and data obtained through our own surveys in Japan and Thailand conducted in 1992-1993, and in Malaysia from 1995-97 with the support of Universiti Pertanian Malaysia.

There is much literature available on this timber. In particular, publications by the Forest Research Institute Malaysia are quite important and provide detailed information on subjects such as processing technologies and physical properties (HONG, 1985; HONG, 1990; HONG and SIM, 1994; K.D. Singh 1985). In addition, there are some articles (Asian Timber, Nov., 1993; ASANO, 1990) about the general situation of its utilization in Asia. Most of this literature includes the merits of rubberwood, allowing for some technological difficulties in processing. To encourage utilization, it has often been refereed to as an ideal timber resource. Nowadays however, where this utilization has developed intensively, a problem has emerged. We found that rubberwood has problems as well as merits, being an agricultural by-product as opposed to timber from natural

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forests or forest plantations. Since the existing literature doesn't analyze this problem sufficiently, we would like to focus on this point.

2 Development of its utilization

2-1. Potential

Rubberwood is supplied when trees are cut for replanting or sometimes when land is converted for other uses. Replanting is carried out after the economic lives of rubber trees expire. This is about 25-30 years, when the subsequent yield of the natural rubber becomes low.

Currently, there are approximately 9 million ha (ARAYA, Nov., 1993) of plantation in the world, and most of this is located in Southeast Asia. Though it has declined 17.7% in Malaysia between 1980 and 1995 to 1.7 million ha, according to the Ministry of Agriculture, Malaysia, it has increased 28.4% in Thailand to 1.9 million ha during the same period and 35.6% in Indonesia to 3.2 million ha between 1980 and 1994, according to the International Rubber Study Group.

There is no exact statistical data on the amount of annual production in the world and estimation is quite difficult. Assuming that about 100 m^3/ha of logs can be expected (SERR, 1990) and that plantations will be cut every 30 years for replanting, we can roughly estimate world annual production at more than 10 million m^3. The yields per area may differ, however, depending on its cultivar and the way of management. Where plantation sites are not located close to facilities for chemical treatment, rubberwood is still not used except for fuel. Moreover, poor farmers generally will not cut their plantations within 30 years. Consequently, this is a very general estimation. At the very least, it does inform us that rubber plantation is a significant potential source of wood in Southeast Asia.

2-2. A brief history and the current situation

Though more than a hundred years has passed since the first rubber plantation was established in tropical Asia, rubberwood was not utilized until quite recently except for fuel, as blue stain or insects can easily damage it. Much research has been conducted to overcome these defects in order to generate a new income source for plantation holders and to supply inexpensive hardwood to the industry. After many years of effort, rubberwood became a common industrial resource in the 1980's (HONG and SIM, 1994).

In the 1980's, utilization began to expand rapidly not only in Southeast Asia but also in Japan and Taiwan. In the 1990's, popularity further increased, and the resulting products have been exported almost everywhere in the world. Nowadays, rubberwood can be considered as one of the most important hardwood resources in Southeast Asia. Although most rubberwood is used for furniture and fixture production, small timbers are used in MDF and particleboard production. In addition, there have been attempts to use it for many other purposes, including plywood production.

Malaysia, Thailand and Indonesia have been centers of rubberwood production and export. It has been estimated that 60% of Thai furniture is made of rubberwood and another 20% is for MDF and particleboard (The Thai Furniture Industries Association, 1996). Though much rubberwood is also produced and utilized in Indonesia, data for analysis is insufficient. The situation in Malaysia will be examined in a later section. Japan and Taiwan have been the main importers of rubberwood and also the main investors in the rubberwood industry in Southeast Asia, contributing much toward its development. Japan has imported large quantities of rubberwood furniture, fixtures and kitchenware, as well as sawntimber. These products are popular, and some companies have established overseas subsidiaries in Southeast Asia to obtain and process rubberwood.

2-3. Background and other factors in the development

It has often been pointed out that rubberwood began as a substitute for ramin timber (Abdul and HOI, 1988; Asian Timber, Jul./Aug., 1984; SMITH et al., 1990). It was produced mostly in Southeast Asia and was popularly utilized for furniture production both domestically and overseas in places such as Taiwan, but the supply was nearly exhausted by the mid 1970's. When we interviewed a key expert in Japan's largest furniture maker, he replied that, in Japan, rubberwood was used mainly as an alternative for domestic beech timbers whose supply decreased in the 1970's.

At that time, the decrease and degradation of natural hardwood resources like ramin and beech, suitable for furniture or fixture production became serious, and the utilization of natural timber was sometimes considered as an environmentally destructive activity. Consequently, many timber processing and manufacturing companies began looking for alternatives. As a result, a chemical treatment method was established and rubberwood received much attention as a new timber resource.

Since then, as the shortage of natural hardwood has become more serious and the furniture and fixture industries have grown, utilization has been extended. Based both on our survey and existing data (HONG, 1994), we list the merits and demerits of rubberwood for users below.

Merits

(a) Low costs: Log price/m^3 of rubberwood, red meranti, keruing and kempas in January of 1990 were RM23, RM281, RM233 and RM152, respectively, in Peninsular Malaysia, according to the Malaysian Timber Industry Board.
(b) Stable supply
(c) Environmental friendliness: As it is just a by-product, utilization is considered to be a resource saving and environmentally friendly activity. Products have been accepted favorably in the international market.
(d) Good quality: Many users believe that it can never be as good as some famous natural hardwood species like oak or maple, but rubberwood has reached an international quality standard. In particular, its whiteness is appreciated.

Demerits

(a) Easily harmed by insects or fungus: Prompt treatment after cutting is needed.
(b) Low utilization percentage: Its tree form is poor, bole height is low and tension wood problems are often found; therefore log sizes are usually small, and the volume of sawlogs obtained from a plantation site is low (HO, 1994).

The recovery rate of sawntimber from sawlog is also quite low; approximately 32 %, due to defects like knots, warping and tapping marks (HO and ROSLAN, 1994).

As most users believe the merits outweigh the demerits, utilization has expanded and expectations have also increased.

3 A case study in Malaysia

Nearly 20 years have passed since rubberwood utilization was established, and the situation has changed especially where development has been intensive. In this section, the situation in Malaysia is examined in order to understand what happens with extensive utilization.

3-1. Development and utilization

In the 1980's when the furniture and fixture industry had not yet matured in Malaysia, large supplies of rubberwood logs and sawntimber were exported mainly to Japan, Taiwan and Singapore (Asian Timber, Nov., 1984). As the industry developed from the late 1980's, however, domestic demand has also expanded. An embargo was placed on the export of log and sawntimber in the 1990's to give the domestic industry priority (Asian Timber, Oct., 1993), and subsequently rubberwood has been consumed mostly in the domestic industry. At present, rubberwood is the most

Table 1. Utilization of wooden raw materials of 15 furniture makers

	Products	Sales in 1995 RM '000, 000	Wooden Raw Materials (per month)	Plans to counter the shortage of rubberwood
A	Occasional, Bedroom	3-4	Rubberwood 200t, Veneer, MDF	Use MDF as substitute
B	Bedroom Living set, Parts	5	Rubberwood: a little, Meranti 20t, Veneer,Plywood, MDF	—
C	Dining set Living set, Sofa set	10	Rubberwood log 150t, Seputir, MDF	Import other timber species from Vietnam
D	Living set, Bedroom	5	Rubberwood, Plywood, MDF	—
E	Dining set	10	Rubberwood 400t, Veneer Plywood, MDF	—
F	Kitchen set	12	Rubberwood 200t (20% of them are imported from Indonesia), Veneer, Plywood, MDF	Import rubberwood from Indonesia
G	Dining set	8	Rubberwood 210m^3, Laminated Rubberwood 110m^3	—
H	Kitchen set	0.78	Rubberwood 380t	—
I	Dining set	32	Rubberwood 400t, Veneer, MDF	—
J	Dining & Living set	n.a.	Rubberwood, Veneer, Plywood, MDF	—
K	Dining set, Bedroom	45	Rubberwood 1,000t, Plywood, MDF	Import hardwood from China
L	Dining set, Dresser	8	Rubberwood, Veneer, Plywood, MDF	—
M	Dining set, Bedroom	0.8	Rubberwood 300t, Veneer, Plywood, MDF	—
N	Dining set, Bedroom Kitchen set	52	Laminated Rubberwood, Veneer, MDF	—
O	Dining set, Chest Rocking chair	70	Rubberwood (90-95%), Local natural hardwood, Veneer, Plywood, MDF	Import rubberwood from Myanmar

Note: interviews were conducted in 1996
"Rubberwood" means rubberwood sawntimber

important timber resource for the furniture and fixtures industry as a foreign currency earner. It has been estimated that 80% of Malaysian wooden furniture was made of rubberwood in 1997 (Asian Timber, Feb., 1999). The results of our survey also show their strong reliance on rubberwood (Table 1). In addition, a few rubberwood MDF mills have also been established.

3-2. The shortage

As demand has increased, however, a problem has emerged.

At first, when utilization started in the 1980's, the price was low and the supply increased without serious price hikes. This was because suppliers were willing to provide it even at low prices, considering it to be a residue of little value.

As demand increased in the 1990's, however, the price rose without an increase of supply. Supplies did not increase even with the price when suppliers judged that the economic timing was not good, considering natural rubber production. When prices increase further to a level where the supplier judges a profit can be achieved even with some losses in natural rubber production, trees are cut in a shorter rotation so the supply can be increased. In spite of recent price hikes, if the price is still deemed low, the supply is limited and will not increased.

Even worse, those limits actually decreased (Table 2). Planted area fluctuates according to the economic situation, not of rubberwood production, but of natural rubber production. In Malaysia, though the demand for rubberwood has increased, many farmers and estate holders have lost interest in the rubber plantations and converted mainly to oil palm plantations, due to the low profitability of rubber plantation management. As the area is reduced, the timber production decreases (Table 3) and the supply becomes sluggish.

The situation may be further explained using Fig.1. The supply curve of rubberwood must be unique and not a straight line, as S^1. Thus, the price is low and stable unless q^1 reaches q^2, which occurred in the 1980's. In the 1990's, when the demand increased and the limited supply shifted from q^2 to q^3, the price increased without a parallel increase of supply. As one of our respondents had already started importing rubberwood from Indonesia, the price rose even over the level that the importer paid (p^3) in the mid 1990's, and it (q^4-q^3) was imported.

This means that two of the four merits; (a) Low costs and (b) Stable supply have lost their significance in Malaysia. Some of our respondents complained about the sluggish supply, the price hike, and the restrictive contracts with suppliers. The price/m^3 in January 1998 was RM68.00, a threefold increase within 7 years according to the Malaysian Timber Industry Board. Although the price was still much cheaper than that of other timber species, this price hike seriously affects the competitiveness of the products on the international market.

3-3. Measures to counter the shortage

Among our respondents, only 5 companies prepared concrete plans to cope with the shortage. One said they would continue to import rubberwood, one said they would begin importing soon, two said they intended to import other timber species to substitute for rubberwood, and another said that they would utilize more wooden panels instead. These measures, however, seem to do little more than to cover the surface of the problem. First, as rubberwood utilization has also developed in neighboring countries and similar problems may happen there, it is not clear whether there will be enough of a surplus to export to Malaysia. Also, it is doubtful whether Malaysian products made with

Table 2. Planted area of natural rubber and oil palm (1,000ha)

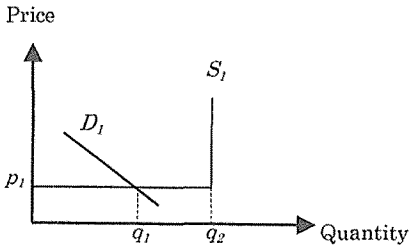
	1980	1990	1991	1992	1993	1994	1995	1996
Rubber plantation	2,004	1,837	1,819	1,792	1,767	1,738	1,679	1,650
Oil palm plantation	1,023	2,030	2,094	2,198	2,306	2,412	2,540	2,615

Source: Ministry of Agriculture, Malaysia

Table 3. Rubberwood production in Peninsular Malaysia (1,000m^3)

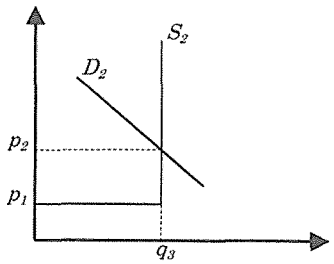
	1985	1988	1990	1991	1992	1993	1994	1995	1996
Log Production	595	1,241	971	1,622	1,837	1,075	1,157	881	284
Production of Sawtimber	n.a.	n.a.	n.a.	101	126	120	94	50	55

Source: Malaysian Timber Industry Board, Forestry Department Peninsular Malaysia



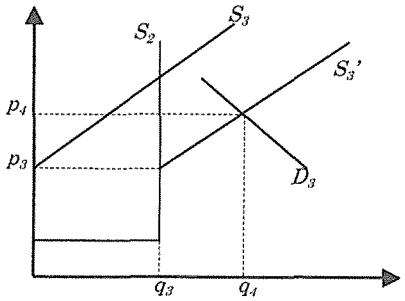
S^1 : Supply from rubber plantation
D^1: Demand
q^1 : Quantity used as an industrial raw material
q^2 : Limit of quantity supplied
p^1 : Price

(a): Situation in the 1980's when the demand was not high



S^2 : Supply from rubber plantation
D^2: Demand increased
q^3 : Limit of quantity supplied ($q^3 < q^2$)
q^2 : Price hiked

(b): Situation in the 1990's when demand increased and the limit of quantity supplies decreased



S^3 : Supply of imported rubberwood
$S^{3'}$: paralleled with S^3
p^3 : The price that the importer pays
p^4 : New price
q^4 : Total quantity supplied

(c): Situation in the mid 1990's when imports occurred

Note: Though the importer must also have a limit of quantity in theory, we simplify the shape as with S^3.

Figure 1 (a)(b)(c): The supply-demand structure of rubberwood

imported resources can be competitive in the international market. Finally, it is also unclear whether consumers will accept products made of substitute materials.

3-4. Away from a by-product to a main product

As a fundamental resolution to overcoming this problem, establishments of rubberwood plantations primarily for timber production are expected (Norini et al., 1994).

There are some merits in rubberwood plantation, since management can be much different from that of natural rubber plantations. As the rubberwood production is only a secondary concern in natural rubber plantation management, there are some problems, listed as below.

(a) Timing of cutting: In natural forest or forest plantations, trees are usually cut when a manager judges that the timber will fetch a premium within the current market. However, in natural rubber plantations, trees are usually cut without consideration of the rubberwood market situation. To put it in an extreme way, rubberwood may be supplied even without the demand and may not be supplied even when there is a rush in demand.

(b) Tapping: Rubber trees are tapped to harvest latex, and this sometimes damages the timber.

(c) Cultivar: Though plantation holders like to plant cultivars improved for high yielding latex, it is said that those cultivars are sometimes not suitable for timber production since the growth is slower and the tree form is not good.

For rubberwood plantations, however, decisions such as planting cite, area, spacing, cultivar, timing of cutting and so on, can be made to improve its timber production.

There is a demerit, too. In natural rubber plantations, the cost of the plantation is compensated with income from the natural rubber production, and rubberwood users need not share it. In rubberwood plantations, however, the costs must be compensated with income from the rubberwood production.

Currently, there are only a few plantations on a trial basis, and it has not expanded in the private sector yet. This may be because rubberwood still seems too cheap in spite of recent hikes, and landholders are suspicious as to whether there will be any economic benefits.

4 Conclusion

Rubberwood is often considered as an ideal timber resource, but our study reveals that an unbalanced supply-demand relationship may occur when the demand becomes larger than the supply. Although the area has expanded in Thailand and in Indonesia, similar situations will also occur when utilization has developed as intensively as in Malaysia.

Price adjustment did not work in the supply-demand relationship in the case of rubberwood, and this was the cause of the unbalance. Rubberwood is very cheap compared to other timber species. This cheapness has greatly encouraged the utilization, while it has discouraged the will of supply among farmers and plantation owners. Though the price has increased, it still seems too low to encourage them. If it further increase and rubberwood becomes a main product, supply may stabilize, but it is quite doubtful whether users will really demand it at such a high price.

As the deforestation problem in Southeast Asia has become very serious, other agricultural by-products are expected to substitute for natural resources. For example, the utilization of bagasse, a by-product of sugar production, has succeeded in the pulp industry, and the utilization of oil palm trunks is being eagerly applied in the wooden panel industry. We would like to point out, however, that every by-product must have a supply curve like S^1. Therefore, though efforts and activities to use agricultural by-products should be appreciated and encouraged, utilization must also be carefully managed.

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