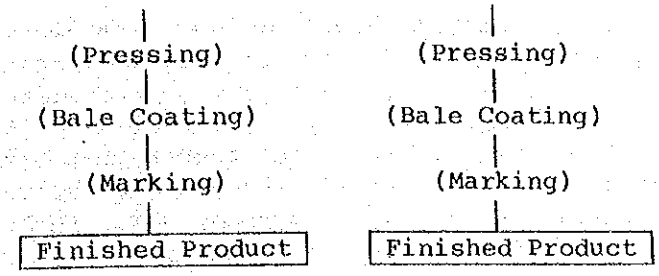
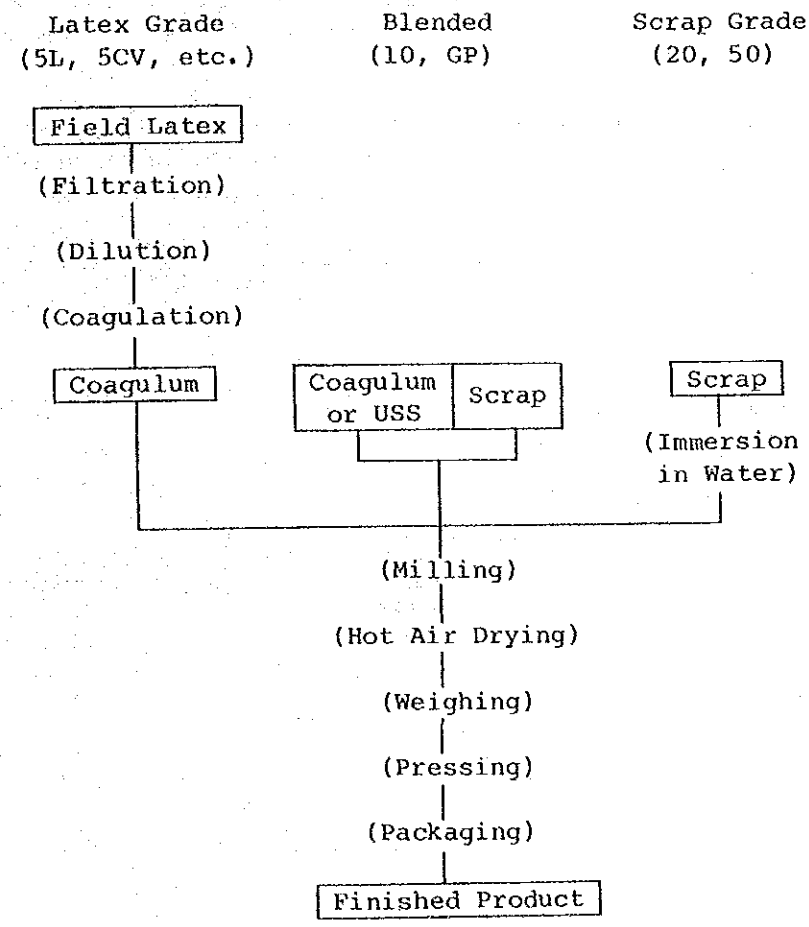


3. TSR



III. Structure of the Industry

Producers of natural rubber are classified into estates and smallholders. In general, estates are producers who maintain plantations for the cultivation of rubber trees of 100 acres (40 hectares)

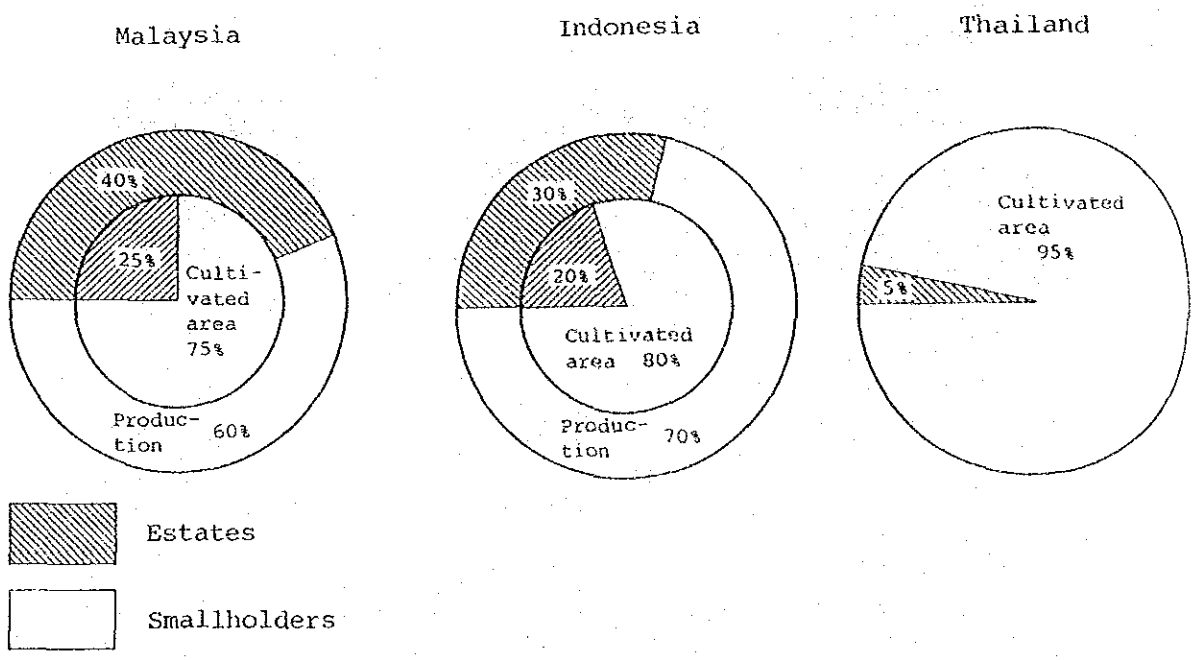
or more, while smallholders cultivate areas of less than 100 acres. However, the usual size of a smallholder is actually four hectares or less.

In Malaysia, for instance, the area under rubber cultivation was about two million hectares in 1980, and estates and smallholders respectively owned about 25% and 75% of this area, while their ratios of production stood at about 40% and 60% respectively.

In Indonesia, government and private estates held about 20% of the cultivated area and 30% of the production in 1979, while smallholders accounted for 80% of the former and 70% of the latter.

In Thailand, 95% of the cultivated area belongs to smallholders and only 5% to estates.

As can be seen above, in every major producing country in Southeast Asia, a large portion of the production depends on smallholders, for whom the governmental policies for natural rubber production are primarily designed.



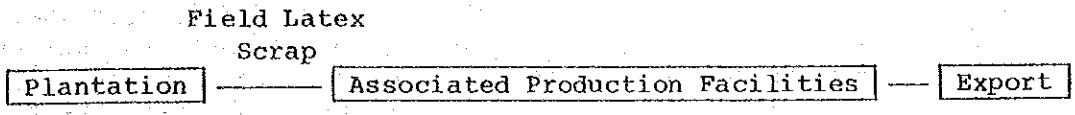
The point most worthy of note in comparing estates with smallholders is the yield. As an exmaple, in Malaysia the average annual yield per hectare is 1,200 kg for estates, while it is some 700 to 750 kg for smallholders, and this latter figure is about double the figure for Thailand. As a reference, the average yield per hectare quoted here refers to the whole area under cultivation; thus it

includes imature areas such as those which are newly planted or replanted where there is as yet no production of natural rubber. Differences in production depend on factors such as the age of the trees, clones, frequency of tapping, manual skillfulness, the application of stimulants and so on.

As can be seen from the above descriptions, the focus for the production development plans of each of the major countries lies in the development of high-yielding clones and in replanting, especially with regard to smallholders.

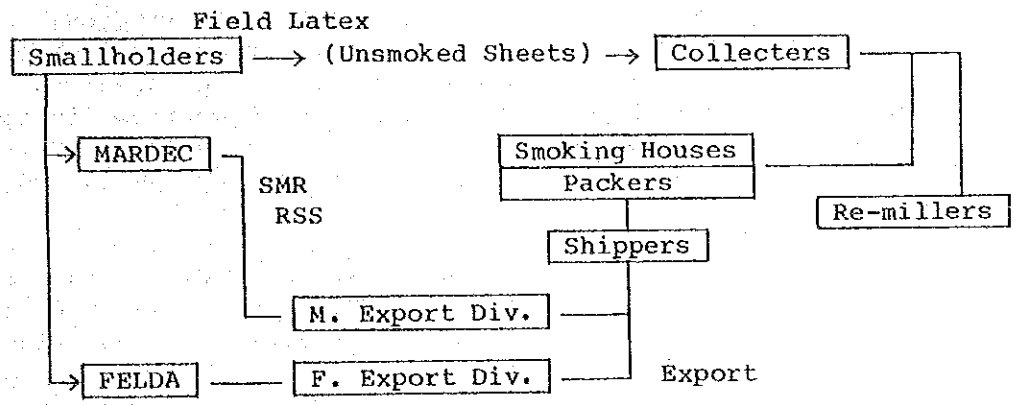
The structure of the natural rubber industry based on estates and smallholders is illustrated in the following charts.

1. Estates

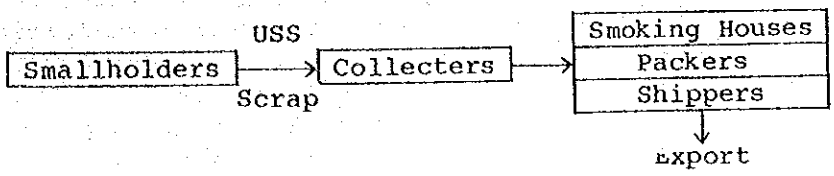


2. Smallholders

2.1 Malaysia



2.2 Thailand



IV. Relationship between Natural and Synthetic Rubber

Natural rubber was the only elastomer for industrial applications until synthetic rubber was developed. The development of the latter began in the 1930s, and was accelerated during World War II.

The synthetic rubbers currently produced and in practical use are:

SBR	(Styrene Butadiene Rubber)
BR	(Polybutadiene Rubber)
IR	(Polyisoprene Rubber)
EPDM	(Ethylene Propylene Diene Terpolymer)
IIR	(Isobutylene Isoprene Rubber)
NBR	(Acrylonitrile Butadiene Rubber)
CR	(Chloroprene Rubber)

The share occupied by synthetic rubber of total world rubber consumption was less than 25% in the latter half of the 1940s, around 60% in 1965, more than 70% in the 1970s, and has remained at about this level to date. Although the above figures indicate the percentages of overall consumption, an analysis in terms of applications reveals the fact that the consumption ratio of synthetic rubber in the tire manufacturing sector is less than that in the non-tire manufacturing sector; in other words the former sector consumes significantly more natural rubber than the latter sector. For example, the consumption ratio of synthetic rubber in the United States is 77% against the overall consumption, 70% in the tire manufacturing sector, and 88% in the non-tire manufacturing sector. For details, see Appendix Table 8.

Natural rubber and synthetic rubber compete with each other in cost and end-use performance, but also complement each other in the development of the desired properties for various products, due to the advantages of their respective features. A comparison in terms of costs must include not only the comparison of purchase prices but also those of expenditures for storage and material handling and processing.

Synthetic rubber, being produced in the various consuming countries themselves, is consequently available within a short procurement term and production can be immediately adjusted against fluctuation in demand, which results in lower storage costs. The packaging of synthetic rubber is palletized for easy handling, whereas the emergence of TSR has brought about improvements in material handling methods for natural rubber.

In the field of processing, natural rubber requires cutting (especially for the conventional grades), warming and mastication, with the addition of removal of foreign materials by means of a strainer in the case of some special applications.

The most important factor with regard to the prices of natural and synthetic rubber is that natural rubber is traded on the open market and the price is therefore unstable, depending on fluctuations in short-term supply-demand forecasts and various speculative factors. In contrast, however, the price of synthetic rubber is stable, because it is fixed on the basis of agreements between producers and users.

As to performance, natural rubber competes with synthetic rubber in the area of physical properties required for the various products and in processability, but is more interchangeable with general-purpose types of synthetic rubber such as SBR, BR and IR.

Synthetic rubber can be roughly classified into general-purpose types such as SBR, BR and IR, and specialty types such as EPDM, IIR, CR, NBR, etc. Each of the latter types of synthetic rubber possesses its own particular properties such as heat resistance, oil resistance, air impermeability, etc. not possessed by other types, with established applications satisfying the specific requirements of the finished products concerned.

As illustrated above, technical considerations define the fields of application:

a. Where natural rubber possesses technical advantages, with almost no competition from synthetic rubber;

b. Where synthetic rubber is technically superior to natural rubber, resulting in negligible competition from the latter; and

c. Where they are mutually interchangeable, resulting in competition between them.

Among the above, the applications covered under Item c. pass from one type to the other according to factors such as price, the balance of supply and demand, and so on.

Natural rubber is regarded to be excellent in physical properties such as fatigue life, tensile strength, tear strength and cut growth resistance.

As described above, a large quantity of natural rubber is used in the tire manufacturing sector, and the consumption ratio of natural rubber is greater in that sector than in the non-tire manufacturing sector. This indicates that many technical requirements of the tire industry are met by the superior properties of natural rubber. For example, natural rubber is used for the tread of truck and bus tires because of its low heat build-up characteristics, and for the belt and ply of steel radial tires due to its superior adhesion to steel.

The consumption ratios of natural and synthetic rubber in the major kinds of tires are shown in C-III-1.

B. PRODUCTION

I. Production of Natural Rubber by Countries

1. Worldwide Production of Natural Rubber

The worldwide production of natural rubber was 2,353,000 tons in 1965 and peaked at 3,860,000 tons in 1979, with an increase of 1.6 times over a period of about two decades. Thereafter, production declined in 1980 and 1981 to a level of 3,665,000 tons in 1981, a 5% decrease over 1979. This reflected the global fall in demand for natural rubber caused by the decreased production of automobiles and tires in the United States, and other factors. As a reference, the total volume of production in 1981 for synthetic rubber was 8,490,000 tons, and the share held by natural rubber of the total supply of new rubber (including both natural and synthetic rubber) was about 30%.

The production of natural rubber is principally centered in Southeast Asia, with additional production in Asian countries including India, Sri Lanka and Vietnam, and in Africa and South America. The three major producing countries in Southeast Asia are Malaysia (42% production share), Indonesia (24%) and Thailand (14%), and the total share of these three countries amounts to 80% of world-wide production. Changes in production levels for these three countries and for the world are shown in Table B-1.

Table B-1 Production of Natural Rubber

(1,000 MT, %)

Year	Malaysia		Indonesia		Thailand		World Total	
	Production	Share	Production	Share	Production	Share	Production	Index*
1965	917	39.0	716	30.5	216	9.2	2,354	100
1970	1,269	40.9	815	26.3	287	9.3	3,103	132
1975	1,459	44.0	823	24.8	355	10.7	3,315	141
1979	1,570	40.7	905	23.4	531	13.8	3,860	164
1980	1,530	39.9	1,020	26.6	501	13.1	3,830	163
1981	1,529	41.7	868	23.7	504	13.8	3,665	156

* Index based on 1965 = 100.

Source: IRSG, Rubber Statistical Bulletin

The volume of production of natural rubber from 1965 through 1981 by countries is shown in Appendix Tables 2 and 3.

2. Production Trends in Major Producing Countries (Malaysia, Indonesia and Thailand)

In each of these three major producing countries, natural rubber is ranked as one of the main foreign currency earning products, with the share of natural rubber in overall export receipts in 1976 standing at 23% for Malaysia, 20% for Indonesia and 9% for Thailand. Consequently, natural rubber occupies an important position in the respective national economies, so that each country is making considerable efforts to maintain and expand the production of this product. The production plans for each country are detailed in the following descriptions.

2.1 Malaysia

As the top producing country in the world, Malaysia is moving ahead with its "Dynamic Production Policy", a program to step up production in order to preserve the balance of supply and demand. The following are the key points of the Policy:

a) The promotion of new planting and replanting
b) The solution of land development and labor problems
c) The establishment of financial incentives
d) Accelerated research and development

The concrete programs for the five-year period from 1981 through 1985 are as follows:

a) The quality of products from smallholders is generally low (mostly RSS-3 or below) because of their deficiency in technical knowhow and management skills. Accordingly, the government is enacting measures for the improvement of quality to raise the added value of the products. To implement this purpose, two organizations, RISDA (Rubber Industry Smallholders Development Authority) and MARDEC (Malaysian Rubber Development Corporation) have been established.

- RISDA

RISDA was established in 1973 as a governmental organization of the Ministry of Primary Industries, with the aim of promoting measures to elevate the social and economic standing of smallholders.

In practical terms, the Agency gives guidance regarding new planting and replanting to smallholders and sets up Group Processing Centers (GPCs) consisting of 20 to 30 smallholders each, to collect raw materials from them and manufacture RSS under properly controlled conditions.

. MARDEC

This is a processing and selling corporation established by the government in 1969, and has Central Processing Factories (CPFs) at various locations to treat the raw materials obtained from smallholders, mainly for the production of SMR.

. FELDA

Another agency for smallholders in Malaysia is the Federal Land Development Authority (FELDA), a governmental agency established by the Ministry of Land and Regional Development in order to develop land for the production of agricultural products such as palm, natural rubber and cocoa.

Its major activities are the development of virgin land, afforestation, the settlement of farmers therein, and the establishment of Central Processing Factories to produce and sell the various products.

2.1.1 Overall Five-Year New Planting Program (natural rubber and oil palm)

544,000 ha
- 36%: FELDA/FELCRA/RISDA
- 40%: State
- 24%: Joint ventures between government and private enterprises

Among above, new planting of natural rubber is scheduled 120,000 acres (48,500 ha) every year.

2.1.2 Overall Five-Year Replanting Program

150,000 ha
- 141,500 ha: RISDA
- 4,000 ha: FELDA
- 4,500 ha: Sarawak and others

60,000 to 80,000 acres (24,000 to 32,000 ha) of rubber trees are replanted every year, and the growth rate from 1962 through 1982 was 9.6%. Projected output from the long-term program is:

	IRSG Report Base (optimistic)	MRRDB Base
1985	1,850,000 MT	1,600,000 to 1,650,000 MT
2000	2,500,000 "	2,200,000 to 2,300,000 "

2.2 Indonesia

Natural rubber production in Indonesia has been in the range of 800,000 to 900,000 tons annually, although a previous peak of 1,020,000 tons was reached in 1980, while its share of world total production has been 23 to 26%. In terms of the national economy of Indonesia, natural rubber accounted for 20% of total export receipts and 7% of GNP in 1979, and some ten million persons are dependent upon the rubber industry.

In Indonesia, natural rubber is produced in Sumatra (the largest quantity, at 75%), Java (8%) and Kalimantan (17%).

Producers are PNP/PTP, i.e., state-operated estates, and private estates and smallholders, and the production ratio is 17% for PNP/PTP, 13% for estates and 70% for smallholders. The respective shares of the area under cultivation in 1979 were 8% (187,000 ha) for PNP/PTP, 11% (271,000 ha) for estates and 81% (1,926,000 ha) for smallholders.

Natural rubber production in Indonesia features a high production ratio of TSR, which is called SIR (Standard Indonesian Rubber). Exports of SIR have leapt from 8,400 tons (0.1% of the total production of rubber) in 1969 to 490,000 tons (57% of the total exports of rubber) in 1977.

The production program estimates the following gains, due to increases in the unit yield by the dissemination of high-yielding varieties of trees, the Nuclear Estates Policy and the Production Management Unit System for smallholders, technical developments, and the more efficient utilization of labor, capital and land:

	Targets in 1980	Adjusted targets
1983	921,000 MT	1,071,000 MT
1988	1,313,000 "	1,515,000 "
1990	1,700,000 "	1,912,000 "

The unit yields are 1,000 kg/ha/year for PNP, approx. 450 to 500 kg/ha/year for estates, and 300 to 350 kg/ha/year for smallholders, averaging approx. 400 kg/ha/year.

2.3 Thailand

Natural rubber production in Thailand has shown steady growth, exceeding the level of 500,000 tons in 1979, and accounting for about 14% of worldwide production.

The area under cultivation has reached about 1.5 million hectares, 90% of which lies in southern Thailand and the remaining 10% in the south-eastern region. Smallholders account for 95% of the cultivated area, and estates only 5%.

The main product is RSS, holding a little over 75% of total production. Approx. 20% of production is held by TSR, which is called TTR (Thai Tested Rubber), and the remainder by Brown Crepe and others.

The Thai Government is taking a great interest in increasing the production of natural rubber, and has made the following production program based on fundamental policies such as the promotion of replanting, improvement of the yield of smallholders, and the acceleration of planting though the development of hitherto undeveloped areas.

(1,000 MT)

	Targets in 1980 Program		Adjusted Targets in 1982
	Trends	Potentials	
1981	637	643	504
1982	688	701	520
1983	750	775	676
1984	832	870	773
1985	907	947	892
1986	979	1,019	977
1987	1,052	1,092	1,052
1988	1,131	1,179	1,132
1989	1,216	1,292	1,222
1990	1,289	1,405	1,290
1995	1,677	2,012	1,744
2000	1,849	2,264	2,119

As mentioned above, the area under cultivation was about 1.5 million hectares in 1979, and the following is a breakdown of this figure:

a. Immature plantations with high-yielding trees: 280,000 ha

b. Mature plantations with high-yielding trees : 400,000 ha
c. Mature plantations with low-yielding trees : 192,000 ha
d. Old plantations : 640,000 ha

The unit yield of natural rubber in Thailand is about 350 kg/ha/year.

II. Production Policies of the Major Producing Countries

1. Malaysia

1.1 New Planting and Replanting Program

In Malaysia, as described previously, a production increase program called the "Dynamic Production Policy" is currently in progress, based on new planting and replanting.

The share held by rubber tree plantations of the total planted area is now 45%, which is planned to be reduced to a level of some 30% in the future to raise the share of other agricultual products. Overall natural rubber production will, however, be increased by the development of high-yielding varieties of trees and replanting. The five-year program for 1981 through 1985 provides for 50,000 ha of new planting and 25,000 to 30,000 ha of replanting every year.

1.2 Measures for Technical Improvement

1.2.1 High-yielding trees of the RRI 600/700/800 series have been planted on a trial basis. In particular, the yield from the RRI 700/800 series averages 3,500 to 4,000 kg/ha/year, which represents some 2,500 kg/ha/year on a commercial basis, and the unit yield is expected to grow in the future by increased planting of trees of the RRI 700/800 and PB (another high-yielding variety) series. Expected yields are:

	Present	The year 2000
Estates	1,400 kg/ha/year	2,000 kg/ha/year
Smallholders	1,000 " or less	1,500 "

The yield is calculated on the basis of areas where tapping is currently performed, without the inclusion of immature areas.

1.2.2 Stimulants, such as esters, are used by nearly 80% of the estates but only by 5% or less of the smallholders. In the future, for smallholders in particular, stimulants are recommended to be used from the 11th or 12th year after the commencement of tapping.

1.2.3 SMR-GP

SMR-GP is a newly-developed SMR having three main features: uniformity of product, constant viscosity and a cost lower than that of other viscosity stabilized SMRs such as CV. SMR-GP consists of 60% latex grade (latex or USS) and 40% fresh cuplump.

The Mooney viscosity value is 58 to 72 units and such stability of viscosity permits a shortened process to be employed in the factory.

SMR GP was introduced in 1979, but only a few cases of adoption have been reported so far.

1.3 Measures for Export Promotion

As a link in the chain of policies for the promotion of exports, the government adjusts and revises the export duty. The trading price of natural rubber is decided on the basis of the international market price, so that the net receipts of an exporter are the trading price minus the export tax. When the market price is low, therefore, the net receipts of the exporter fall, resulting in a decrease of the net receipts of the farmer as well. Accordingly, the government practices a policy to offset declines in the net incomes of the exporter and the farmer by providing an exemption of export duty or by adjusting and revising the export duty and the base price, with the aim of lightening the tax burden.

Examples of the criteria and rates of export duty are as follows.

1.3.1 From Aug. 9, 1981 through Oct. 31, 1982

M¢ 154 or below: Nil
154.01 - 165: 20% (M¢ 165-154) x 0.20 = M¢ 2.20/kg
165.01 - 176: 25% (M¢ 176-165) x 0.25 = M¢ 2.75/kg
176.01 - 187: 30% (M¢ 187-176) x 0.30 = M¢ 3.30/kg
187.01 - 198: 35% (M¢ 198-187) x 0.35 = M¢ 3.85/kg
198.01 - 209: 40% (M¢ 209-198) x 0.40 = M¢ 4.40/kg
209.01 - 220: 45% (M¢ 220-209) x 0.45 = M¢ 4.95/kg
220.01 or higher: 50%

For example, when the contract price is M¢ 195:
M¢ 2.2 + 2.75 + 3.30 + (M¢ 195-187) x 0.35 = M¢ 11.05/kg

The base for the calculation of export duty was, however, adjusted by classifying natural rubber into the following groups depending on type:

- First Group : Based on the price of RSS-1.
  Objects: RSS-1 and -2, SMR-CV, -LV, -L and -WF, ADS latex in masterbatch form, and other premium varieties of rubber.

- Second Group: Based on the price of RSS-3.
  Objects: RSS types other than those in the First Group above.

- Third Group : Based on the price of SMR 20.
  Objects: All SMRs other than those in the First Group.

Research Cess	M¢ 3.85/kg	M¢ 13.77/kg in total
Replanting Cess	M¢ 9.92/kg	

1.3.2 On and after Nov. 1st, 1982

M¢ 170 or below: Nil
170.01-181: 20% (M¢ 181-170) x 0.20 = M¢ 2.20/kg
181.01-192: 25% (M¢ 192-181) x 0.25 = M¢ 2.75/kg
192.01-203: 30% (M¢ 203-192) x 0.30 = M¢ 3.30/kg
203.01-214: 35% (M¢ 214-203) x 0.35 = M¢ 3.85/kg
214.01-225: 40% (M¢ 225-214) x 0.40 = M¢ 4.40/kg
225.01-236: 45% (M¢ 236-225) x 0.45 = M¢ 4.95/kg
236.01 or higher: 50%

For example, when the contract price is M¢ 195:
M¢ 2.2 + 2.75 + (M¢ 195-192) x 0.30 = M¢ 5.85/kg

This figure is less than that based on the former criteria by M¢ 5.2/kg.

The research cess and replanting cess remain unchanged.

2. Indonesia

2.1 Measures for the Promotion of Production

The Third Five-Year Program (FYDP III) which began in 1979 pays great attention to increasing production levels and to raising the unit yield, especially for smallholders. The program is being carried out by means of two development systems: PMU, Project Management Units (UPP in Indonesian), and NES, Nuclear Estates for Smallholders (PIR in Indonesian).

The main activity of PMU is to guide smallholders in the replanting and rejuvenation of plantations where cultivation is being performed. There are two types of such plantations, the Major Unit (10,000 ha/unit) and the Minor Unit (2,500 ha/unit), and 136 units have been completed, which are planned to be increased to 321 units by the end of the Fourth Five-Year Program.

NES is a system in which core estates provide guidance regarding new planting in virgin areas and provide a variety of other technical guidance to improve the level of production of the smallholders. Latex and cup-lump from the smallholders are processed by the central estates and sold through the Joint Marketing Organization (JMO). Under the NES system, the net receipts of the smallholders are expected to increase to some 70% of the FOB price (The present net receipts of smallholders stand at only around 40% of the FOB price, because of the exploitation of intermediary margins due to the intervention of cargo collectors and traders, and because of relatively high processing costs arising from widely dispersed and obsolete facilities).

The main product handled by the NES system is RSS (60-70%), and the seven NES systems currently existing will be increased to ten in the future.

For replanting and new planting, there is a system though which a long-term (17-year) loan can be obtained from the Government, for which the interest rate is 6% per year for the first three years and 10.5% per year for the remaining years.

2.2 Measures for Technical Improvement

There is no newly-developed product as such, similar to GP in Malaysia. The basic concept for production is to supply products with the market in mind to meet the requirement of users, and the production ratio between RSS and SIR will be held at the present level.

The application of stimulants to trees aged 10 to 15 years from the commencement of tapping is recommended.

The yield of smallholders is 300 to 350 kg/ha/year, and that of estates is 650 to 700 kg/ha/year at present, which will be raised to 1,200 and 1,500 to 2,000 kg/ha/year respectively within 15 years.

Training courses and the supply of skilled labor are available for technical improvements. A 20-year credit system is provided for rejuvenation, rehabilitation and intensification, also.

2.3 Measures for Export Promotion

2.3.1 Repeal of the Export Duty (beginning of 1980)

2.3.2 Export Prepayment System from Banks

After the conclusion of an export contract, the exporter can be prepaid several percentage of the contracted amount of money from a bank, on the basis of an Export Certificate which is granted from the Department of Trade and Cooperative, upon submission of the contract.

3. Thailand

3.1 Policies for the Promotion of Production

The basic policy for natural rubber production in Thailand is a growth in production to meet worldwide demand, with the aim of becoming the second-largest producing country in the world next to Malaysia in the future. For this purpose, the following measures are being promoted.

3.1.1 Acceleration of Replanting

Replanting is carried out on 3.3% (about 50,000 ha) of the total planted area every year.

3.1.2 Improvement of Yield of Smallholders

The yield is improved by the use of stimulants for older

trees and by the replacement of old trees with high-yielding varieties.

3.1.3 Promotion of New Planting through Development of Virgin Areas

a) Development of new plantations around existing ones
b) Studies and experiments on the feasibility of planting rubber trees in virgin areas of north-eastern Thailand
c) Diversification from other agricultural products such as cassava

The concrete measures being taken are:

a) Technical guidance regarding tapping and in other fields by the Rubber Research Center (RRC)
b) Finaicial support for smallholders
c) Subsidies for diversification from other agricultural products

There is also a program to establish processing centers similar to MARDEC and RISDA in Malaysia and NES in Indonesia.

3.2 Technical Improvement

The focus is to raise the yield of smallholders, aiming at 1,250 kg/ha/year for presently-planted areas and 900 to 950 kg/ha/year for newly-developed areas, in the eastern and north-eastern regions.

3.3 Measures for Export Promotion

3.3.1 Export Duty

The export duty and replanting cess are levied according to the following formula, with a special tax exemption measure (Baht 1.7-2/kg) in effect since July 1981, in which Baht 1.7~2/kg) is deducted from the export duty.

The export duties and replanting cess are calculated twice a month depending on fluctuations in the standard price, covering the periods from the 1st to the 15th, and from the 16th to the final day of the month.

• Examples from the period Nov. 1 to 15, 1982 are:

		(BHT/kg)
RSS:		
(14.15 - 5.80) x 0.40 - 2 =		1.34 ------ (i)
		0.915 ------ (ii)
	Total	2.255
TTR:		
(14.15 - 6.33) x 0.40 - 2 =		1.328 ------ (i)
		0.915 ------ (ii)
	Total	2.243
CREPES:		
(12.03 - 4.92) x 0.40 - 2 =		1.144 ------ (i)
		0.703 ------ (ii)
	Total	1.847

in which
(i) is the export duty, and
(ii) is the replanting cess.

3.3.2 Loans to Packers

An exporter, on the basis of an export contract, can borrow the entire contracted amount of money at an interest rate of 7% per year three months before the date of shipment, provided that the loan must be repaid within three months after the shipment date.

III. Production Costs

Recent production costs, especially in Malaysia, have been increasing steeply accompanying the rise in labor costs.

An example of changes in the production costs for a large Malaysian estate is given below.

• Area of estate (for natural rubber) 10,000 ha
• Amount of production 14,000 - 15,000 tons/year
(RSS-1 12,000 - 13,000 tons)
(SMR-20 2,000 - 2,500 tons)

• Production costs (M¢/kg)

	1978	1981
Variable Costs		
Upkeep & Cultivation	7.79	10.28
Tapping & Collection	60.97	79.78
Total	(68.76)	(90.06)

Indirect Fixed Costs		
Management	11.57	13.57
Fees, Rent, Insurance	2.72	2.57
Labor Welfare	5.13	5.88
Others	5.67	5.84
Total	(25.09)	(27.86)
Processing Costs		
Direct Costs	13.70	17.21
Research Cess	2.20	3.85
Total	(15.90)	(21.06)
Replanting	(6.44)	(11.77)
Total Cost	116.19	150.75

The above costs do not include export duty.

For the total cost, M¢ 150.75/kg in 1981, an analysis of return on investment is as follows:

Average Price RSS-1 (83%)	M¢ 261.32/kg
" SMR-20 (17%)	221.33
Weighted Average	254.52
Export Duty Weighted Average	41.79
Net Selling Price	212.73
Cost/kg	150.75
Net Return/kg	61.98
Production (kg)	15,437
Net Return (M$1,000)	9,568
*Investment (")	151,000
Return on Investment	6.33%

* Investment 11,006 hectares @ M$13,700/ha = M$150,782,000

(Source: Tan Sri DR. B. C. Sekhar, Briefing Notes on the Rubber Industry)

The following figures provide an estimate of return on investment on the basis of the 1981 production cost, M¢150.75/kg, and the market price of November 1982.

RSS-1 Price	M¢ 192/kg
SMR-20 "	170
Weighted Average	188.26
Export Duty Weighted Average	4.10
Net Selling Price	184.16
Cost/kg	150.75
Net Return	33.41

Production (kg)	15,437
Net Return (M$1,000)	5,158
Investment (")	151,000
Return on Investment	3.42%

According to the source quoted above, the production cost for smallholders in Malaysia is reported as M¢158.5/kg in 1981.

The production cost of RSS-3 in Thailand as of November 1982 can be estimated as follows.

Unsmoked Sheet	BHT 13.80/kg
Cost of Smoking	0.30
Transportation	0.35
Insurance	0.02
Interest	0.15
Management Costs	0.18
Replanting Cess	0.92
Export Duty	1.34
Profit	0.98
Total	18.04
	(US¢78.4/kg)

IV. Possible Effect of the Use of Stimulant on Natural Rubber Supply Flexibility

1. Ethrel Stimulation

a. The development of a stimulant generally known as "Ethrel" has had an important impact on natural rubber production. Stimulation by Ethrel, a 2-chloroethyl phosphoric acid, improves the yield of natural rubber by 50 to 80%.

This increasingly popular technique was introduced at the beginning of the 1970s and is now recommended by the governments of many producing countries.

b. In Malaysia, the technique is used on 80% of all rubber trees in the estate sector which have been tapped for over 15 years, but only for 5% or less of the same trees in the small holder sector.

In Indonesia, as well, it is used widely in the estate sector but only on a small scale in the small holder sector.

In Thailand, the technique has just begun to come into use.

c. There are two methods of stimulation: the direct application of the 2-4% concentration of Ethrel mixed with palm oil and grease to the tapping panel from which tree-lace was removed; and the application of Ethrel to a spot of a few centimeters below the tapping cut where the epidermis is removed.

The frequency of application may be anywhere from once a month to twice a year, depending on the concentration of Ethrel used, and the methods of the particular estate.

d. Selection of rubber trees is important in the application of the stimulant. As a rule, the stimulant is applied only to rubber trees 10 to 15 years after their first tapping. It is not generally applied to young trees because it could reduce their longevity. In Thailand, its use is held off until five years prior to cutting.

2. Effect on Supply Flexibility

As Ethrel stimulation is designed to improve productivity and reduce costs, it seems to be difficult to use stimulant for supply adjustment.

In addition, while the application of the stimulant to young trees increases short-term production, it reduces their longevity, thus necessitating earlier replanting. It is therefore unfavorable from the view of long-term management.

When production reduction is necessary due to the market conditions, reducing tapping areas which means a reduction of tapping and collection costs is more efficient than suspending the use of the stimulant (However, the reverse may be the case, depending on the tappers' wage system and contract provisions such as profit sharing between the tapper and the estate).

V. Past and Future Trends in Synthetic Rubber Production

1. Production of Synthetic Rubber

As described in the foregoing chapter, the development of synthetic rubber was stimulated during World War II, and production and consumption have grown rapidly since then.

The amount of production grew from 3,795,000 tons in 1965 to a

peak of 9,330,000 tons in 1979, about 2.5 times the former level over a 15-year period, while natural rubber showed a growth of 1.6 times in the same period. The share of synthetic rubber of total consumption of new rubber rose from 60% in 1965 to 70% in 1979. Unlike natural rubber, the major consuming countries of synthetic rubber are also the major producing countries, and the shares held by these countries of world production in 1981 were 26% for the United States, 19% for the EC countries and 12% for Japan, the combined share of these three regions accounting for a little less than 60% of the world total.

In terms of the production ratios according to type, the general-purpose grades SBR, BR and IR held 47%, 17% and 3% shares of production respectively, amounting to 67% of worldwide synthetic rubber production.

Volume of production by countries is listed in Table B-2, with further details given in Appendix Table 5.

Table B-2 Production of Synthetic Rubber

(1,000 MT)

	1965	1970	1975	1979	1980	1981
USA	1,842	2,232	1,990	2,720	2,241	2,248
Canada	206	205	173	283	253	263
UK	175	306	261	278	212	190
France	148	316	350	541	511	487
W. Germany	164	302	316	418	390	397
Italy	120	155	200	270	250	235
Australia	21	33	38	43	46	43
Japan	161	698	789	1,107	1,094	1,010
Brazil	39	75	109	224	249	223
Rest of the world	918	1,553	2,627	3,445	3,426	3,397
World total	3,795	5,875	6,850	9,330	8,670	8,490
Index	100	155	181	246	228	224

Source: IRSG, Rubber Statistical Bulletin

2. Future Trends for Synthetic Rubber

Synthetic rubber marked a sharp growth during the 1960s and 1970s, but the trend has changed over the past several years, with the share held by synthetic rubber of worldwide rubber consumption remaining stable or declining. One reason is a rise in the price of synthetic rubber caused by increased oil prices, and another factor

is that the popularity of radial tires has boosted the consumption of natural rubber. It is considered that this trend will continue in the future.

In addition to the share of consumption, growth in total consumption itself is expected to slacken, due to a reduction in the size of tires coupled with their increased life-span. The situation of synthetic rubber in the major regions is given below.

In the United States, parallel with the automobile industry, the tire industry has fallen into a severe slump, which has dealt the synthetic rubber industry a strong blow. As a result, some leading manufacturers have retreated from the production of synthetic rubber; American Synthetic Rubber has ceased production of SBR, Firestone has given up its emulsion-SBR business, and B.F. Goodrich has pulled out of IR production and sold off its BR and EPDM Divisions to Polysar in Canada. Under such conditions, Polysar is making strong advances in the development of its synthetic rubber business. In addition to the above-mentioned acquisition from B.F. Goodrich, the company is constructing a new plant of 45,000 tons annual capacity in Canada and has purchased IIR-manufacturing equipment from Cities Service Co. in the United States.

The synthetic rubber industry in Europe is currently in more severe circumstances than that in the United States, because the decline in demand has been aggravated by a large quantity of imports from regions such as Eastern Europe and South America. Therefore, a restructuring of the industry is now under way, with Enoxy, a joint venture between the Italian Government and Occidental Oil Company of the United States, at the center of the program. Thus Enoxy has achieved the top position in the industry by purchasing SIR, ANIC and ISR, and Bayer has acquired Firestone's plants (Solution SBR and BR) in France.

In Japan, the consumption of synthetic rubber is in a declining trend after reaching a peak in 1980. The problem in Japan is the strained supply-demand relationship of the raw material butadiene, which is affected by the reduction of ethylene production, so that synthetic rubber manufacturers are forced to scale down operation due to both declining demand and the restricted supply of the raw material.

The following figures, compiled from material published by IISRP (International Institute of Synthetic Rubber Producers), shows the average operating ratios of the various types of synthetic rubber plants in the world (with the exception of CPEC) in 1981.

SBR	53.2%	CR	72.1%
BR	70.6%	EPDM	73.3%
IR	42.3%	IIR	79.0%

C. CONSUMPTION

I. World Rubber Consumption

The world consumption of natural rubber in 1981 was 3.7 million tons. This is 4.4% less than the previous peak of consumption, 3.87 million tons in 1979. The consumption of synthetic rubber in 1981 was 8.435 million tons, 7.6% less than the peak of consumption in the past, which was 9.125 million tons in 1979.

The world consumption of new rubber including natural and synthetic rubber was 12.135 million tons in 1981, 6.6% less than in 1979.

Both synthetic rubber and new rubber were consumed less in 1981 than in 1977, and only the consumption of natural rubber was slightly higher (1%) in 1981 than in 1977.

A remarkable decrease in rubber consumption was seen in the United States, where new rubber consumption was 2.657 million tons in 1981, a large drop of 23% from 3.447 million tons in 1977, although it exceeded the figure for consumption in 1980, which registered 2.565 million tons.

This was caused by the decrease in automobile production, longer tire life achieved by adoption of the radial tire, shorter traveling distances caused by higher gasoline prices, smaller tire sizes due to downsizing of cars, etc. This is illustrated by the fact that the number of replaced tires per passenger car decreased from 1.28/car in 1977 to 0.98/car in 1980, and this trend is likely to continue.

The consumption of natural rubber has gradually decreased as the consumption of synthetic rubber has increased. For example, in 1965, natural rubber accounted for about 40% of new rubber consumption, but in 1979, the share decreased to less than 30%. Since 1976, however, it has been rather steady at about 30%.

Table C-1 and Appendix Tables 6 and 7 show the consumption of natural rubber, synthetic rubber and total new rubber, and the percentage share of synthetic rubber.

Table C-1 Trends in New Rubber Consumption

(1,000 MT)

		1965	1970	1975	1979	1980	1981
USA	Natural	523	568	666	740	585	635
	Synthetic	1,565	1,949	1,964	2,501	1,980	2,022
	Total	2,088	2,517	2,630	3,241	2,565	2,657
Canada	Natural	43	51	72	94	80	82
	Synthetic	98	135	180	232	200	210
	Total	141	186	252	326	280	292
UK	Natural	187	188	171	138	131	120
	Synthetic	183	274	266	301	248	220
	Total	370	462	437	439	379	340
France	Natural	123	158	156	177	188	167
	Synthetic	154	261	278	318	322	293
	Total	277	419	434	495	510	460
Germany, FR	Natural	158	201	197	185	180	169
	Synthetic	209	358	360	447	421	396
	Total	367	559	557	632	601	565
Italy	Natural	87	113	118	128	132	123
	Synthetic	113	197	220	285	288	265
	Total	200	310	338	413	420	388
Australia	Natural	39	40	50	45	42	42
	Synthetic	41	54	50	51	59	58
	Total	80	94	100	96	101	100
Japan	Natural	202	283	285	390	427	436
	Synthetic	176	496	585	830	885	851
	Total	378	779	870	1,220	1,312	1,287
Brazil	Natural	27	37	59	76	81	74
	Synthetic	38	85	176	225	244	202
	Total	65	122	235	301	325	276
Others	Natural	1,059	1,354	1,594	1,897	1,914	1,852
	Synthetic	1,163	1,816	2,948	3,935	4,038	3,918
	Total	2,222	3,170	4,542	5,832	5,952	5,770
World total	Natural	2,448	2,993	3,368	3,870	3,760	3,700
	Synthetic	3,740	5,625	7,027	9,125	8,685	8,435
	Total	6,188	8,618	10,395	12,995	12,445	12,135
	(Ratio of synthetic to total)	(60.4)	(65.3)	(67.6)	(70.2)	(69.8)	(69.5)
Index	Natural	100	122	138	158	154	151
	Synthetic	100	150	188	244	232	226
	Total	100	139	168	210	201	196

Source: IRSG

II. Consumption by Use in Main Consuming Countries

The applications of natural rubber are roughly divided into tires and tire products, and non-tire products (belts, hoses, footwear, etc.).

In the main consuming countries, most of the natural rubber is used for tires and tire products.

For example, in 1981, the United States used 470,000 tons (74%) of the total consumption (635,000 tons) of natural rubber for the production of tires and tire products.

The Table C-2 shows the past consumption by use and the percentage share of natural rubber used for tires and tire products against total natural rubber consumption in the main consuming countries.

The share held by natural rubber of total rubber use for tires and tire products shows a rising trend in all the main consuming countries.

For example, in the United States it increased from 24% in 1972 to 30% in 1981, and, in the same period, it increased from 41% to 47% in the United Kingdom, from 41% to 45% in France, from 38% to 44% in the Federal Republic of Germany and from 39% to 42% in Japan. This was caused by the increased production of radial tires (radial tires use more natural rubber than conventional tires) and by the relatively higher price of synthetic rubber due to increased costs.

III. Impact of Technological Innovations on Rubber Consumption

1. Technological Impact

The impact of technological innovations will be discussed focussing on the tire industry, since much of the new rubber consumed is used in the tire industry, and 65% ~ 78% of the consumption of new natural rubber is accounted for by this industry.

The technological progress of the tire industry has been remarkable in the past 20 years, and new technological innovations will continue in the future, accompanying the development of new products and the enhancement of product performance.

Table C-2 Consumption of Natural Rubber by Use (Major Countries)

(1,000 MT)

	1971	1973	1975	1977	1979	1981
USA						
Tire	425	515	497	623	578	470
Non-tire	162	197	169	179	162	165
Total	587	712	666	802	740	635
Share held by Tire	(72.5)	(72.4)	(74.7)	(77.7)	(78.0)	(74.0)
UK						
Tire	102	90	96	96	79	78
Non-tire	83	97	75	67	59	42
Total	185	187	171	163	138	120
Share held by Tire	(55.0)	(48.0)	(56.2)	(58.8)	(57.5)	(65.0)
France						
Tire	116	120	118	130	146	138
Non-tire	43	42	38	34	31	29
Total	159	162	156	164	177	167
Share held by Tire	(73.2)	(73.7)	(75.8)	(79.5)	(82.4)	(82.8)
Germany, FR						
Tire	106	107	106	121	122	110
Non-tire	92	99	91	56	63	59
Total	198	206	197	177	185	169
Share held by Tire	(53.6)	(52.0)	(53.9)	(68.5)	(65.9)	(64.9)
Japan						
Tire	166	217	197	223	290	336
Non-tire	129	118	88	97	100	100
Total	295	335	285	320	390	436
Share held by Tire	(56.2)	(64.8)	(69.1)	(69.7)	(74.4)	(77.1)

Source: IRSG

Of the technological innovations in the tire industry over the past 20 years, the main items which have affected the state of rubber technology are as follows: The development of radial tires, low profile tires, durability, wear resistance, high speed durability, driving performance at high speed, higher performance on wet road, all-weatherability, studless technology, fuel efficiency, etc.

It is difficult to predict the future major technological inno-

vations which will affect the tire industry, but if the present state of tire technology, future government regulations, new car trends, etc. are taken into consideration, all-round performance enhancement including higher fuel efficiency, lower noise level, economy and safety will be strongly required. Furthermore, the radial tire and low profile tire will be increasingly used worldwide for passenger cars, trucks and buses.

In addition, the radial construction will be increasingly adopted for other tire categories; i.e., in the small tire groups, the tires for light trucks and motorcycles and the pillow type will be changed to the radial construction, and in the large tire groups, the tires for agricultural machinery, aircraft and construction equipment will be increasingly of the radial construction also.

Therefore, an explanation of the radial tire is given below.

2. Features of the Radial Tire

A brief explanation is given here of the radial tire, which greatly affects the consumption of new rubber and is expected to expand both in regard to the markets and the tire categories in which it is used.

The radial tire is highly superior to the conventional tire (bias tire) which has so far been widely used, in both high-speed driving performance and service life, and it is quite different in terms of tire construction and rubber compound used from the conventional tire. In the past 20 to 30 years, the transportation of goods and the traveling styles of passengers and drivers have changed towards higher speeds and longer distances, and emphasis is increasingly being placed on safety and economy. In such a transition, the radial tire has been widely disseminated as the most suitable tire. The cords of the conventional tire are placed diagonally to the rotating surface of the tire, whereas those of the radial tire (carcass) are placed radially at right angles to the rotating surface, and to hold these radial carcass cords in place, hoop-like "belts" are used in the rotating direction of the tire tread. A large amount of the tension is supported by these belts, resulting in a long service life.

3. The Dissemination of Radial Tires

The dissemination of the radial tire by tire category and by countries is now examined.

The largest dissemination of the radial tire is seen in the passenger car category, and in regional terms all the European countries achieved a dissemination rate of 90% both in the replacement market (REP market) and new car market (OE market). Japan and the United States show a dissemination rate of about 60 to 80%, and future expansion is expected in these areas.

The dissemination of the radial tire in the truck and bus categories is high (80 to 95%) in Europe, but not so high in other countries. In the replacement market, the dissemination rate in 1981 was 40% for the United States and about 35% for Japan, whereas in the new car market, only a small number of radial tires have been installed at the users' option.

However, the superior features of the radial tire such as economy (long life, retreadability), puncture resistance, and fuel efficiency, which drew great attention after the oil crisis, are being recognized by users, and it is quite certain that the radial tire will be increasingly used worldwide in the future centering on the developed countries with their networks of paved roads.

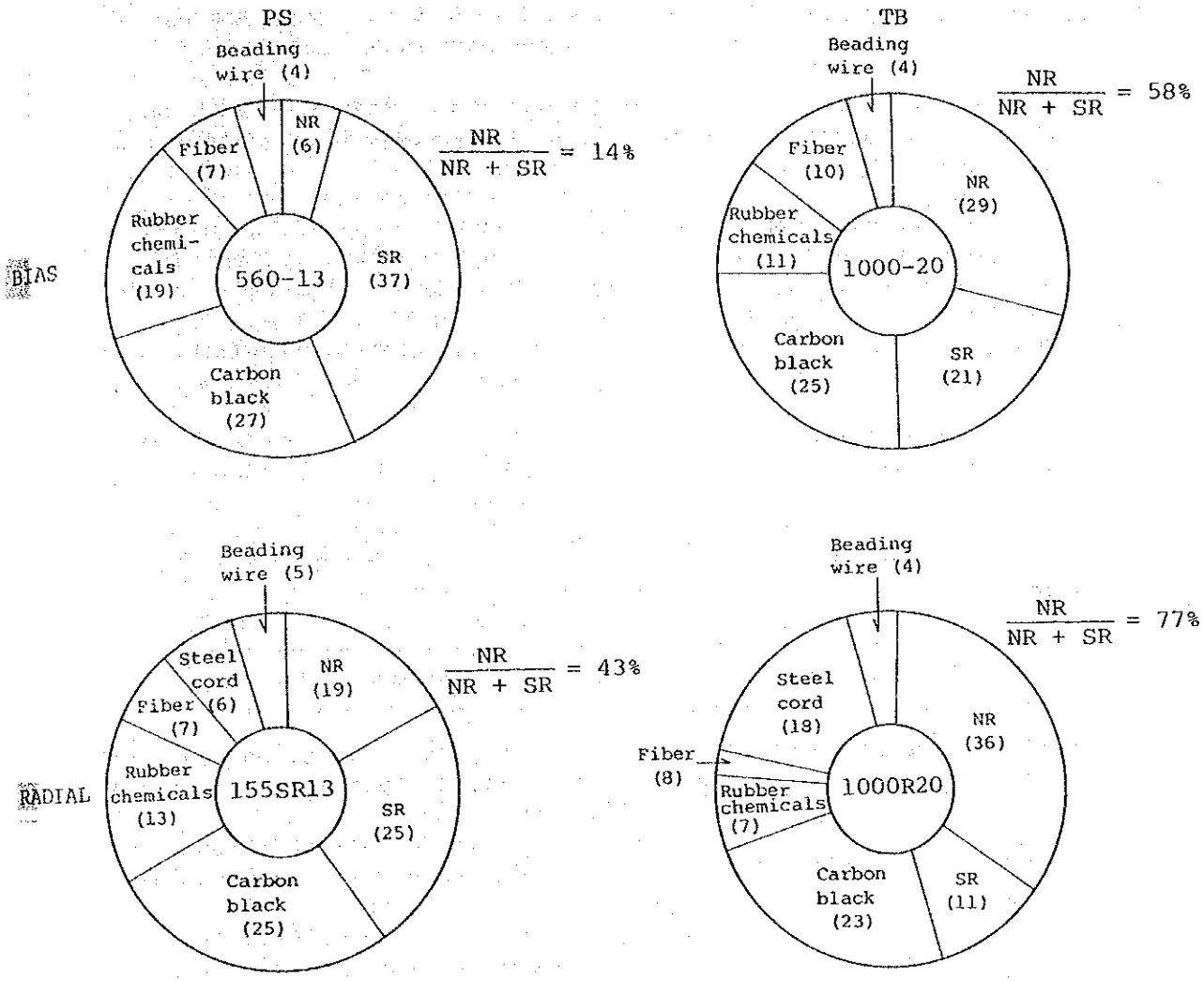
4. Quantity of Rubber Used in Tires

The quantity of rubber by weight used per tire differs greatly depending on the type of tire (category, speed range), using term (summer or winter), shape of tire, constituent materials (textile, steel) and the construction of the tire. This means that the quantity and types of rubber to be used in the future will depend on which type and construction (radial or bias) of tire will increase in use. Fig. C-1 shows the typical weight component ratios of the materials used in bias and radial tires for the passenger car and truck/bus categories.

In the case of the bias tire for passenger cars (PS, BIAS), the quantity of compounded rubber (NR + SR + Carbon + Rubber chemicals) used is 89% by weight and the quantity of new rubber is about 1/2 (43%), whereas natural rubber accounts for 6% of the total weight. However, in the case of the radial tire, the quantity of natural rubber used increases to 19%.

In the case of tires for trucks and buses, the quantity of natural rubber used is 29% of the total weight for bias tires, whereas for radial tires this figure increases to 36%. In other words, more natural rubber is used in the construction of radial tires.

Fig. C-1 Typical Natural Rubber Content of Radial Tires



5. Tire Performance and Limits of Rubber Compounding

In addition to the basic function of supporting the weight of the vehicle, pneumatic tires must fulfill the high performance requirements described in Item 1, Technological Impact above. They require the integration of technologies based on a balance among opposing performance requirements.

For example, performance under wet conditions and fuel efficiency are mutually opposing performance factors; i.e., if wet performance is improved for rainy weather conditions, fuel efficiency decreases, and on the contrary, if the ratio of natural rubber used

is increased to improve fuel efficiency, the wet performance decreases, since in order to secure good performance in wet conditions, it is necessary to use more synthetic rubber (SBR). In practice, the appropriate rubber compounding ratio is used to achieve a balance between these two performance factors.

In addition, to ensure permeability resistance to air, butyl rubber is used on the inner surface of tubeless tires rather than natural rubber.

As mentioned above, the optimum rubber compounding is used for each part of the tire to fulfill the corresponding performance requirements. In other words, there are certain limits to the compounding ratio of natural rubber and synthetic rubber, in order to achieve the optimum compounding of materials based on a balance of the respective performance factors.

The factors affecting the ratio of use of the two basic types of rubber and the factors restricting changes in this ratio are as follows.

Projection of Factors affecting Future Ratios of Use for Natural Rubber

Type of factors	Factors
Factors causing changes in the ratio of use	1. An increase in the use of natural rubber will occur due to increased use of the radial tire. 2. The trend towards fuel efficiency and all-weatherability will increase the use of natural rubber. 3. Higher-speed and low profile and studless tires will result in a decrease in the use of natural rubber. 4. The use of the natural rubber will increase or decrease depending on price competitiveness with synthetic rubber.
Factors impeding changes in the ratio of use	5. The development of a synthetic rubber possessing such properties as to completely replace natural rubber is unlikely. 6. From the performance viewpoint, there is a limit to the increased use of natural rubber. (Examples: Wet skid performance, wear resistance, air permeability resistance, thermal deterioration resistance.)

The present performance balance for each type of tire is the result of users' preferences and of previous performance requirements, and for each tire category (TB, LT, PS, MC, etc.), a different optimum compounding ratio is used to meet the different performance requirements.

It is difficult to predict future technological developments, but there is a clear tendency towards economy, safety, driving and riding comfortability recently in evidence. Furthermore passenger cars and leisure vehicles becoming more fashionable and personalized.

Under these circumstances, the areas which will show changes in the optimum compounding ratio of rubber used in tires will be performance of tire, and the main factors will be the radial tire, the low profile tire, higher fuel efficiency, lower noise level and lower price.

It is expected in the future that on the basis of this balance of performances, the optimum compounding, i.e., the ratio of use of natural rubber to synthetic rubber, will undergo changes.

From the viewpoint of compounding techniques, the percentage range of the use of natural rubber is as follows.

Range of Variation in the Ratio of Use of Natural Rubber to Synthetic Rubber

(%)

		Percentage of natural rubber used		
		Min.	Present	Max.
Truck/bus	Radial	65	77	80
	Bias	50	58	75
Passenger car	Radial	35	43	50
	Bias	10	14	30

It can be seen from the above Table that if tire construction changes from bias to radial types, the use of natural rubber will increase by 19% for truck/bus tires and by 29% for passenger car tires.

However, it is considered that the present ratio of use of natural rubber for radial tires has almost reached its limit, with only a 3% allowance to the maximum value for truck/bus tires and 7% for passenger car tires. A higher ratio of natural rubber may disturb the balance of performance of the tire.

For the bias tire, the ratio of use of natural rubber has a greater allowance to the maximum value.

The balance of performance of a tire is greatly affected by the factors of service conditions. In particular, the driving speed, load weight, road conditons and climate exert a great influence on performance. Therefore, the maximum and minimum values shown above have been determined taking tire categories and service conditions into consideration.

6. Effect of Price Differences between Natural Rubber and Synthetic Rubber on Ratio of Use

Since the ratio of natural rubber to synthetic rubber used in tires is determined by the balance of performance factors and the optimum compounding ratio, it is expected that the ratio will not be affected greatly due to variations in the price differential, but will be maintained within certain limits. This fact is illustrated by the case of Japan. Fig. C-2 shows the price differential in percentage form between the synthetic rubber SBR 1500 and the natural rubber Tokyo Regular #3, with the price of the former being taken as 100.

Since 1962, the price of natural rubber has fallen below that of synthetic rubber four times, in 1967 to 1968, 1971 to 1972, 1974 to 1976 and 1980 to 1982, and the difference has gradually increased in size.

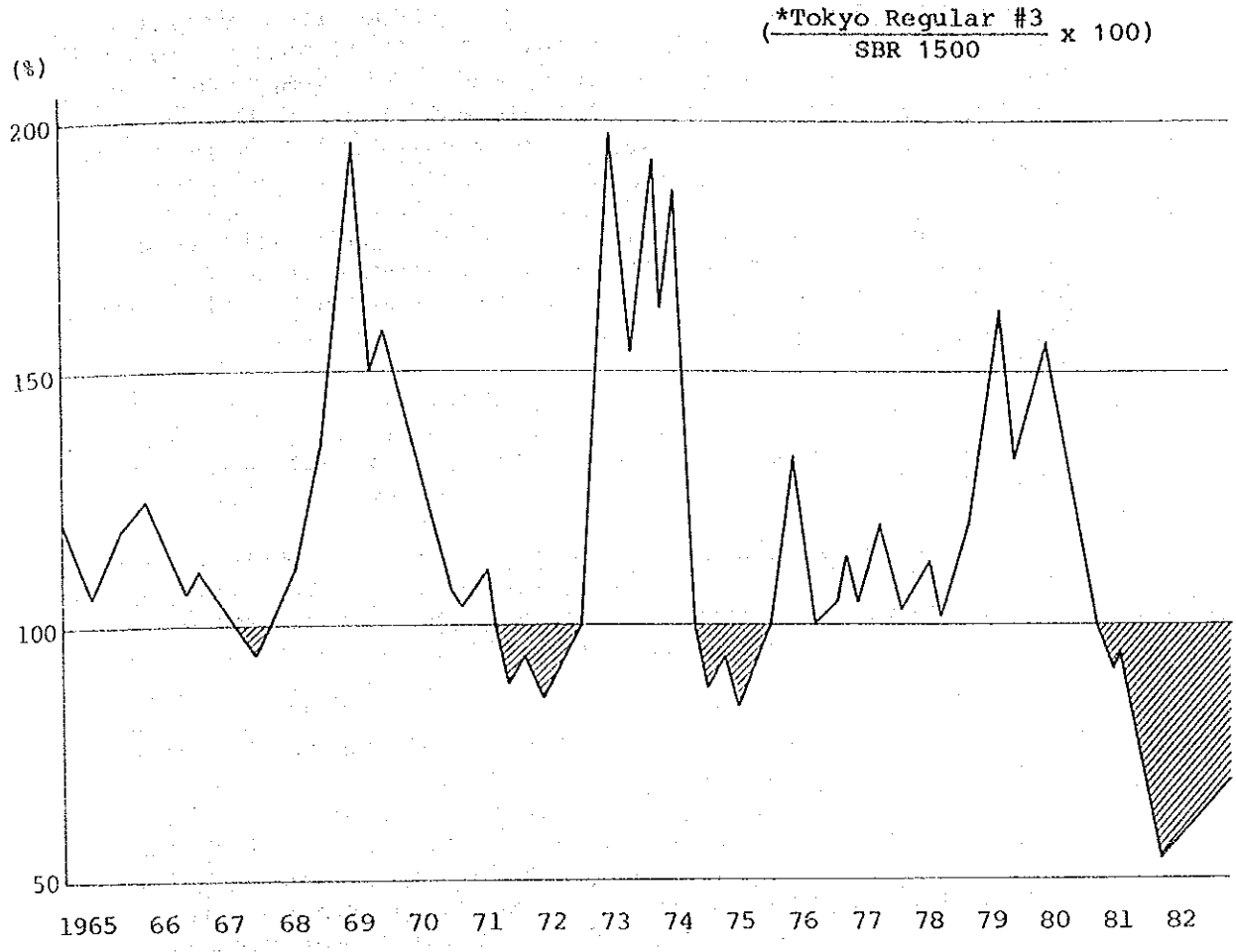
The ratio of use of natural rubber by Japanese tire manufacturers has changed as follows.

Price Ratio and Use Ratio of Natural Rubber to Synthetic Rubber

		'74	'75	'76	'77	'78	'79	'80	'81	'82
Price ratio $\frac{\text{Tokyo \#3(*)}}{\text{SBR 1500(*)}} \times 100\%$	Average Trend	+20	-15	≈ 0	+5	+7	+40	+30	-15	-40
		↘	↗	↷	→	↗	↑	↘	↘	→
Ratio of use $\frac{\text{NR}}{\text{NR + SR}} \times 100\%$		-	35.8	35.6	35.7	37.4	38.7	39.0	41.5	43.3

(* Tokyo regular price: market price + delivery charges;
SBR 1500: open market quotation)

Fig. C-2 Price Ratio of Natural Rubber to Synthetic Rubber



*Tokyo regular price: market price + delivery charges;
SBR 1500: open market quotation

Note: Trends shown in this Figure is not comparable to the previous table. Although the previous table indicates annual average of price ratio, this figure shows peak and trough of price ratio.

The ratio of use of natural rubber by Japanese tire manufacturers since 1975 has shown a gradual increase regardless of changes in the price differential. From 1977 to 1980, the price of natural rubber increased sharply but the use of natural rubber did not decrease, rather showing a rising trend. This means that the use of natural rubber is increasing as the use of the radial tire increases for the domestic new cars and replacement market and for the export market.

Therefore, in forecasting the use of natural rubber, it is necessary to consider the limits on the balance of performance factors and the dissemination of radial tyres in the market by tire category and region.

7. Present Situation and Future Prospects for Guayule

7.1 Guayule (scientific name: Parthenium argentatum A. Gray) grows naturally in dry areas of Mexico and Texas, and produces a rubber possessing virtually the same chemical and physical properties as the rubber tree (Hevea brasiliensis) cultivated in Southeast Asia.

In 1910, guayule held a 10% share of the world natural rubber supply and for more than 40 years it was one of the sources of supply for commercial natural rubber. However, after World War II, the cultivation of guayule was discontinued. The reason for this is that Southeast Asia became able to provide a sufficient and stable supply of Hevea rubber to the consuming areas, and the advent of synthetic rubber made it virtually unnecessary to seek other supply sources for natural rubber. However, the situation has gradually changed, and at present the following conditions exist:

a. Despite the progress of synthetic rubber, the demand for natural rubber is continuously increasing, with natural rubber prossessing the physical properties required in many areas of use such as truck, bus and aircraft tires.

b. The problems of increased price and supply difficulties for petroleum, the main source of hydrocarbons, has reduced the competitiveness of synthetic rubber, a petrochemical product, and renewed attention is being paid to trees for the production of natural rubber.

c. The Hevea rubber tree can only be cultivated in a limited number of tropical regions. Any changes, political, economic or ecological, in these regions will endanger the supply of natural rubber.

d. As the world population increases, it has become necessary to effectively utilize and economically develop marginal land, especially the rain-sparse dry regions.

Such being the situation, although the present economic environment is quite different from that existing when guayule rubber was last produced on a commercial basis, the cultivation of guayule will only be viable when present commercial requirements are met by improvements in the quality of the rubber and in cultivation techniques.

7.2 Present Situation of Guayule Rubber

Research and development for the commercialization of guayule rubber are promoted mainly by government agencies granting subsidies to the private sector in the following countries or regions.

a. USA (California, Arizona, New Mexico, Texas)
b. Mexico
c. Australia (New South Wales)
d. South Africa
e. West African countries
f. Israel

The development objectives differ in content from country to country, but the following are included:

a. Effective utilization and economic development of rain-sparse dry regions;

b. Product substitution for synthetic rubber produced from petroleum;

c. From the viewpoints of strategy, national defense and the conservation of foreign currencies, the establishment of domestic supply sources for natural rubber currently being imported.

The progress made by each country is examined below. However, it should be noted that commercial production has not yet been realized.

7.2.1 Mexico

During World War II, Mexico produced rubber from the wild guayule tree, and a pilot plant (annual production: about 20 tons), the only one in the world, was established for the production of rubber from this source. This rubber was used in the production of tires by Goodyear, Goodrich, Firestone and

Michelin, which were tested and appraised as being of the same quality as tires made from Hevea rubber.

In 1981 the operation of the pilot plant was discontinued, and the Government has budgeted funds for the construction of a full-fledged commercial plant which is scheduled to produce 5,000 tons per year.

7.2.2 The United States

Emphasis has been placed on the improvement of plants and on research in agricultural technology for the efficient cultivation of guayule trees with a higher rubber content. Experimental farms have been established at eleven locations in California. An estimated cost calculation for guayule rubber is as follows:

- Total cultivated area: 100,000 acres
  If a 4-year cycle is used, the area under active cultivation will be 25,000 acres annually.
- Rubber extracted: 2,000 lbs/acre/year
- Annual production: 50 million lbs
- Initial capital investment required: 70 million dollars
  (land, cultivation-related facilities, extracting factory)
- Operating cost: 57.2 cents/lb
- Estimated by-product profit: 28.3 cents/lb
- Total: 28.9 cents/lb
  If the interest rate on the funds required for investment is taken as 5%, 7 cents/lb will be added to the cost, giving a total cost of 37.9 cents/lb.

The above estimates were computed by the Firestone Tire & Rubber Co.

7.2.3 Australia

The "Three-Year Plan for Guayule Research and Development" was established by the NSW Ministry of Agriculture in 1980. Seeds introduced from the United States were planted in four experimental farms, and the improvement of plants and the development of cultivation techniques suitable for the conditions in this state are now under way.

7.3 The Future of Guayule

The commercial production of guayule is related not only to agricultural technology and extraction techniques but is also affected by economic, social and political factors. In other words, investment conditions, the utilization of arid regions, trends of Hevea natural rubber and synthetic rubber and the necessity of storing strategic materials must all be taken into consideration. Opinions differ regarding future prospects, but it is expected that guayule rubber will hold a share of the natural rubber market in the near future, sometime after 1985. This is due to the fact that, even if it is not competitive in price with Hevea rubber, research and development on guayule rubber will result in such advantages as the stabilization of price and supply, strategic security and the merits of agricultural administration, if natural rubber is produced and supplied in the consuming countries.

IV. TSR (Technically Specified Rubber)

As stated previously, TSR is a new type of natural rubber for which research began in the early 1960s. The method of production and specifications were established by Malaysia in 1965.

This product has the following special features:

a. The grading of rubber, which was previously carried out by visual inspection, can be now effected by mechanical means.

b. Transportation, storage and handling can be efficiently done by packing into lots of 33.33 kg/bale (111.11 kg/bale for RSS and 100 kg/bale for Crepes) and palletizing.

c. The required mastication time has been shortened.

d. It is now possible for the producer to effectively use scrap such as cuplump and tree lace, which could previously only be used for the Crepe type, resulting in a higher added value.

Since this product provides advantages for both users and producers, its production and applications have been rapidly expanding.

Appendix Table 9 shows the specifications of SMR.

The ratio of TSR production in the main producing countries is 41% for Malaysia, 65% for Indonesia and 15% for Thailand. As above Indonesia is most advanced in producing TSR, and Thailand is very slow.

This is because the United States, which is the main importer of natural rubber from Indonesia, has a high ratio of use of TSR, whereas in the case of Thailand, where there are traditionally many smallholders and the production of USS is high, Japan, the largest importer from Thailand, has a low ratio of use of TSR.

The share held by TSR production of total world natural rubber production is considered to be about 40%.

The highest ratio of use of TSR is registered by the United States, at 73% in 1981, while Japan has the lowest ratio of use, at only 19%.

The European countries show levels of between 30 and 60%. The differences in the ratio of use of TSR among the United States, Europe and Japan are caused by differences in appraising the total cost merits of TSR among the tire manufacturers in these countries, and also differences in the criteria for selection based on different appraisals of the properties of TSR and RSS (Appendix Table 10).

V. Import Policies

1. Import Duty

The import duty for natural rubber is zero in the major consuming countries such as the United States, the EC countries, Japan, China and the USSR, and this is true for most of the other consuming countries except Brazil, which is a producer as well as an importer, and which levies an import duty of 30%.

2. Inventories

For natural rubber, the producing countries (mainly in Southeast Asia) and consuming countries (the United States, the EC countries, Japan, etc.) are divided into two distinct groups. The consuming countries are not generally natural rubber producers and moreover the producing countries and the consuming countries are located geographically distant from each other. Therefore, the consuming countries maintain a reasonable amount of stocks to cope with any radical fluctuations in the supply and demand situation and any unexpected problems, such as changes of government, port workers' strikes, etc.

Total stocks held by the consuming countries fluctuate around a 10-week supply against consumption.

The quantity of stocks varies from country to country and from company to company, due to differences in storage costs and conditions or the existence of speculative factors.

Furthermore, natural rubber may sometimes be stored by government agencies from the standpoint of strategic necessity, one typical example of this being the stockpile maintained by the General Services Administration (GSA) in the United States. This stockpile is huge, and any purchase or discharge by GSA exerts a great effect on the market price of natural rubber.

The United Kingdom, Italy and Australia also maintained strategic stockpiles until the early 1970s.

D. INTERNATIONAL TRADE

I. Trade Structure

The principal characteristic of the international trade in natural rubber is that the main producing countries and consuming countries are distinctly divided. The main producing countries are developing countries mainly situated in Southeast Asia, whereas the main consuming countries are developed countries such as the United States, Europe and Japan. These consuming countries do not produce natural rubber, a very important material for them, and must depend entirely on imports, the only exception to this being China, which produces about 45% of the quantity required for domestic consumption.

Natural rubber can be said to be a typical "export commodity", since about 85 to 90% of production is exported (Appendix Table 11).

Imports of natural rubber by the main consuming countries have remained in the same pattern for several years; e.g., the United States imports most of its requirements, about 50%, from Indonesia; the EC countries import mainly from Malaysia and also from Africa; and Japan predominantly imports from Thailand, about 70 to 80% of its requirements. Appendix Table 12 shows the imports of rubber by the main consuming countries according to producing countries, for the first half of 1982.

II. Structure of International Trade in Natural Rubber

Exchanges influencing the price of natural rubber are located in Singapore and Malaysia, which are the collecting and distribution centers as well as the shipping centers for Southeast Asia, the main producing region.

Exporters in the producing areas consist of:

a. Exporters who have estates and carry out the complete process from tapping to exporting.

b. Exporters who buy the raw material from intermediate collecting agencies and export the product after smoking, sorting and packing.

c. Exporters who perform both of the above roles.

d. Exporters who buy, sell and export only the product packed for export.

Each exporting country controls these traders by enforcing its own registration system. These exporters sell the goods through the rubber exchanges in Singapore and Malaysia, or directly or through their agencies to the overseas spot market by making an offer or accepting a bid.

The selling price is determined for each type, grade, shipping date and destination, considering the supply-demand trend, financial situation and shipping conditions, using as a barometer the quoted price at the rubber exchanges in Singapore and Malaysia.

International trade was carried out on an FOB basis for many years, but due to the collapse of the Freight Conference, a diversification of the destinations and the development of shipping businesses in the producing countries, C&F and CIF terms are also being employed recently.

1. Exchanges in Producing Areas

Exchanges which provide indicators for the price in the producing areas are established in Singapore and Kuala Lumpur. In Singapore, the exchange is called the Rubber Association of Singapore (RAS), which was organized on the basis of the RAS Act of 1967, and consists of ordinary members with voting rights, associate members without voting rights and overseas members. The ordinary members are further divided into the categories of estates' selling agents, brokers, manufacturers' buying agents and dealers.

Transactions are made through the broker members and are divided into guaranteed dealing and non-guaranteed dealing, and further into settlement contracts where clearing is conducted for each change in the market price and non-settlement contracts.

The broker members receive orders from members and also from non-members, i.e., ordinary investors, and conclude the business. The speculative trade engaged in by these ordinary investors plays a large role in the formation of prices for natural rubber and smoothes the seasonal price fluctuations and fluctuations which would be caused by temporary imbalances in supply and demand.

The rubber exchange in Kuala Lumpur is called the Malaysian Rubber Exchange and Licensing Board (MRELB), and was orginally linked with the RAS, but under the MRELB Act of 1974, it commenced

full licensing operations concerning rubber exports as an exchange independent from the RAS. The organization and the trading formats correspond to those of the RAS, and in the area of contracts, it is still linked with the RAS dealing. Major traders are registered with both exchanges as members of one type or another.

2. Exchanges in Consuming Areas

The exchanges in the consuming areas are located in London, New York, Tokyo, etc.

The Tokyo Rubber Exchange is a membership system based on the Commodity Exchange Act, and consists of broker members and members, where broker members receive orders from members or non-members and deal on behalf of other members, while members can only deal on their own account.

Transactions mainly consist of hedge buying and hedge selling against orders from ordinary investors, and the price in most cases reflects the price trend at the exchanges in the producing area, although it may sometimes lead the price in the producing area through sensing the business trend more accurately.

The exchange in London is called The London Rubber Terminal Market Association, and consists of broker members who deal only on behalf of others, dealer members who deal on either their own or other's account, registered trade associate members who are treated favorably in dealing, and general associate members (brokers). The dealing carried out through this Association has been utilized as another leading indicator of rubber prices by many traders, but recently, as the position of the rubber industry in EC, has declined, the volume of transactions has been decreasing.

3. Function of Dealers in each Country

Generally, the exporters in the exporting countries are small-scale enterprises, and, with the exception of some firms, have no organization capable of collecting sufficient information in the consuming countries. Therefore, the intermediate dealers play an active role between the exporters in the exporting countries and the users in the consuming countries.

Traditionally, the so-called commodity dealers located in London are also influential dealers in the natural rubber industry, and they cover the market extensively from the developed countries to the developing countries, freely using their information-collecting

ability. Large Japanese trading houses are also strengthening their position in this industry by making the most use of their highly-developed organization and information-collecting abilities.

As representative dealer associations, there are the Rubber Trade Association of London (RTAL) and the Rubber Trade Association of New York (RTANY). Especially the RTAL, with a proud history of its own, has established the foundations for the conditions of trade in various kinds of natural rubber. Consequently, the conditions of international contracts concerning the natural rubber trade are prepared by this Association.

III. Outline of the International Natural Rubber Agreement (INRA) and the Activities of the International Natural Rubber Organization (INRO)

1. International Natural Rubber Agreement

1.1 Objectives

To contribute to the stabilization of export revenues for the exporting countries and to the securing of stable supplies for the importing countries, through avoiding excessive natural rubber price fluctuations.

1.2 Effective date

Draft agreement adopted:	October 6, 1979
Provisionally effective:	October 23, 1980
Effective date :	April 15, 1982

1.3 Member countries (as of September 2, 1982)

Exporting countries:	7
Importing countries:	24

1.4 Price stabilizing mechanism

A buffer stock is adopted and a certain price range is fixed. Then, depending on where the market price is positioned within this price range, the product is purchased or stock is sold to

stabilize the market price. The necessary funds for this mechanism are covered by subscriptions from the member countries. The buffer stock consists of a normal stockpile of 400,000 tons and an emergency stockpile of 150,000 tons, totaling 550,000 tons.

This Agreement has not adopted a price stabilization mechanism by means of export controls as found in other commodity agreements.

2. Activities of the International Natural Rubber Organization

When the INRA became provisionally effective in 1980, the INRO was established.

Since the indicator price fell below the lower intervention price late in October 1981, purchases began on November 5.

Purchases up to October 1982 are said to amount to 250,000 tons, but the impact on the market is limited to "maintaining the lower invention price", and is not enough to raise the market price to the levels required to stabilize the export revenues expected by the exporting countries.

The reasons for this are as follows:

a. There is a limit to artificially manipulating the price decline caused by the decrease in demand accompanying the severe worldwide economic recession.

b. In such a mechanism, where if the price exceeds the lower intervention price purchases must be stopped, it is difficult to expect the market price to be maintained higher than the lower intervention price.

Consequently, some people are of the opinion that as long as the international economic environment remains unchanged, it will be difficult to expect a recovery in the market price of natural rubber even if purchases for the buffer stock are increased to 400,000 tons or 550,000 tons. Particularly in the exporting countries there is a movement to endeavor to recover the market conditions by carrying out the supply rationalization plan of the ANRPC (Association of Natural Rubber Producing Countries).

Such being the situation, although the buffer stock is discharged when the market price becomes high, it is doubtful whether the present mechanism can dampen the vigor of increasing prices with limited discharges of stock.

IV. Marine Transportation

1. Shipping Ports

Since the conventional grade of natural rubber is transported as bare cargo, it is subject to many problems such as wetting when loading, adhesion of foreign matter during transportation, wetting by seawater, etc.

This is partly because this product has been transported chiefly in conventional ships, since port facilities in the South-east Asian countries were poor and the progress of containerization was slow. Recently, however, due to the necessity of rationalizing transportation and of promoting the industrialization of their countries, the exporting nations are endeavoring to improve port facilities and containerization is making rapid progress.

1.1 Malaysia

The main ports are Port Kelang and Penang Port, and under the fourth Malaysia Plan (1981-1985), the Port Improvement Project is now in progress.

The extension of the container terminal in Port Kelang is planned, to enable the handing of 250,000 TEUS by 1985.

1.2 Indonesia

The main shipping ports are Belawan, Semarang, Surabaya, and Tanjung Priok.

Container yards have been completed in Belawan and Tanjung Priok, but related facilities are not yet adequate.

1.3 Thailand

The main shipping port is Songkhla in the south, and, in addition, there are ports in Phuket, Bangkok and Pattani, although a container yard has been completed only in Bangkok.

The port in the south of the country has no pier alongside which oceangoing vessels can tie up, and loading must be carried out using barges.

In 1981, the Songkhla and Phuket Port Development Project

was established to promote the economic development of southern Thailand, and this project is being continued with financial assistance from the Asian Development Bank. The project is scheduled to be completed in 1986.

2. LASH Shipping

LASH ships are used for ocean transportation between the main producing countries in Southeast Asia and the largest consuming country, the United States.

The LASH system is a transportation system where 400 - 500 ton LASH barges are directly loaded on board the ship. In the mid-1970s, Goodyear began using this system for the transportation of natural rubber, and subsequently it began to be adopted by other major users in the United States.

The characteristics of the LASH system are:

a. It is possible to load and unload cargoes without requiring a wharf, and therefore, it is suitable for ports not sufficiently equipped with wharf facilities.

b. The transportation cost can be reduced because the cargoes can be directly transported to the consignee's own shed or warehouse by means of feeder services utilizing rivers and canals.

c. Damage to the cargo is less due to reduced transshipment.

These characteristics are well suited for the United States, where, after a large lot is imported, the river and canal systems can be utilized for domestic transportation. This system is widely used in the United States, but for transportation in other countries it is rarely utilized.

V. Price

1. Trends in International Prices

Appendix Table 13 shows the trends in the price of natural rubber in Singapore/Kuala Lumpur and London/New York, which represent the producer market and consumer market respectively. Appendix Figure 2 shows the changes in Singapore prices and the factors involved.

2. Factors Affecting Market Prices

Leading natural rubber markets exist in Singapore, Kuala Lumpur, London and New York, and also in Hamburg, Tokyo and Kobe, and the prices formed in these markets influence one another.

The distribution price of natural rubber, whether it is under a long-term contract between shipper and consumer or a spot contract through an offer or bid, is determined using the prices in these commodity markets as a reference.

As to the determining factors for the market price, the price of primary products is determined on the basis of the balance of supply and demand, and natural rubber price is no exception to this. However, natural rubber has the following characteristics:

a. Tapping is possible throughout the year. Although there is a temporary decrease in the harvest during the defoliation (wintering) period, a relatively constant harvest can be expected. Therefore, natural rubber is not much affected by price fluctuations due to good or bad harvests, unlike the grains or coffee.

b. The rubber tree requires 6 to 7 years after planting before it can be tapped, and it is impossible to increase production immediately when the price has become high. Furthermore, since the industry depends on many smallholders, it is also difficult to decrease production immediately, from the viewpoint of their income levels, when the price has become low. Therefore, price elasticity can be said to be low.

For the above reasons, it can be said that the supply of natural rubber will not fluctuate much in the short term, and therefore it is expected that factors on the supply side will not play a very important role in determining the price.

Actually, price fluctuations for natural rubber are caused largely by factors on the demand side rather than the supply side, and prices are particularly affected by the trend of demand in the tire industry, accompanying that of the automobile industry.

Moverover, natural rubber is one of the war supplies, and outbreaks of war or disturbances are a significant factor in price fluctuations.

E. DEMAND AND SUPPLY PROJECTIONS

I. Demand for Natural Rubber

1. Major Projections

To estimate the demand for natural rubber, firstly the total new rubber consumption (total consumption of natural and synthetic rubber) is estimated and then the result is multiplied by the percentage share held by natural rubber.

Various demand projection for total new rubber consumption are made. Major results of existing projections are as follows:

(1,000 MT)

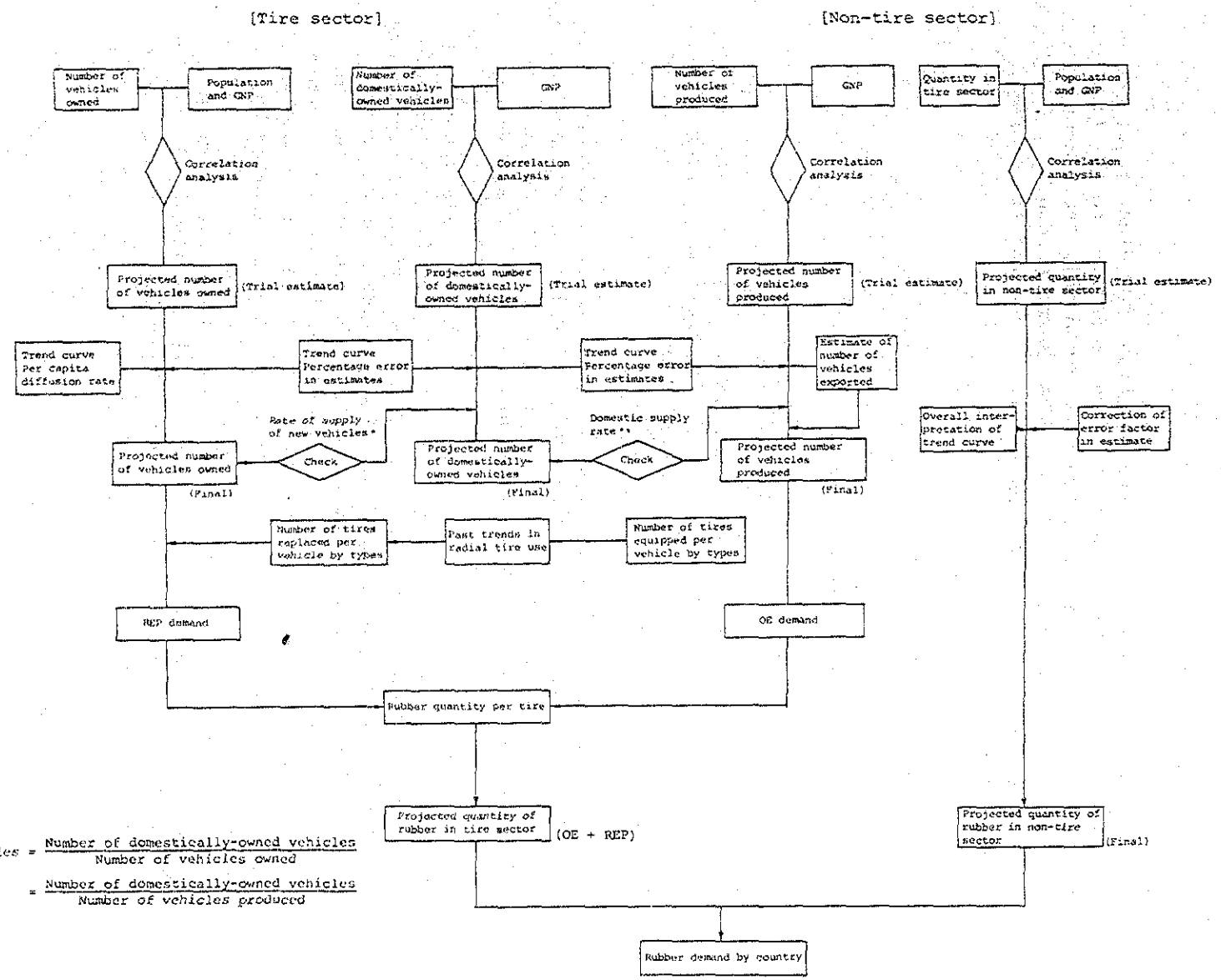
Organization or person making estimate	Year of estimate		1980	1985	1990	2000
World Bank /FAO	1978			18,600 (5.7)	23,500 (4.8)	-
CERS/IRSG	1980		12,900	15,900 (4.3)	19,150 (3.8)	-
	1981 (Revised)		12,450	15,350 (4.3)	18,550 (3.9)	-
H.P. Smit (ESCAP)	1980	H		14,901 (4.5)	19,192 (5.2)	30,902 (4.9)
		M		14,191 (3.5)	17,445 (4.2)	25,495 (3.9)
		L		13,358 (2.2)	15,239 (2.7)	19,256 (2.4)

Note: Figures in ( ) show annual growth rate.

2. Demand Projection

For the purposes of this estimate, demand has been classified into the tire sector and the non-tire sector, and total new rubber demand has been calculated based on the following flow chart for each of the eight main consuming countries (the United States, Canada, the United Kingdom, France, the Federal Republic of Germany, Italy, Australia and Japan) and rest of the world.

Flow Chart for the Rubber Demand Projection



* Supply rate of new vehicles = $\frac{\text{Number of domestically-owned vehicles}}{\text{Number of vehicles owned}}$

** Domestic supply rate = $\frac{\text{Number of domestically-owned vehicles}}{\text{Number of vehicles produced}}$

REP: Replacement
OE : Original equipment

2.1 Tire Sector

For the tire sector, the functions for eight major countries and rest of the world were estimated according to the flow chart, firstly for the number of vehicles owned (H), the number of vehicles sold domestically (DS) and the number produced (P), using the annual data from 1965 through 1981. These functions are:

$$H = a + bY + cGY + dN + eGN$$
$$DS = a + bY + cGY$$
$$P = a + bY + cGY$$

where Y : GNP
GY: the growth rate of GNP
N : population, and
GN: the rate of increase of population

By means of these functions, estimates were calculated for passenger cars and trucks, with only the statistically significant parameters being used the purposes of estimation. The estimated parameters are shown in Table E-1.

The number of vehicles owned, the number sold domestically and the number produced were projected using these functions, and the results were checked by comparing them with the past trends, the supply rate of new vehicles and the domestic supply rate to finalize the estimates. The demand for replacement tires (REP demand) was projected on the basis of the estimated number of vehicles owned, taking into account the prevailing tredns of radial tires and the number of replacement tires per vehicle by types. On the other hand, the final estimate of the number of vehicles produced was determined from the number of vehicles sold domestically and the trial estimates for the number of vehicles produced and the number of vehicles exported. The final estimate of the number of vehicles produced was then multiplied by the number of tires per vehicle by types to determine the final estimate of tires for new vehicles (Demand for original equipment: OE demand). The sum of the REP demand and the OE demand was then multiplied by the quantity of rubber per tire to obtain the estimated demand of rubber in the tire sector.

2.2 Non-Tire Sector

For the non-tire sector, the rubber demand functions were estimated directly from the annual data for 1965 through 1981, hence the explanatory parameters are the population and GNP. The estimates were calculated for each of the eight major countries and rest of the world, as in the case of the tire sector. Using these functions, the trial estimate of rubber demand in the non-tire sector was calculated, which was then checked against factors

Table E-1 Estimated Parameters

Country	Type	Explanatory variable				R	Coefficient			
		GNP	GNP growth rate	Popu-lation	Popu-lation increase rate		GNP	GNP growth rate	Popu-lation	Popu-lation increase rate
Number of vehicles owned										
USA	Passenger car	o	o	o	o	0.999	1.39595	-8,018.3	118.8	-468,040
	Truck	o	o	o	o	0.993	2.02224	-13,514.3	22.3712	222,633
Canada	Passenger car	o	o	o	o	0.996	5.48407	-6,554.4	11.7956	23,028.1
	Truck	o				0.968	1.93601			
Japan	Passenger car	o		o		0.999	4.06441		96.7635	
	Truck	o		o		0.999	9.04806		-7.4759	
Germany, FR	Passenger car	o		o		0.994	29.3334		-47.262	
	Truck	o		o		0.988	1.18854		0.678447	
Italy	Passenger car	o		o		0.991	9.6342		130.949	
	Truck	o		o		0.988	0.601936		7.6689	
France	Passenger car	o		o		0.996	13.2795		-16.9888	
	Truck	o		o		0.966	0.966476		-3.65819	
UK	Passenger car	o		o		0.991	12.0615		119.764	
	Truck	o		o		0.319092	0.06144		3.51216	
Australia	Passenger car	o		o		0.993	-3.38621		129.417	
	Truck	o		o		0.956	-1.38976		32.5771	
Others	Passenger car	o		o		0.998	11.7013		36.8209	
	Truck	o		o		0.987	3.97064		8.40026	

Table E-1 (cont'd.)

Country	Type	Explanatory variable: GNP	Explanatory variable: GNP growth rate	R	Coefficient: GNP	Coefficient: GNP growth rate	Coefficient: Population
Number of vehicles sold in domestic market							
USA	Passenger car	o	o	0.896	2.54018	30,853.5	
	Truck	o	o	0.828	2.6983	10,463.7	
Canada	Passenger car	o	o	0.868	0.343266	771.734	
	Truck	o	o	0.930	0.287557	-11.9834	
Japan	Passenger car	o	o	0.883	1.73292	1,734.76	
	Truck	o	o	0.878	0.82482	4,248.22	
Germany, FR	Passenger car	o	o	0.8998	2.47124	3,362.99	
	Truck	o	o	0.485	0.089048	371.835	
Italy	Passenger car	o		0.662	0.677294		
	Truck	o	o	0.835	0.09115	126.283	
France	Passenger car	o	o	0.9598	1.16243	3,583.49	
	Truck	o	o	0.957	0.22028	7.76626	
UK	Passenger car	o	o	0.7595	1.86652	2,758.22	
	Truck	o	o	0.479	0.100475	475.289	
Australia	Passenger car	o	o	0.882	0.441405	326.567	
	Truck	o	o	0.935	0.196286	-39.7076	
Others	Passenger car	o	o (population)	0.950	1.80368	28,971.7	
	Truck	o	o	0.935	0.33802		1.24372

Table E-1 (cont'd.)

Country	Type	Explanatory variable		R	Coefficient		
		GNP	GNP growth rate		GNP	GNP growth rate	Population
Number of vehicle production							
USA	Passenger car	o	o	0.871	-0.0979	38,373.4	
	Truck	o	o	0.675	1.69092	13,541.4	
Canada	Passenger car	o	o	0.551	0.352542	3,833.57	
	Truck	o	o	0.901	0.471747	-329.676	
Japan	Passenger car	o	o	0.996	5.35465	3,331.27	
	Truck	o	o	0.960	2.30534	3,161.96	
Germany, FR	Passenger car	o	o	0.890	2.49939	9,514.26	
	Truck	o	o	0.915	0.242876	657.757	
Italy	Passenger car	o	o	0.368	0.032388	2,179.83	
	Truck	o	o	0.8899	0.116281	166.926	
France	Passenger car	o	o	0.878	2.02464	8,820.69	
	Truck	o	o	0.945	0.283385	567.105	
UK	Passenger car	o	o	0.838	-1.9380	5,555.94	
	Truck	o	o	0.570	-0.214806	718.702	
Australia	Passenger car	o	o	0.484	0.17315	726.174	
	Truck	o	o	0.448	-0.0324	-446.908	
Others	Passenger car	o	o	0.985	1.64826	13,001.1	
	Truck	o	o	0.946	0.35767	2,507.89	

such as the past trends to determine the final estimated quantity of rubber in the non-tire sector.

2.3 Rubber Demand by Countries

The sum of the final estimated rubber quantities in both the tire and the non-tire sectors gives the estimated quantity of rubber demand by countries. For the detailed estimates, refer to Appendix Table 19.

3. Assumptions for Projecting Total New Rubber Demand

3.1 GNP Growth Rate

The following projected figures have been used for this forecast by the Study Team:

(%)

Country	1980-1985	1985-2000		
		(High)	(Medium)	(Low)
USA	1.7	3.7	3.1	2.5
Canada	1.8	3.7	3.1	2.5
UK	1.1	3.7	3.1	2.5
France	1.6	3.7	3.1	2.5
Germany, FR	1.1	3.7	3.1	2.5
Italy	1.8	3.7	3.1	2.5
Australia	2.5	3.7	3.1	2.5
Japan	3.0	3.7	3.1	2.5
Others	0.8	4.4	3.8	3.2

3.2 Rate of Increase of Population

The following projections have been used:

(%)

Country	1980-1985	1985-2000
USA	0.7	0.7
Canada	1.2	0.8
UK	-0.3	0.2
France	0.4	0.4
Germany, FR	0.2	0.1
Italy	0.2	0.3
Australia	1.5	1.0
Japan	0.8	0.6
Others	1.7	1.8

3.3 Number of Vehicles Owned

The number of vehicles owned is as follows: For the details, see Appendix Table 14.

a. Number of passenger cars

(million)

Country	1980	1985	1990	2000
USA	123.5	137.2	151.8	184.3
Canada	10.4	11.4	12.5	14.5
UK	15.4	16.8	19.0	22.0
France	19.2	21.8	24.6	30.0
Germany, FR	23.2	26.2	29.0	32.5
Italy	17.8	19.8	21.6	23.6
Australia	5.8	6.9	7.4	8.4
Japan	23.7	28.0	32.6	40.4
Others	83.0	96.8	115.0	148.0
World Total	322	364.9	413.5	503.3
(Growth rate)(%)	(4.3)	(2.5)	(2.5)	(2.0)

b. Number of trucks and buses

(million)

Country	1980	1985	1990	2000
USA	35.6	39.3	43.7	52.3
Canada	3.02	3.33	4.11	5.00
UK	1.91	1.90	1.93	2.00
France	2.57	2.80	3.05	3.50
Germany, FR	1.62	1.80	1.96	2.32
Italy	1.36	1.48	1.70	2.10
Australia	1.46	1.69	1.76	1.82
Japan	14.2	16.8	19.2	24.4
Others	29.6	33.7	39.9	52.5
World Total	91.34	102.8	117.51	145.94
(Growth rate)(%)	(6.2)	(2.4)	(2.7)	(2.2)

3.4 Number of Vehicles Produced

The number of vehicles produced is as follows. For the details see Appendix Table 15.

a. Passenger car production

(million)

Country	1980	1985	1990	2000
USA	6.4	8.2	9.1	11.0
Canada	0.85	1.15	1.27	1.57
UK	0.92	1.05	1.35	1.65
France	2.94	3.06	3.25	4.00
Germany, FR	3.52	3.70	4.30	4.50
Italy	1.45	1.33	1.60	2.10
Australia	0.32	0.39	0.46	0.64
Japan	7.04	7.13	7.71	8.17
Others	5.9	5.7	7.8	11.8
World Total	29.34	31.71	36.84	45.43
(Growth rate)(%)	(3.0)	(1.6)	(3.0)	(2.1)

b. Production of trucks and buses

(thousand)

Country	1980	1985	1990	2000
USA	1,630	3,200	3,550	4,200
Canada	527	545	681	900
UK	389	242	260	300
France	357	458	542	675
Germany, FR	357	355	408	484
Italy	167	203	238	330
Australia	48	58	63	72
Japan	4,010	4,030	4,390	4,990
Others	2,010	2,470	3,000	4,350
World Total	9,495	11,561	13,132	16,301
(Growth rate)(%)	(3.5)	(4.0)	(2.6)	(2.2)

3.5 Number of Tires per Car

Because of the longer life of radial tires and the decreasing traveling distance per car due to the increased price of gasoline, the number of replacement tires per car shows a decreasing tendency; and this tendency is expected to intensify as tire life increases further in the future.

The number of tires replaced per car in the major countries is as follows:

Country	Passenger cars						Trucks and buses					
	1970	1975	1980	1985	1990	2000	1970	1975	1980	1985	1990	2000
USA	1.49	1.24	0.98	0.98	0.83	0.71	0.92	0.83	0.80	0.80	0.73	0.59
Canada	1.86	1.38	1.16	1.06	0.95	0.76	0.77	0.82	0.88	0.88	0.80	0.70
UK	1.04	1.04	1.09	1.00	0.90	0.70	1.22	0.99	1.03	0.95	0.91	0.81
France	1.14	1.09	0.89	0.89	0.85	0.77	1.19	0.94	0.85	0.80	0.75	0.67
Germany, FR	1.15	1.10	0.78	0.76	0.74	0.71	1.77	1.26	1.36	1.20	1.13	1.00
Italy	1.31	0.68	0.58	0.57	0.55	0.51	1.61	0.96	1.68	1.08	0.95	0.74
Australia	1.16	1.51	0.97	1.07	0.96	0.77	0.73	1.03	0.82	0.80	0.78	0.70
Japan	1.58	1.23	0.93	0.81	0.72	0.66	1.07	0.93	1.35	1.21	1.13	1.01
Others	1.18	0.87	0.85	0.83	0.81	0.77	2.40	2.24	2.57	2.48	2.52	2.60

3.6 Amount of Rubber per Tire

The amount of rubber used per tire is expected to decrease as tires become lighter in weight and smaller in size, especially in the United States.

The following Table shows the amount of rubber per tire.

Weight of Rubber Used per Tire

(kg)

		Passenger cars				Trucks and buses			
		1980	1985	1990	2000	1980	1985	1990	2000
USA	C	5.5	5.4	5.3	5.0	18.6	→		
	R	6.0	5.9	5.8	5.6	20.5			
Canada	C	5.4	5.2	5.1	4.9	18.6			
	R	5.9	5.8	5.7	5.5	20.5			

(cont'd.)

(kg)

		Passenger cars				Trucks and buses			
		1980	1985	1990	2000	1980	1985	1990	2000
UK	C	4.8	4.8	4.8	4.8	19.5	→		
	R	5.2	5.2	5.2	5.2	21.4			
France	C	4.8	4.8	4.8	4.8	20.5			
	R	5.2	5.2	5.2	5.2	22.3			
Germany, FR	C	4.9	4.9	4.9	4.9	22.3			
	R	5.3	5.3	5.3	5.3	24.7			
Italy	C	4.5	4.5	4.5	4.5	18.6			
	R	5.0	5.0	5.0	5.0	20.5			
Australia	C	5.3	5.2	5.1	4.9	18.6			
	R	5.9	5.8	5.7	5.5	20.5			
Japan	C	4.2	4.2	4.2	4.2	11.2			
	R	4.7	4.7	4.7	4.7	12.1			
Others	C	4.8	4.8	4.8	4.8	18.6			
	R	5.2	5.2	5.2	5.2	20.5			

Note: C: Conventional tire; R: Radial tire

4. Projection of Total New Rubber Demand

On the basis of the assumptions described in Item 3 above, the total new rubber demand has been estimated as follows:

(1,000 MT, %)

	1980	1985	1990	2000	1980/2000
High			16,123(3.0)	19,839(2.1)	(2.4)
Medium	12,445(3.7)	13,884(2.2)	15,722(2.5)	18,670(1.7)	(2.1)
Low			15,243(1.9)	17,583(1.4)	(1.7)

Note: Figures in ( ) shows annual growth rate.

5. Projection of Natural Rubber Demand

The decreasing trend in the ratio of use of natural rubber has

bottomed out, as stated in Section C, Subsection I above, and as the use of radial tires increases, the use of natural rubber is expected to increase again. On the basis of ESCAP's estimates by use and types of rubber, the percentage share of natural rubber is estimated as follows:

(%)

	1980	1985	1990	2000
Tire	36.1	39.9	42.9	45.8
Non-tire	24.0	24.1	24.2	24.5
Average	30.2	33.6	35.0	36.7

On the basis of the above percentage shares of natural rubber, demand for natural rubber up to the year 2000 is estimated as follows:

(1,000 MT, %)

	1980	1985	1990	2000	1980/2000
High			5,640 (3.9)	7,280 (2.6)	(3.4)
Medium	3,760 (2.2)	4,670 (4.4)	5,500 (3.3)	6,850 (2.2)	(3.0)
Low			5,350 (2.8)	6,450 (1.9)	(2.7)

Note: Figures in ( ) show annual growth rate.

II. Supply of Natural Rubber

1. Major Results of Existing Projections

The long-term supply of natural rubber is determined by the government policy of each producing country regarding the expansion of new planting, increase of yield by replanting of high-yielding trees and production increases through the use of stimulants.

Various organizations have projected the long-term supply for natural rubber, and the main estimates are as follows:

(1,000 MT, %)

Organization or person making estimate	Year of estimate	1980	1985 **	1990 **	2,000
World Bank/FAO	1978	4,350	5,245 (4.05)	6,135 [3.62] (3.18)	-
IRSG	1979	4,000	5,000 (4.56)	6,000 [4.14] (3.71)	-
World Bank/FAO	1979	3,890	4,680 (3.77)	5,690 [3.88] (3.99)	-
CERS*/IRSG	1980		4,500-4,700	5,000-5,500	-
J.J. Riedle	1980		-	5,335	-
CERS/IRSG	1981	3,767	4,835 (5.12)	6,357 [5.37] (5.63)	-

* Committee of Expert Rubber Statisticians
** Figures in ( ) show annual growth rate in 1980/90; [ ], 1985/90

All the estimates made before 1980 forecast that the growth rate of supply after 1981 would greatly exceed the actual growth rate of 2.13% p.a. achieved in the period 1970 to 1980.

A factor further reinforcing these estimates is the estimate made by CERS/IRSG in 1981.

At the General Meeting of IRSG in 1980, the main producing countries reported on their own future plans for new planting, replanting, and smallholder policies, and these greatly exceeded the estimates which had previously been made.

Therefore, a revised estimate incorporating the producing countries' plans resulted in the estimate issued in 1981 by CERS/IRSG.

Estimate Made by CERS/IRSG in 1981

(1,000 MT, %)

Producing country	Forecast for 1980	1985	Growth rate 1980/85	1990	Growth rate 1985/90	Growth rate 1980/90
Malaysia	1,550	1,850	(3.60)	2,000	(1.57)	(2.58)
Indonesia	950	1,070	(2.41)	1,700	(9.70)	(5.99)
Thailand	513	945	(13.00)	1,369	(7.69)	(10.31)
Others	754	970	(5.17)	1,288	(5.83)	(5.50)
Total	3,767*	4,835	(5.12)	6,357	(5.63)	(5.37)

* The actual figures for 1980 were 1,530 for Malaysia, 1,020 for Indonesia, 501 for Thailand and 779 for others, totaling 3,830 (thousand tons).

2. Supply Projection

For this estimate of the long-term supply prospects for natural rubber, the reports given by the main producing countries at the IRSG General Meeting of 1980 and the CERS/IRSG 1981 estimates are used as a base, incorporating the latest revised plans of the main producing countries (Malaysia, Indonesia and Thailand) acquired in the field survey made by the Study Team in October, 1982 (For details of the latest modified plans, see B-I-2 above).

2.1 Production Plans of the Main Producing Countries

2.1.1 Malaysia

If the past growth of production in Malaysia is observed in five-year units, a steep decrease can be seen, as shown in Appendix Table 16: 6.72% p.a. for 1965-1970, 2.83% p.a. for 1970-1975 and 0.95% p.a. for 1975-1980. This is the result of switching from rubber to other more profitable agricultural products such as oil palm and cocoa. However, the Malaysian Government is endeavoring to increase production by implementing the "Dynamic Production Policy", to secure the position of natural rubber as an important product for the country.

Malaysia's long-term production plan is a rather mild one, and the planned growth rates of 1.52% p.a. for 1980-1985, 1.64% p.a. for 1985-1990 and 2.48% p.a. for 1990-2000 will be easily achieved.

2.1.2 Indonesia

The past rates of production growth in Indonesia were 2.61% p.a. for the period 1965-1970, 0.18% p.a. for 1970-1975 and 4.4% p.a. for 1975-1980. Indonesia has a positive production plan and the 1982 estimates provide an upward revision of the figures contained in the 1980 plan.

As a result, the growth rate for 1980-1990 (6.5% p.a.) greatly exceeds the past growth rates, and a high growth rate of 9% p.a. is planned for 1985-1990.

When estimating production in Indonesia, this should be considered as the most optimistic figure (Production will reach 2,550,000 tons if the government targets of a cultivated area of 2,500,000 ha, a mature area of 85% and a yield of 1,200 kg/ha/year are realized). The cultivated area and yield are shown in Appendix Tables 17 and 18.

2.1.3 Thailand

The growth of production in Thailand over the past 15 years has been the highest in the world. Especially in the period 1975-1980, a rate of 7.14% p.a. was registered, and this increase in production was remarkable.

However, the yield in Thailand is still lower than those of Malaysia and Indonesia, and the potential for increased production through replanting is large. The production plan in Thailand is 12.23% p.a. for 1980-1985 and 7.66% p.a. for 1985-1990, and these figures should also be considered as the most optimistic projections (If the cultivated area is 2 million ha, the mature area is 85% and the yield is 1,200 kg/ha/year, production will reach 2 million tons, whereas if the cultivated area is 1.6 million ha, production will be 1.6 million tons).

3. Supply Projection of Natural Rubber

Based on the above-mentioned opinions, the supply of natural rubber is projected as follows:

Long-Term Supply Projection for Natural Rubber

(1,000 MT, %)

	1980	1985	80/85	1990	85/90	80/90	2000	90/2000	80/2000
Malaysia									
High		1,700	(2.13)	2,000	(3.30)	(2.71)	2,500	(2.26)	(2.49)
Medium	1,530	1,650	(1.52)	1,800	(1.76)	(1.64)	2,300	(2.48)	(2.06)
Low		1,600	(0.95)	1,700	(1.22)	(1.06)	2,000	(1.64)	(1.35)
Indonesia									
High		1,230	(3.82)	1,900	(9.09)	(6.42)	2,330	(2.06)	(4.22)
Medium	1,020	1,150	(2.43)	1,700	(8.13)	(5.24)	2,000	(1.64)	(3.42)
Low		1,070	(0.96)	1,500	(6.99)	(3.93)	1,750	(1.55)	(2.74)
Thailand									
High		892	(12.23)	1,290	(7.66)	(9.92)	2,100	(4.99)	(7.43)
Medium	501	800	(9.81)	1,100	(6.58)	(8.18)	1,600	(3.82)	(5.98)
Low		700	(6.92)	900	(5.15)	(6.03)	1,300	(3.75)	(4.88)
Others									
High		970	(4.5)	1,200	(4.35)	(4.4)	1,700	(3.54)	(4.0)
Medium	779	950	(4.1)	1,150	(3.90)	(4.0)	1,550	(3.03)	(3.5)
Low		920	(3.4)	1,100	(3.64)	(3.5)	1,400	(2.44)	(3.0)
Total									
High		4,792	(4.58)	6,390	(5.92)	(5.25)	8,630	(3.05)	(4.15)
Medium	3,830	4,550	(3.51)	5,750	(4.79)	(4.15)	7,450	(2.62)	(3.38)
Low		4,290	(2.29)	5,200	(3.92)	(3.11)	6,450	(2.18)	(2.64)

Note: Figures in ( ) show annual growth rate.

III. Future Supply and Demand for Natural Rubber

From the above figures, if a comparison is made between the supply and demand projections for 1990 and 2000, it can be said that a slight excess of supply is to be expected overall. For 1990, demand is projected at 5.64 million tons, 5.5 million tons and 5.35 million tons for the high, medium and low cases respectively, while supply is projected at 6.39 million tons, 5.75 million tons and 5.2 million tons respectively. The rate of over-supply is 13.3% for the high and medium cases, and only in the case of low does the demand exceed supply by 2.8%. For the year 2000, demand is projected at 7.28 million tons, 6.85 million tons and 6.45 million tons for the high, medium and low cases respectively, while supply is projected at 8.63 milion, 7.45 million and 6.45 million tons respectively, and in the case of the high and medium cases, an excess of supply is projected, as is the case for 1990. The proportion of over-supply in the year 2000 registers 18.5% and 8.8% respectively, whereas in the case of the low estimate, supply and demand are balanced.

(1,000 MT, %)

		1980	1985	1990	2000
Demand	High			5,640	7,280
	Medium	3,760	4,670	5,500	6,850
	Low			5,350	6,450
Supply	High		4,792	6,390	8,630
	Medium	3,830	4,550	5,750	7,450
	Low		4,290	5,200	6,450
Balance	High		+122 (2.6)	+750 (13.3)	+1,350 (18.5)
	Medium	+70 (1.9)	-120 (-2.6)	+250 (4.5)	+600 (8.8)
	Low		-380 (8.1)	-150 (-2.8)	±0 (-)

IV. Export Possibilities of Natural Rubber Produced in Brazil

Brazil is a producing country of natural rubber but on balance it is a net importer. Self-sufficiency in natural rubber increased somewhat from about 60% in the early 1960s to 75% in the late 1960s due to a downturn in demand, but subsequently it decreased again to 50% in the early 1970s and further to 30% in the late 1970s.

	Production	Consumption	Self-sufficiency
	(1,000 MT)		
1960-1964	116	193	60%
1965-1969	122	163	75%
1970-1974	117	232	50%
1975-1979	111	345	32%

During this period, production decreased steeply in 1974 due to crop damage caused by disease and subsequently showed a recovery, which, however, has been unable to overtake the increased consumption, which stood at a rate of 8% in the period 1970-1980.

At the General Meeting of IRSG in 1980, where the natural rubber producing countries reported on their future plans, Brazil's plan was for the production of 56,000 tons in 1985 and 130,000 tons in 1990.

If the growth of consumption is estimated, assuming that growth continues at the rate of 5% per year after 1980, consumption will be 104,000 tons in 1985 and 133,000 tons in 1990, with the result that supply and demand will be almost balanced in 1990.

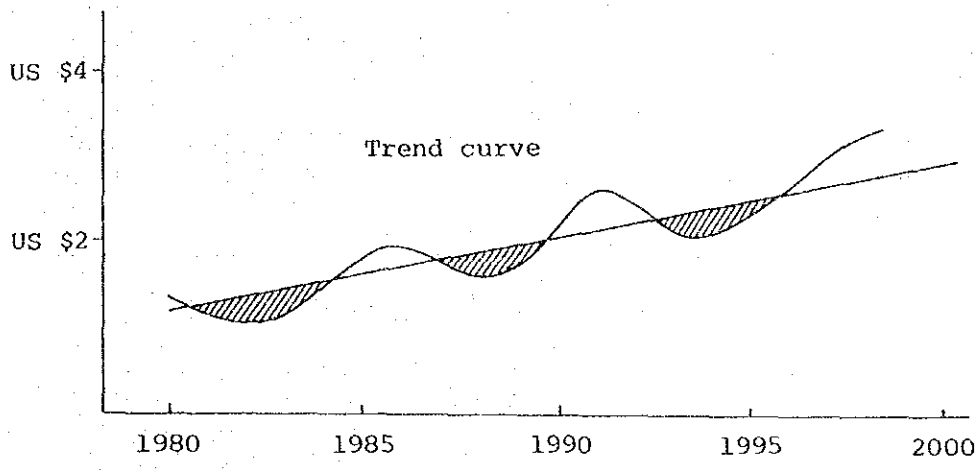
Therefore, for natural rubber, it seems advisable to aim first at establishing self-sufficiency by trying to achieve this production plan, and in the meantime, to introduce new technology, to accumulate knowhow and to gradually move towards the development of new regions.

Concerning the price of natural rubber, the 5-year cycle fluctuation theory is valid on the basis of the past pattern. The past trends show that the prices of natural rubber and synthetic rubber are related to each other in the long term, although different in the short term, and cyclically both prices repeat the pattern of approaching each other or inverting their relative positions, while moving on the same trend curve.

The future prices for both natural rubber and synthetic rubber are projected to show a trend based on the increased price of crude oil in the long term.

The long-term price forecast presented at the 27th General Meeting (1982) of IRSG also suggests a similar trend.

	SBR	RSS-1 (N.Y.)
1980	US$1.32/kg	S$1.63/kg
1985	1.50	1.37
1990	2.00	2.37
1995	2.50	2.38
2000	3.00	3.05



(Estimated by the Study Team)

Appendix Table 1 Production, Consumption and Stocks of Natural Rubber

(1,000 MT)

	Production	Consumption	Excess(+) or Deficiency(-) against Consumption	Stocks
1965	2,352.5	2,447.5	- 95	1,165
1966	2,392.5	2,542.5	- 150	1,175
1967	2,522.5	2,535	- 12.5	1,267.5
1968	2,685	2,780	- 95	1,247.5
1969	2,995	2,910	+ 85	1,375
1970	3,102.5	2,992.5	+ 110	1,520
1971	3,085	3,092.5	- 7.5	1,485
1972	3,120	3,230	- 110	1,420
1973	3,505	3,402.5	+ 102.5	1,585
1974	3,445	3,517.5	- 72.5	1,590
1975	3,315	3,367.5	- 52.5	1,550
1976	3,585	3,505	+ 80	1,635
1977	3,625	3,715	- 90	1,545
1978	3,755	3,725	+ 30	1,575
1979	3,860	3,870	- 10	1,565
1980	3,830	3,760	+ 70	1,635
1981	3,665	3,700	- 35	1,600

Source: IRSG, Rubber Statistical Bulletin

Appendix Table 2 Production of Natural Rubber

(MT)

	Malaysia	Indonesia	Thailand	Sri Lanka	India	Brazil	Africa	Others	Total *
1965	916,935	716,466	216,405	118,311	49,387	29,291	159,250	141,630	2,352,500
1966	972,837	736,675	207,535	131,015	53,195	24,347	176,500	131,171	2,392,500
1967	990,446	700,834	216,119	143,204	62,339	21,494	163,000	126,544	2,522,500
1968	1,100,284	793,910	259,221	148,719	68,845	22,958	169,000	121,778	2,685,000
1969	1,268,014	880,426	283,381	150,834	79,951	23,950	182,000	121,487	2,995,000
1970	1,269,203	815,161	287,163	159,158	89,905	24,976	213,000	85,721	3,102,500
1971	1,318,518	819,311	318,823	141,409	98,884	24,231	205,561	89,217	3,085,000
1972	1,304,317	773,655	336,919	140,371	109,137	25,818	212,176	97,856	3,120,000
1973	1,542,323	885,802	389,982	154,675	123,232	23,402	230,170	112,852	3,505,000
1974	1,524,673	854,964	379,489	132,008	128,351	18,606	230,182	138,993	3,445,000
1975	1,459,282	822,500	355,033	148,751	136,019	19,348	215,110	141,000	3,315,000
1976	1,612,388	847,500	411,856	152,134	147,758	20,298	204,351	184,250	3,585,000
1977	1,587,972	835,000	430,886	146,243	151,609	22,560	209,353	199,050	3,625,000
1978	1,582,395	902,500	466,968	155,662	132,991	23,708	202,697	233,350	3,755,000
1979	1,570,113	905,000	531,213	152,704	147,200	24,959	192,852	264,450	3,860,000
1980	1,529,994	1,020,000	501,109	133,151	155,380	27,813	183,937	275,650	3,830,000
1981	1,529,382	867,500	504,024	123,946	150,655	30,257	176,750	277,650	3,665,000

* Including allowances for apparent discrepancies in officially reported statistics.

Source: IRSG, Rubber Statistical Bulletin

Appendix Table 3 Share of Natural Rubber Production by Countries

(%)

	Malaysia	Indonesia	Thailand	Sri Lanka	India	Brazil	Africa	Others
1965	39.0	30.5	9.2	5.0	2.1	1.2	6.8	6.2
1966	40.7	30.8	8.7	5.5	2.2	1.0	7.4	5.5
1967	39.3	27.8	8.6	5.7	2.5	0.9	6.5	5.0
1968	41.0	29.6	9.7	5.5	2.6	0.9	6.3	4.5
1969	42.3	29.4	9.5	5.0	2.7	0.8	6.1	4.1
1970	40.9	26.3	9.3	5.1	2.9	0.8	6.9	2.8
1971	42.7	26.6	10.3	4.6	3.2	0.8	6.7	2.9
1972	41.8	24.8	10.8	4.5	3.5	0.8	6.8	3.1
1973	44.0	25.3	11.1	4.4	3.5	0.7	6.6	3.2
1974	44.3	24.8	11.0	3.8	3.7	0.5	6.7	4.0
1975	44.0	24.8	10.7	4.5	4.1	0.6	6.5	4.3
1976	45.0	23.6	11.5	4.2	4.1	0.6	5.7	5.1
1977	43.8	23.0	11.9	4.0	4.2	0.6	5.8	5.5
1978	42.1	24.0	12.4	4.1	3.5	0.6	5.4	6.2
1979	40.7	23.4	13.8	4.0	3.8	0.6	5.0	6.9
1980	39.9	26.6	13.1	3.5	4.1	0.7	4.8	7.2
1981	41.7	23.7	13.8	3.4	4.1	0.8	4.8	7.6

Source: IRSG, Rubber Statistical Bulletin

Appendix Table 4 Production, Consumption and Stocks of Synthetic Rubber

(1,000 MT)

	Production	Consumption	Excess(+) or deficienty(-) against consumption	Stocks*
1965	3,795	3,740	+ 55	810
1966	4,210	4,135	+ 75	872.5
1967	4,345	4,270	+ 75	947.5
1968	4,937.5	4,870	+ 67.5	1,010
1969	5,520	5,357.5	+ 162.5	1,165
1970	5,875	5,625	+ 250	1,432.5
1971	6,215	6,185	+ 30	1,490
1972	6,765	6,730	+ 35	1,525
1973	7,760	7,575	+ 185	1,710
1974	7,575	7,450	+ 125	1,835
1975	6,850	7,027.5	- 177.5	1,655
1976	8,025	7,915	+ 110	1,765
1977	8,615	8,615	-	1,765
1978	8,910	8,770	+ 140	1,905
1979	9,330	9,125	+ 205	2,110
1980	8,670	8,685	- 15	2,095
1981	8,490	8,435	+ 55	2,150

* Including allowances for apparent discrepancies in officially reported statistics

Source: IRSG, Rubber Statistical Bulletin

Appendix Table 5 Production of Synthetic Rubber

(1,000 MT)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981 Production capacity	1981 Operating ratio
Germany, FR	164	196	190	238	292	302	306	300	393	372	316	373	414	407	418	390	397	560	
UK	175	194	204	237	273	306	285	317	364	336	261	320	329	294	278	212	190	558	
France	148	164	189	223	275	316	323	368	458	463	350	437	479	492	541	511	487	677	
Italy	120	122	118	125	135	155	160	186	230	240	200	250	240	250	270	250	235	539	
Netherlands	100	110	125	163	214	200	191	186	263	245	216	247	240	223	238	212	211	356	
Belgium	20	20	20	25	35	50	60	60	65	65	65	115	119	124	125	115	108	135	
Spain	-	1	11	27	35	39	45	50	68	68	66	73	87	86	87	81	75	100	
Sweden										1	6	8	8	15	10	13	17	17	
Turkey											8	19	21	16	23	23	20	46	
Finland												6	6	6	6	6	6	8	
Austria													3	4	4	5	5	6	
Total for Western Europe	727	807	857	1,038	1,259	1,378	1,370	1,467	1,841	1,790	1,488	1,848	1,946	1,917	2,000	1,818	1,751	3,002	58.3
USA	1,842	2,002	1,942	2,165	2,286	2,232	2,277	2,455	2,607	2,396	1,990	2,425	2,660	2,662	2,720	2,241	2,248	3,132	
Canada	206	203	200	197	199	205	197	195	230	209	173	210	238	248	283	253	263	305	
Total for North America	2,048	2,205	2,142	2,362	2,485	2,437	2,474	2,650	2,837	2,605	2,163	2,635	2,898	2,910	3,003	2,494	2,511	3,437	73.1
Brazil	39	54	52	59	62	75	78	95	126	155	129	164	188	206	224	249	223	321	
Argentina	3	10	17	23	38	39	43	48	58	50	40	45	36	34	37	33	28	64	
Mexico	-	1	20	34	41	44	49	53	54	66	60	69	63	80	84	91	105	132	
Total for Central and South America	42	65	89	116	141	158	170	196	238	271	229	278	287	320	345	373	356	517	68.9
Japan	161	233	281	381	526	698	780	819	967	858	789	941	971	1,029	1,107	1,094	1,010	1,500	
Australia	21	20	26	30	33	33	43	42	43	45	38	42	44	44	43	46	43	80	
India	16	16	22	25	25	30	33	28	21	18	23	23	27	28	32	22	29	61	
Korea, Rep. of									10	17	24	35	43	62	60	75	82	125	
Taiwan													23	47	85	73	71	100	
Total for Asia and Oceania	198	269	329	436	584	761	856	889	1,041	938	874	1,041	1,108	1,210	1,327	1,310	1,235	1,866	66.2
S. Africa	16	19	24	25	24	29	30	30	28	32	32	35	27	32	31	39	36	56	64.3
Bulgaria						4	12	12	18	18	19	21	25	25	30	30	30		
Czechoslovakia	30	30	33	35	43	50	52	51	55	51	57	57	59	59	59	60	63		
German DR	95	101	110	102	114	118	129	133	134	139	144	146	147	145	150	150	155		
Poland	39	37	40	41	48	62	66	78	94	101	108	117	119	126	130	118	111		
Romania	31	35	51	54	55	61	71	73	83	92	99	95	136	147	149	150	160		
USSR	543	620	639	698	735	793	950	1,150	1,350	1,500	1,600	1,700	1,800	1,950	2,025	2,040	2,000		
China	25	25	30	30	35	35	35	35	40	40	40	50	60	70	80	90	85		
Total for centrally planned economies	763	848	903	960	1,030	1,123	1,315	1,532	1,774	1,941	2,067	2,186	2,346	2,522	2,623	2,638	2,604	2,858	91.1
Grand Total	3,795	4,210	4,345	4,937	5,520	5,875	6,215	6,765	7,760	7,575	6,850	8,025	8,615	8,910	9,330	8,670	8,490	11,736	72.4

Sources: IRSG, Rubber Statistical Bulletin

Appendix Table 6 Consumption of Natural Rubber

(MT)

	USA	UK	France	Germany, FR	Italy	Netherlands	Other Western Europe	Eastern Europe
1965	522,966	186,700	122,515	157,861	87,000	20,800	135,000	425,000
1966	554,435	183,900	125,987	157,604	91,400	22,550	142,500	430,000
1967	496,693	178,500	127,821	141,338	100,000	19,700	137,500	445,000
1968	591,201	194,100	128,810	170,000	100,000	20,566	150,000	460,000
1969	607,802	191,400	149,511	191,241	102,000	20,357	160,000	465,000
1970	568,290	188,200	158,229	200,725	113,000	22,000	177,500	465,000
1971	587,080	184,800	159,203	198,247	121,000	22,000	192,500	475,000
1972	650,878	174,000	160,154	192,997	118,000	23,200	197,500	485,000
1973	711,977	186,500	162,265	205,592	120,000	23,353	195,000	490,000
1974	738,362	167,300	162,367	193,938	125,000	24,750	217,500	500,000
1975	665,950	170,500	156,204	197,101	118,000	22,604	205,000	475,000
1976	686,679	168,300	166,757	195,233	135,000	21,924	190,000	460,000
1977	801,797	172,400	163,623	176,496	128,000	21,190	215,000	425,000
1978	770,766	139,2000	163,172	184,892	113,000	18,746	210,000	425,000
1979	740,449	137,500	177,029	184,527	128,000	20,385	217,500	430,000
1980	585,000	130,800	187,684	179,674	132,000	20,147	210,000	415,000
1981	635,000	120,000	167,246	169,124	123,000	19,020	202,500	400,000

	China	Australia	Brazil	Canada	India	Japan	Others	Total
1965	140,000	38,970	26,554	43,480	64,675	201,500	236,500	2,447,500
1966	155,000	37,630	30,862	47,268	66,693	216,000	248,500	2,542,500
1967	165,000	37,280	32,133	46,113	72,516	243,000	257,500	2,535,000
1968	180,000	43,960	38,156	45,477	84,206	255,000	289,750	2,780,000
1969	195,000	42,030	35,072	49,664	86,692	268,000	317,500	2,910,000
1970	210,000	40,170	36,739	50,616	86,469	283,000	345,000	2,992,500
1971	210,000	40,500	41,761	52,030	93,125	295,000	382,500	3,092,500
1972	210,00	46,330	44,219	60,355	101,100	312,000	420,000	3,230,000
1973	217,500	52,090	51,156	60,446	123,298	335,000	455,000	3,402,500
1974	217,500	59,360	57,945	63,306	133,538	312,000	505,000	3,517,500
1975	225,000	49,878	58,704	72,291	129,138	285,200	505,000	3,367,500
1976	240,000	49,978	66,111	84,695	133,494	302,000	560,000	3,505,000
1977	280,000	41,432	71,354	90,353	142,763	320,000	587,500	3,715,000
1978	300,000	41,110	72,492	89,069	158,168	355,000	645,000	3,725,000
1979	335,000	45,376	75,943	93,750	167,675	390,000	685,000	3,870,000
1980	340,000	42,211	81,059	80,000	170,800	427,000	720,000	3,760,000
1981	275,000	41,921	74,366	82,000	181,365	436,000	730,000	3,700,000

Source: IRSG, Rubber Statistical Bulletin

Appendix Table 7 Consumption of New Rubber

(1,000 MT, %)

		1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Germany, FR	SR	209	212	201	253	328	358	369	362	443	404	360	438	431	429	447	421	396
	NR	158	158	141	170	191	201	198	193	206	194	197	195	176	185	185	180	169
	Total	367	370	342	423	519	559	567	555	649	598	557	633	607	614	632	601	565
	SR ratio	56.9	57.3	58.8	59.8	63.2	64.0	65.1	65.2	68.3	67.6	64.6	69.2	71.0	69.9	70.7	70.0	70.1
UK	SR	183	199	206	234	256	274	275	278	331	279	266	327	321	313	301	248	220
	NR	187	184	179	194	191	188	185	174	187	167	171	168	172	139	138	131	120
	Total	370	383	385	428	447	462	460	452	518	446	437	495	493	452	439	379	340
	SR ratio	49.5	52.0	53.5	54.7	57.3	59.3	59.8	61.5	63.9	62.6	60.9	66.1	65.1	69.2	68.6	65.4	64.7
France	SR	154	175	188	196	231	261	283	298	305	308	278	286	295	296	318	322	293
	NR	123	126	128	129	150	158	159	160	162	162	156	167	164	163	177	188	167
	Total	277	301	316	325	381	419	442	458	467	470	434	453	459	459	495	510	460
	SR ratio	55.6	58.1	59.5	60.3	60.6	62.3	64.0	65.1	65.3	65.7	64.1	63.1	64.3	64.5	64.2	63.1	63.7
Italy	SR	113	132	155	160	178	197	207	220	240	255	220	260	275	265	285	288	265
	NR	87	91	100	100	102	113	121	118	120	125	118	135	128	113	128	132	123
	Total	200	223	255	260	280	310	328	338	360	380	338	395	403	378	413	420	388
	SR ratio	56.5	59.2	60.8	61.5	63.6	63.5	63.1	65.1	66.7	67.1	65.1	65.8	68.2	70.1	69.0	68.6	68.3
Nether-lands	SR	21	24	24	28	28	46	55	57	62	62	56	53	53	52	70	70	67
	NR	21	23	20	21	20	22	22	23	23	25	23	22	21	19	20	20	19
	Total	42	47	44	49	48	68	77	80	85	87	79	75	74	71	90	90	86
	SR ratio	50.0	51.1	54.5	57.1	58.3	67.6	71.4	71.3	72.9	71.3	70.9	70.7	71.6	73.2	77.8	77.8	77.9
Subtotal	SR	680	742	774	871	1,021	1,140	1,189	1,215	1,381	1,308	1,180	1,364	1,375	1,355	1,421	1,349	1,241
	NR	576	582	568	614	654	689	685	668	698	673	665	687	661	619	648	651	598
	Total	1,256	1,324	1,342	1,485	1,675	1,829	1,874	1,883	2,079	1,981	1,845	2,051	2,036	1,974	2,069	2,000	1,839
	SR ratio						62.3	63.4										
Others in EC	SR	35	36	36	44	52	67	71	90	74	92	102	121	112	115	111	141	114
	NR	27	26	27	31	34	39	35	37	37	42	38	43	67	41	40	39	42
	Total	62	62	63	75	86	106	106	127	111	134	140	164	179	156	151	180	156
	SR ratio	56.5	58.1	57.1	58.7	60.5	63.2	67.0	70.9	66.7	68.7	72.9	73.8					
Others in Western Europe	SR	130	158	165	193	225	250	267	302	375	367	325	345	405	400	432	410	407
	NR	135	143	138	150	160	175	193	198	195	218	205	190	215	210	218	210	203
	Total	265	301	303	343	385	425	460	500	570	585	530	535	620	610	650	620	610
	SR ratio	49.1	52.5	54.5	56.3	58.4	58.8	58.0	60.4	65.8	62.7	61.3	64.5					

Appendix Table 7 (cont'd.)

(1,000 MT, %)

		1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Total of	SR	845	936	975	1,108	1,298	1,453	1,527	1,607	1,830	1,767	1,607	1,830	1,892	1,870	1,964	1,900	1,762
Western	NR	738	751	733	795	848	895	913	903	930	933	908	920	943	870	906	900	843
Europe	Total	1,583	1,687	1,708	1,903	2,146	2,348	2,440	2,510	2,760	2,700	2,515	2,750	2,835	2,740	2,870	2,800	2,605
	SR ratio	53.4	55.5	57.1	58.2	60.5	61.9	62.6	64.0	66.3	65.4	63.9	66.5	66.7	68.2	68.4	67.9	67.6
USA	SR	1,565	1,693	1,654	1,927	2,057	1,949	2,127	2,328	2,440	2,210	1,964	2,172	2,645	2,519	2,501	1,980	2,022
	NR	523	554	497	591	608	568	587	651	712	738	666	687	802	771	740	585	635
	Total	2,088	2,247	2,151	2,518	2,665	2,517	2,714	2,979	3,152	2,948	2,630	2,859	3,447	3,290	3,241	2,565	2,657
	SR ratio	75.0	75.3	76.9	76.5	77.2	77.4	78.4	78.1	77.4	75.0	74.7	76.0	76.7	76.6	77.2	77.2	76.1
Canada	SR	98	109	110	106	129	135	158	172	187	182	180	202	207	204	232	200	210
	NR	43	47	46	45	50	51	52	60	60	63	72	85	90	89	94	80	82
	Total	141	156	156	151	179	186	210	232	247	245	252	287	297	293	326	280	292
	SR ratio	69.5	69.9	70.5	70.2	72.1	72.6	75.2	74.1	75.7	74.3	71.4	70.4	70.0	69.6	71.2	71.4	71.9
Total of	SR	1,663	1,802	1,764	2,033	2,186	2,084	2,285	2,500	2,627	2,392	2,144	2,374	2,852	2,723	2,733	2,180	2,232
North	NR	566	601	543	636	658	619	639	711	772	801	738	772	892	860	834	665	717
America	Total	2,229	2,403	2,307	2,669	2,844	2,703	2,924	3,211	3,399	3,193	2,882	3,146	3,744	3,583	3,567	2,845	2,949
	SR ratio	74.6	75.0	76.5	76.2	76.9	77.1	78.1	77.9	77.3	74.9	74.4	75.5	76.2	76.0	76.6	76.6	75.7
Brazil	SR	38	51	57	71	71	85	97	115	150	166	176	202	205	222	225	244	202
	NR	27	31	32	38	35	37	42	44	51	58	59	66	71	72	76	81	74
	Total	65	82	89	109	106	122	139	159	201	224	235	268	276	294	301	325	276
	SR ratio	58.5	62.1	64.0	65.1	67.0	69.7	69.8	72.3	74.6	74.1	74.9	75.4					
Japan	SR	176	222	273	348	426	496	525	588	710	615	585	658	690	741	830	885	851
	NR	202	216	243	255	268	283	295	312	335	312	285	302	320	355	390	427	436
	Total	378	438	516	603	694	779	820	900	1,045	927	870	960	1,010	1,096	1,220	1,312	1,287
	SR ratio	46.6	50.7	52.9	57.7	61.4	63.7	64.0	65.3	67.9	66.3	67.2	68.5					
Australia	SR	41	39	43	53	51	54	59	58	66	65	50	57	53	58	51	59	58
	NR	39	38	37	44	42	40	41	46	52	59	50	50	41	41	45	42	42
	Total	80	77	80	97	93	94	100	104	118	124	100	107	94	99	96	101	100
	SR ratio	51.3	50.6	53.8	54.6	54.8	57.4	59.0	55.8	55.9	52.4	50.0	53.3					
India	SR	20	22	25	25	31	32	37	38	25	21	32	34	34	38	38	46	44
	NR	65	67	73	84	87	86	93	101	123	134	129	133	143	158	168	171	181
	Total	85	89	98	109	118	118	130	139	148	155	161	167	177	196	206	217	225
	SR ratio	23.5	24.7	25.5	22.9	26.3	27.1	28.5	27.3	16.9	13.5	19.9	20.4					

Appendix Table 7 (cont'd.)

(1,000 MT, %)

		1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Subtotal	SR	275	334	398	497	579	667	718	799	951	867	843	951	982	1,059	1,144	1,234	1,155
(Brazil-	NR	333	352	385	421	432	446	471	503	561	563	523	551	575	626	679	721	733
India)	Total	608	686	783	918	1,011	1,113	1,189	1,302	1,512	1,430	1,366	1,502	1,557	1,685	1,823	1,955	1,888
Others in	SR	177	208	228	277	284	320	380	359	505	572	378	600	569	633	704	751	726
free world	NR	246	254	264	288	312	349	385	418	432	503	499	562	600	644	686	719	732
(incl.	Total	423	462	492	565	596	669	765	777	937	1,075	877	1,162	1,169	1,277	1,390	1,470	1,458
error)	SR ratio	41.8	45.0	46.3	49.0	47.7	47.8	49.7	46.2	53.9	53.2	43.1	51.3					
Countries	SR	452	542	626	774	863	987	1,098	1,158	1,456	1,439	1,221	1,551	1,551	1,692	1,848	1,985	1,881
out of	NR	579	606	649	709	744	795	856	921	993	1,066	1,022	1,113	1,175	1,270	1,365	1,440	1,465
free	Total	1,031	1,148	1,275	1,483	1,607	1,782	1,954	2,079	2,449	2,505	2,243	2,664	2,726	2,962	3,213	3,425	3,346
world	SR ratio	43.8	47.2	49.1	52.2	53.7	55.4	56.2	55.7	59.5	57.4	54.4	58.2	56.9	57.1	57.5	58.0	56.2
(excl. North America and Western Europe)																		
Eastern	SR	750	820	865	910	960	1,060	1,225	1,415	1,610	1,800	2,000	2,100	2,250	2,400	2,485	2,510	2,450
Europe	NR	425	430	445	460	465	465	475	485	490	500	475	460	425	425	430	415	400
	Total	1,175	1,250	1,310	1,370	1,425	1,525	1,700	1,900	2,100	2,300	2,475	2,560	2,675	2,825	2,915	2,925	2,850
	SR ratio	63.8	65.6	66.0	66.4	67.4	69.5	72.1	74.5	76.7	78.3	80.8	82.0					
China	SR	30	35	40	45	50	47	50	50	52	52	55	60	70	85	95	110	110
	NR	140	155	165	180	195	208	210	210	218	218	225	240	280	300	335	340	275
	Total	170	190	205	225	245	255	260	260	270	270	280	300	350	385	430	450	385
	SR ratio	17.6	18.4	19.5	20.0	20.4	18.4	19.2	19.2	19.3	19.3	19.6	20.0					
Total of	SR	780	855	905	955	1,010	1,107	1,275	1,465	1,662	1,852	2,055	2,160	2,320	2,485	2,580	2,620	2,560
centrally	NR	565	585	610	640	660	673	685	695	708	718	700	700	705	725	765	755	675
planned	Total	1,345	1,440	1,515	1,595	1,670	1,780	1,960	2,160	2,370	2,570	2,755	1,860	3,025	3,210	3,345	3,375	3,235
economies	SR ratio	58.0	59.4	59.7	59.9	60.5	62.2	65.1	67.8	70.1	72.1	74.6	75.5	76.7	77.4	77.1	77.6	79.1
World	SR	3,740	4,135	4,270	4,870	5,357	5,625	6,185	6,730	7,575	7,450	7,027	7,915	8,615	8,770	9,125	8,685	8,435
Total	NR	2,448	2,543	2,535	2,780	2,910	2,993	3,093	3,230	3,403	3,518	3,368	3,505	3,715	3,725	3,870	3,760	3,700
	Total	6,188	6,678	6,805	7,650	8,267	8,618	9,278	9,960	10,978	10,968	10,395	11,420	12,330	12,495	12,995	12,445	12,135
	SR ratio	60.4	61.9	62.7	63.7	64.8	65.3	66.7	67.6	69.0	67.9	67.6	69.3	69.9	70.2	70.2	69.8	69.5

Note : SR ratio: percentage share of SR to total

Source: IRSG, Rubber Statistical Bulletin

Appendix Table 8 Consumption of Natural and Synthetic Rubber by Use

Country: USA

(MT, %)

	Total Products (A)			Tires & Tire Products (E)			Non-Tire Products (I)			F/B	J/B	H/D	L/D
	NR (B)	SR (C)	Total (D)	NR (F)	SR (G)	Total (H)	NR (J)	SR (K)	Total (L)				
1971	587,080	2,126,748	2,713,828	425,407	1,374,327	1,799,734	161,673	752,421	914,094	72.5	27.5	66.3	33.7
1972	650,878	2,328,287	2,979,165	469,414	1,479,714	1,949,128	181,464	848,573	1,030,037	72.1	27.9	65.4	34.6
1973	711,977	2,440,221	3,152,198	515,209	1,507,120	2,022,329	196,768	933,101	1,129,869	72.4	27.6	64.2	35.8
1974	738,362	2,210,148	2,948,510	561,083	1,404,589	1,965,672	177,279	805,559	982,838	76.0	24.0	66.7	33.3
1975	665,950	1,963,735	2,629,685	497,370	1,196,189	1,693,559	168,580	767,546	936,126	74.7	39.1	64.4	35.6
1976	686,679	2,172,161	2,858,840	490,971	1,221,788	1,712,759	195,708	950,373	1,146,081	71.5	28.5	59.9	40.1
1977	801,797	2,645,160	3,446,957	622,757	1,463,937	2,086,694	179,040	1,181,223	1,360,263	77.7	22.3	60.5	39.5
1978	770,766	2,519,155	3,289,921	590,577	1,377,592	1,968,169	180,189	1,141,563	1,321,752	76.6	23.4	59.8	40.2
1979	740,449	2,501,086	3,241,535	577,917	1,324,272	1,902,189	162,532	1,176,814	1,339,346	78.0	28.1	58.7	41.3
1980	585,000	1,980,000	2,565,000	438,794	1,082,166	1,520,960	146,206	897,834	1,044,040	75.0	25.0	59.3	40.7
1981	635,000	2,022,000	2,657,000	469,704	1,109,840	1,579,544	165,296	912,160	1,077,456	74.0	26.0	59.4	40.6

Country: UK

(MT, %)

	Total Products (A)			Tires & Tire Products (E)			Non-Tire Products (I)			F/B	J/B	H/D	L/D
	NR (B)	SR (C)	Total (D)	NR (F)	SR (G)	Total (H)	NR (J)	SR (K)	Total (L)				
1971	184,800	274,800	459,600	101,600	140,000	241,600	83,200	134,800	218,000	55.0	45.1	52.6	47.4
1972	174,000	278,200	452,200	91,400	132,000	223,400	82,600	146,200	228,800	52.5	47.5	49.4	50.6
1973	186,500	330,600	517,100	89,500	135,100	224,600	97,000	195,500	292,500	48.0	52.0	43.4	56.6
1974	167,300	279,200	446,500	90,100	123,500	213,600	77,200	155,700	232,900	53.9	46.1	47.8	52.2
1975	170,500	266,300	436,800	95,800	118,100	213,900	74,700	148,200	222,900	56.2	43.8	49.0	51.0
1976	168,300	327,400	495,700	98,400	131,800	230,200	69,900	195,600	265,500	58.5	41.5	46.4	53.6
1977	163,400	321,000	484,400	96,000	126,100	222,100	67,400	194,900	262,300	58.8	41.2	45.9	54.1
1978	139,200	313,400	452,600	84,400	118,600	203,000	54,800	194,800	249,600	60.6	39.4	44.9	55.1
1979	137,500	301,100	438,600	79,100	107,600	186,700	58,400	193,500	251,900	57.5	42.5	42.6	57.4
1980	130,800	247,400	378,200	83,500	99,400	182,900	47,300	148,000	195,300	63.8	36.2	48.4	51.6
1981	120,000	220,000	340,000	78,000	88,000	166,000	42,000	132,000	174,000	65.0	35.0	48.8	51.2

Appendix Table 8 (cont'd.)

Country: France

(MT, %)

	Total Products (A)			Tires & Tire Products (E)			Non-Tire Products (I)			F/B	J/B	H/D	L/D
	NR (B)	SR (C)	Total (D)	NR (F)	SR (G)	Total (H)	NR (J)	SR (K)	Total (L)				
1971	159,203	283,473	442,676	116,576	158,689	275,265	42,627	124,784	167,411	73.2	26.8	62.2	37.8
1972	160,154	297,847	458,001	118,950	173,663	292,613	41,204	124,184	165,388	74.3	25.7	63.9	36.1
1973	162,265	304,698	466,963	119,636	178,137	297,773	42,629	126,561	169,190	73.7	26.3	63.8	36.2
1974	162,367	308,432	470,799	123,760	183,623	307,383	38,607	124,809	163,416	76.2	23.8	65.3	34.7
1975	156,204	277,669	433,873	118,458	165,219	283,677	37,746	112,450	150,196	75.8	24.2	65.4	34.6
1976	166,757	286,144	452,901	127,865	175,854	303,719	38,892	110,290	149,182	76.7	23.3	67.1	32.9
1977	163,623	294,822	458,445	130,056	184,312	314,368	33,567	110,510	144,077	79.5	20.5	68.6	31.4
1978	163,172	296,232	459,404	132,598	178,102	310,700	30,574	118,130	148,704	81.3	18.7	67.6	32.4
1979	177,029	317,849	494,878	145,869	192,314	338,183	31,160	125,535	156,695	82.4	17.6	68.3	31.7
1980	187,684	341,935	529,619	156,922	197,575	354,497	30,762	144,360	175,122	83.6	16.4	66.9	33.1
1981	167,246	293,435	460,681	138,455	170,059	308,514	28,791	123,376	152,167	82.8	17.2	67.0	33.0

Country: Germany, FR

(MT, %)

	Total Products (A)			Tires & Tire Products (E)			Non-Tire Products (I)			F/B	J/B	H/D	L/D
	NR (B)	SR (C)	Total (D)	NR (F)	SR (G)	Total (H)	NR (J)	SR (K)	Total (L)				
1971	198,247	369,197	567,444	106,188	171,432	277,620	92,059	197,765	289,824	53.6	46.4	48.9	51.1
1972	192,997	362,441	555,438	104,983	173,740	278,723	88,014	188,701	276,715	54.4	45.6	50.2	49.8
1973	205,592	442,622	648,214	106,844	167,185	274,029	98,748	275,437	374,185	52.0	48.0	42.3	57.7
1974	193,938	404,211	598,149	113,283	165,410	278,693	80,655	238,801	319,456	58.4	41.6	46.6	53.4
1975	197,101	359,890	556,991	106,291	156,129	262,420	90,810	203,761	294,571	53.9	46.1	47.1	52.9
1976	195,233	438,325	633,558	114,939	165,546	280,485	80,294	272,779	353,073	58.9	41.1	44.3	55.7
1977	176,496	431,225	607,721	120,931	171,477	292,408	55,565	259,748	315,313	68.5	31.5	48.1	51.9
1978	184,892	429,457	614,349	117,275	161,433	278,708	67,617	268,024	335,641	63.4	36.6	45.4	54.6
1979	184,527	447,071	631,598	121,559	165,010	286,569	62,968	282,061	345,029	65.9	34.1	45.4	54.6
1980	179,674	421,323	600,997	120,298	154,772	275,070	59,376	266,551	325,927	67.0	33.0	45.8	54.2
1981	169,124	396,230	565,354	109,777	141,421	251,198	59,347	254,809	314,156	64.9	35.1	44.4	55.6

Appendix Table 8 (cont'd.)

Country: Italy

(MT, %)

	Total Products (A)			Tires & Tire Products (E)			Non-Tire Products (I)			F/B	J/B	H/D	L/D
	NR (B)	SR (C)	Total (D)	NR (F)	SR (G)	Total (H)	NR (J)	SR (K)	Total (L)				
1971	121,000	206,500	327,500	75,000	98,500	173,500	46,000	108,000	154,000	62.0	38.0	53.0	47.0
1972	118,000	220,000	338,000	73,500	100,700	174,200	44,500	119,300	163,800	37.7	37.7	51.5	48.5
1973	120,000	240,000	360,000	73,000	105,000	178,000	47,000	135,000	182,000	60.8	39.2	49.4	50.6
1974	125,000	255,000	380,000	72,000	104,000	176,000	53,000	151,000	204,000	57.6	42.4	46.3	53.7
1975	118,000	220,000	338,000	67,400	94,500	161,900	50,600	125,500	176,100	57.1	42.9	47.9	52.1
1976	140,000	255,000	395,000	71,600	101,500	173,100	68,400	153,500	221,900	51.1	48.9	43.8	56.2
1977	128,000	275,000	403,000	70,700	110,000	180,700	57,300	165,000	222,300	55.2	44.8	44.8	55.2
1978	113,000	265,000	378,000	65,200	101,200	166,400	47,800	163,800	211,600	57.7	42.3	44.0	56.0
1979	128,000	285,000	413,000	75,000	108,000	183,000	53,000	177,000	230,000	58.6	41.4	44.3	55.7
1980	132,000	288,000	420,000	74,000	102,000	176,000	58,000	186,000	244,000	56.1	43.9	41.9	58.1
1981	123,000	265,000	388,000	71,300	87,500	158,800	51,700	177,500	229,200	58.0	42.0	40.9	59.1

Country: Japan

(MT, %)

	Total Products (A)			Tires & Tire Products (E)			Non-Tire Products (I)			F/B	J/B	H/D	L/D
	NR (B)	SR (C)	Total (D)	NR (F)	SR (G)	Total (H)	NR (J)	SR (K)	Total (L)				
1971	295,000	525,000	820,000	165,800	258,300	424,100	129,200	266,700	395,900	56.2	43.8	51.7	48.3
1972	312,000	588,000	900,000	188,300	293,000	481,300	123,700	295,000	418,700	60.4	39.6	53.5	46.5
1973	335,000	710,000	1,045,000	217,100	345,300	562,400	117,900	364,700	482,600	64.8	35.2	53.8	46.2
1974	312,000	615,000	927,000	218,200	326,900	545,100	93,800	288,100	381,900	69.9	30.1	58.8	41.2
1975	285,200	584,800	870,000	197,100	343,000	540,100	88,100	241,800	329,900	69.1	30.9	62.1	37.9
1976	302,000	658,000	960,000	207,460	367,290	574,750	94,540	290,710	385,250	68.7	31.3	60.0	40.1
1977	320,000	690,000	1,010,000	223,000	393,300	616,300	97,000	296,700	393,700	69.7	30.3	61.0	39.0
1978	355,000	741,000	1,096,000	250,400	413,800	664,200	104,600	327,200	431,800	70.5	29.5	60.6	39.4
1979	390,000	830,000	1,220,000	290,200	455,800	746,000	99,800	374,200	474,000	74.4	25.6	61.1	38.9
1980	427,000	885,000	1,312,000	324,800	503,700	828,500	102,200	381,300	483,500	76.1	23.9	63.1	36.9
1981	436,000	851,000	1,287,000	336,200	466,100	802,300	99,800	384,900	484,700	77.1	22.9	62.3	37.7

Appendix Table 8 (cont'd.)

Country: Brazil

(MT, %)

	Total Products (A)			Tires & Tire Products (E)			Non-Tire Products (I)			F/B	J/B	H/D	L/D
	NR (B)	SR (C)	Total (D)	NR (F)	SR (G)	Total (H)	NR (J)	SR (K)	Total (L)				
1971	41,761	97,488	139,249	31,521	57,453	88,974	10,240	40,035	50,275	75.5	24.5	63.9	36.1
1972	44,219	111,290	155,509	33,113	65,373	98,486	11,106	45,917	57,023	74.9	25.1	63.3	36.7
1973	51,154	149,542	200,696	38,563	77,451	116,014	12,591	72,091	84,682	75.4	24.6	57.8	42.2
1974	57,945	166,227	224,172	42,895	92,131	135,026	15,050	74,096	89,146	74.0	26.0	60.2	39.8
1975	58,704	176,346	235,050	44,952	102,263	147,215	13,752	74,083	87,835	76.6	23.4	62.6	37.4
1976	66,111	201,636	267,747	50,315	115,280	165,595	15,796	86,356	102,152	76.1	23.9	61.8	38.2
1977	71,354	204,729	276,083	54,743	117,885	172,628	16,611	86,844	103,455	76.7	23.3	62.5	37.5
1978	72,492	222,004	294,496	56,204	125,445	181,649	16,288	96,559	112,847	77.5	22.5	61.7	38.3
1979	75,943	225,457	301,400	58,045	132,924	190,969	17,898	92,533	110,431	76.4	23.6	63.4	36.6
1980	81,059	243,825	324,884	62,834	140,571	203,405	18,225	103,254	121,479	77.5	22.5	62.6	37.4
1981	74,366	201,315	275,681	59,752	121,276	181,028	14,614	80,039	94,653	80.3	19.7	65.7	34.3

Source: IRSG

Appendix Table 9 Standard Malaysian Rubber Specifications Mandatory from January 1, 1979

Parameter [a]	SMR CV	SMR LV [b]	SMR L	SMR WF	SMR 5	SMR GP	SMR 10	SMR 20	SMR 50
	Latex				Sheet material	Blend	Field grade material		
	Viscosity stabilized		——			Viscosity stabilized			
Dirt retained on 44 aperture (max., % wt)	0.03	0.03	0.03	0.03	0.05	0.10	0.10	0.20	0.50
Ash content (max.; % wt)	0.50	0.50	0.50	0.50	0.60	0.75	0.75	1.00	1.50
Nitrogen content (max.; % wt)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Volatile matter (max.; % wt)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Wallace Rapid Plasticity — minimum initial value (P_0)	-	-	30	30	30	-	30	30	30
Plasticity Retention Index PRI (min., %)	60	60	60	60	60	50	50	40	30
Color limit (Lovibond Scale, max.)	-	-	6.0	-	-	-	-	-	-
Mooney viscosity ML 1 + 4, 100°C	- [c]	- [d]	-	-	-	- [e]	-	-	-
Cure	R [f]	R [f]	R [f]	R [f]	-	R [f]	-	-	-
Color coding marker [g] Plastic wrap color Plastic strip color	Black Transparent Orange	Black Transparent Magenta	Light green Transparent Transparent	Light green Transparent Opaque white	Light green Transparent Opaque white	Blue Transparent Opaque white	Brown Transparent Opaque white	Red Transparent Opaque white	Yellow Transparent Opaque white

a) Testing for compliance shall follow ISO test methods.
b) Contains 4p.h.r. light, non-staining mineral oil. Additional producer control parameter: acetone extract 6% - 8% by weight.
c) Three subgrades, viz. SMR CV50, CV60 and CV70 with producer viscosity limits at 45 - 55, 55 - 65 and 65 - 75 units respectively.
d) One grade designated SMR LV50 with producer viscosity limits at 45 - 55 units.
e) Producer viscosity limits are imposed at 58 - 72 units.
f) Cure information is provided in the form of a rheograph (R).
g) The color of printing on the bale identification strip.

Appendix Table 10 Ratio of TSR Consumption

(%)

	USA	UK	France	Germany, FR	Italy	Japan	USSR
1980		47	25	45	58	19.2	
1981	72.5	47	30	45	60	19.1	
1982	73.8 (Jan.-July)					17.3 (Jan.-June)	18.4 (Apr.-June)

Source: Estimates by INRO, RTAJ

Appendix Table 11 Net Exports of Natural Rubber

(MT)

	Malaysia	Indonesia	Thailand	Sri Lanka	India	Aftica	Others	Total	Exports/ Production ratio
1965	919,200	708,465	211,405	123,624	n.a.	154,250	123,976	2,197,500	93.4
1966	965,503	679,875	202,535	124,870	n.a.	170,500	108,238	2,242,500	93.7
1967	990,293	651,557	211,119	135,600	n.a.	159,000	97,866	2,325,000	92.2
1968	1,114,267	770,910	252,221	144,704	n.a.	166,000	89,198	2,600,000	96.8
1969	1,291,982	857,426	276,381	141,559	n.a.	178,000	82,211	2,882,500	96.2
1970	1,304,082	790,161	279,163	154,051	n.a.	207,000	52,834	2,785,000	89.8
1971	1,356,059	757,815	307,323	137,818	-	191,442	50,482	2,835,000	91.9
1972	1,331,205	733,905	324,443	138,311	-	191,201	53,689	2,810,000	90.1
1973	1,590,685	841,548	368,204	131,067	1,428	207,087	63,589	3,180,000	90.7
1974	1,531,007	794,742	365,188	127,551	1,455	205,473	72,059	3,110,000	90.3
1975	1,424,333	788,292	334,737	160,874	-	191,994	41,222	2,920,000	88.1
1976	1,579,944	811,473	372,952	136,933	8,195	173,206	78,363	3,165,000	88.3
1977	1,606,801	800,178	404,009	134,530	11,132	175,351	75,284	3,210,000	88.6
1978	1,564,857	863,151	441,780	138,045	4,047	165,197	80,429	3,245,000	86.4
1979	1,609,526	861,004	517,803	128,189	-	150,850	87,275	3,320,000	86.0
1980	1,481,906	976,131	456,803	120,943	-	146,075	75,527	3,260,000	85.1
1981	1,454,268	808,732	476,042	132,523	-	139,500	66,650	3,075,000	83.9

Source: IRSG, Rubber Statistical Bulletin

Appendix Table 12 Trade Flow of Natural Rubber (Jan./June, 1982)

(MT)

from \ to	USA		UK		France		Germany, FR		Italy		Japan	
	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%
Malaysia	110,182	32.8	44,858	54.9	48,255	61.6	49,802	55.3	49,157	64.2	27,612	12.3
Singapore*	13,958	4.1	21,256	26.0	511	0.7	15,704	17.5	1,592	2.1	1,829	0.8
Indonesia	169,323	50.3	1,606	2.0	6,355	8.1	10,203	11.3	4,519	5.9	16,086	7.2
Thainland	18,433	5.5	408	0.5	525	0.7	3,547	3.9	34	0.1	176,510	78.7
Sri Lanka	3,237	1.0	4,090	5.0	2,305	2.9	4,511	5.0	7,215	9.4	2,092	0.9
Africa	16,814	5.0	7,572	9.3	19,329	24.7	2,927	3.3	11,542	15.0	-	-
Others	4,354	1.3	1,864	2.3	1,040	1.3	3,349	3.7	2,557	3.3	55	0.1
Total	336,301	100	81,654	100	78,320	100	90,043	100	76,616	100	224,184	100

* Singapore is importing NR from several NR producing countries (mainly from Malaysia and Indonesia).

Source: IRSG, Rubber Statistical Bulletin

Appendix Table 13 Natural Rubber Prices (per metric ton)

	London (Sterling)			New York (US Dollars)			Kuala Lumpur (Ringgits)			Singapore (S'pore Dollars)		
	RSS 1	RSS 3	SMR 20	RSS 1	RSS 3	TSR 20	RSS 1	RSS 3	SMR 20	RSS 1	RSS 3	TSR 20
1965	190.7	186.3		566.4	556.3		1,544	1,512		1,544		
1966	179.0	174.8		520.8	514.3		1,441	1,407		1,441		
1967	151.6	145.1		438.8	429.8		1,192	1,134		1,192		
1968	170.8	165.6		437.4	429.4		1,171	1,131		1,171		
1969	222.3	219.9		577.5	568.0		1,539	1,512		1,529		
1970	180.4	175.1		462.5	454.1		1,244	1,193		1,244		
1971	143.7	139.2		399.0	388.6		1,016	925		1,016		
1972	147.7	141.9		402.1	381.8		935	881		935		
1973	300.2	287.0		785.1	753.4		1,655	1,567	1,580	1,667		
1974	342.4	318.7	325.2	868.0	803.6		1,794	1,605	1,600	1,820		
1975	287.5	276.5	281.6	658.9	633.7		1,357	1,300	1,316	1,346		
1976	475.0	460.2	465.4	872.3	837.6		1,991	1,897	1,898	1,931		
1977	508.6	493.4	507.5	916.9	880.3		2,028	1,940	1,958	2,007		
1978	552.7	540.4	536.5	1,108.1	1,072.6		2,300	2,225	2,156	2,256		
1979	638.2	625.3	621.8	1,423.3	1,386.1		2,794	2,711	2,638	2,778		
1980	663.0	637.6	595.9	1,625.4	1,564.7		3,123	2,987	2,737	3,079		
1981	577.0	533.8	535.0	1,251.9	1,159.7		2,578	2,308	2,199	2,344		

Source: IRSG, Rubber Statistical Bulletin

Appendix Table 14-1 Number of Passenger Cars

(millions, %)

		1965		1970		1975		1980		1985		1990		2000	
		Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth
USA	High											152.7	2.2	188.3	2.1
	Medium	75.3		89.3	3.6	106.7	3.6	123.5	3.0	137.2	2.1	151.8	2.0	184.3	2.0
	Low											150.9	1.9	180.7	1.8
Canada	High											12.8	2.3	15.8	2.1
	Medium	5.3		6.6	4.5	8.9	6.2	10.4	3.2	11.4	1.9	12.5	1.9	14.5	1.5
	Low											12.2	1.4	13.3	0.9
UK	High											19.5	3.0	23.8	2.0
	Medium	9.1		11.8	5.3	14.1	3.6	15.4	1.8	16.8	1.8	19.0	2.5	22.0	1.5
	Low											18.5	2.0	20.3	0.9
France	High											25.5	3.2	33.2	2.7
	Medium	8.8		12.3	6.9	15.6	4.9	19.2	4.2	21.8	2.6	24.6	2.4	30.0	2.0
	Low											23.8	1.8	27.1	1.3
Germany, FR	High											30.2	2.9	36.3	1.9
	Medium	9.7		14.4	8.2	18.2	4.8	23.2	5.0	26.2	2.5	29.0	2.0	32.5	1.2
	Low											27.8	1.2	29.0	0.4
Italy	High											22.1	2.2	25.1	1.3
	Medium	5.5		10.2	13.2	15.1	8.2	17.8	3.4	19.8	2.2	21.6	1.8	23.6	0.9
	Low											21.1	1.3	22.0	0.4
Australia	High											7.5	1.7	8.8	1.6
	Medium	2.9		3.8	5.6	4.9	5.2	5.8	3.4	6.9	3.5	7.4	1.4	8.4	1.3
	Low											7.3	1.1	8.0	0.9
Japan	High											32.8	3.2	41.1	2.3
	Medium	2.2		8.8	32.0	17.4	14.6	23.7	6.4	28.0	3.4	32.6	3.1	40.0	2.1
	Low											32.3	2.9	39.0	1.9
Others	High											117.0	3.8	154.3	2.8
	Medium	21.1		36.4	11.5	59.5	10.3	83.0	6.9	96.8	3.1	115.0	3.6	148.0	2.6
	Low											113.0	3.1	141.8	2.3
Total	High											420.1	2.9	526.7	2.3
	Medium	139.9		193.6	6.7	260.4	6.1	322	4.3	364.9	2.5	413.5	2.5	503.3	2.0
	Low											406.9	2.2	481.2	1.7

Source: The Study Team

Appendix Table 14-2 Number of Trucks and Buses

(millions, %)

		1965		1970		1975		1980		1985		1990		2000	
		Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth
USA	High											44.9	2.7	56.8	2.4
	Medium	15.1		19.1	4.8	26.2	6.5	35.6	6.3	39.3	2.0	43.7	2.2	52.3	1.8
	Low											42.5	1.6	48.2	1.3
Canada	High											4.30	5.2	5.62	2.7
	Medium	1.23		1.48	3.7	2.16	7.9	3.02	6.9	3.33	2.0	4.11	4.3	5.00	2.0
	Low											3.93	3.4	4.41	1.2
UK	High											1.93	0.3	2.00	0.4
	Medium	1.83		1.91	0.9	1.94	0.3	1.91	-0.3	1.90	-0.1	1.93	0.3	2.00	0.4
	Low											1.93	0.3	1.99	0.3
France	High											3.12	2.2	3.75	1.9
	Medium	1.91		2.12	2.1	2.38	2.3	2.57	1.5	2.80	1.7	3.05	1.7	3.50	1.4
	Low											2.99	1.3	3.26	0.9
Germany, FR	High											2.02	2.3	2.52	2.2
	Medium	1.00		1.23	4.2	1.29	1.0	1.62	4.7	1.80	2.2	1.96	1.7	2.32	1.7
	Low											1.91	1.2	2.14	1.1
Italy	High											1.73	3.2	2.23	2.6
	Medium	0.67		0.93	6.8	1.19	5.0	1.36	2.7	1.48	1.7	1.70	2.8	2.10	2.1
	Low											1.67	2.4	1.98	1.7
Australia	High											1.80	1.3	1.99	1.0
	Medium	0.87		0.96	1.9	1.17	4.0	1.46	4.7	1.69	2.9	1.76	0.8	1.82	0.3
	Low											1.71	0.3	1.64	-0.4
Japan	High											20.1	3.6	26.9	3.0
	Medium	4.1		8.8	16.5	10.9	4.4	14.2	5.4	16.8	3.4	19.4	2.9	24.4	2.3
	Low											18.7	2.2	22.1	1.7
Others	High											40.6	3.8	54.9	3.1
	Medium	11.4		16.3	7.4	20.4	4.6	29.6	7.7	33.7	2.6	39.9	3.4	52.5	2.8
	Low											39.2	3.1	50.0	2.5
Total	High											120.5	3.2	156.71	2.7
	Medium	38.11		52.92	6.8	67.63	5.0	91.34	6.2	102.8	2.4	117.51	2.7	145.94	2.2
	Low											114.54	2.2	135.72	1.7

Source: The Study Team

Appendix Table 15-1 Passenger Car Production

(millions, %)

		1965		1970		1975		1980		1985		1990		2000	
		Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth
USA	High											9.4	2.8	11.8	2.3
	Medium	9.3		6.6	-6.6	6.7	0.3	6.4	-0.9	8.2	5.1	9.1	2.1	11.0	1.9
	Low											8.9	1.7	10.3	1.5
Canada	High											1.32	2.8	1.70	2.6
	Medium	0.71		0.94	5.7	1.06	2.5	0.85	4.3	1.15	6.2	1.27	2.0	1.57	2.1
	Low											1.22	1.2	1.45	1.7
UK	High											1.49	7.2	1.82	2.0
	Medium	1.72		1.64	-0.9	1.27	-5.0	0.92	-6.2	1.05	2.7	1.35	5.2	1.65	2.0
	Low											1.22	3.0	1.49	2.0
France	High											3.39	2.1	4.41	2.7
	Medium	1.43		2.46	11.5	2.95	3.7	2.94	0	3.06	0.8	3.25	1.2	4.00	2.1
	Low											3.11	0.3	3.61	1.5
Germany, FR	High											4.46	3.8	4.90	1.0
	Medium	2.73		3.53	5.3	2.91	-3.8	3.52	3.8	3.70	1.0	4.30	3.1	4.50	0.5
	Low											4.15	2.3	4.13	0
Italy	High											1.61	3.9	2.13	2.8
	Medium	1.10		1.72	9.4	1.35	-4.7	1.45	1.4	1.33	-1.7	1.60	3.8	2.10	2.8
	Low											1.58	3.6	2.07	2.7
Australia	High											0.47	3.8	0.67	3.6
	Medium	0.34		0.39	3.2	0.35	-2.2	0.32	-1.9	0.39	4.1	0.46	3.2	0.64	3.4
	Low											0.45	2.8	0.61	3.1
Japan	High											8.03	2.4	9.09	1.3
	Medium	0.70		3.18	35.3	4.57	7.5	7.04	9.0	7.13	0.3	7.71	1.6	8.17	0.6
	Low											7.41	0.8	7.32	-0.1
Others	High											8.3	7.8	13.0	4.6
	Medium	0.9		2.5	22.6	4.2	10.9	5.9	7.0	5.7	-0.7	7.8	6.5	11.8	4.2
	Low											7.3	5.1	10.6	3.8
Total	High											38.47	3.9	49.52	2.6
	Medium	18.93		22.96	3.9	25.36	2.0	29.34	3.0	31.71	1.6	36.84	3.0	45.43	2.1
	Low											35.34	2.2	41.58	1.6

Source: The Study Team

Appendix Table 15-2 Production of Trucks and Buses

(millions, %)

		1965		1970		1975		1980		1985		1990		2000	
		Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth	Number	Annual growth
USA	High											3,740	3.2	4,670	2.3
	Medium	1,800		1,730	-0.8	2,270	5.6	1,630	-6.4	3,200	14.4	3,550	2.1	4,200	1.7
	Low											3,360	1.0	3,770	1.2
Canada	High											708	5.4	1,003	3.5
	Medium	140		250	12.3	391	9.4	527	6.2	545	0.7	681	4.6	900	2.8
	Low											655	3.7	805	2.1
UK	High											263	1.7	330	2.3
	Medium	455		457	0.1	380	-3.6	389	0.5	242	-9.1	260	1.4	300	1.4
	Low											256	1.1	274	0.7
France	High											563	4.2	743	2.8
	Medium	210		314	8.4	278	-2.4	357	5.1	458	5.1	542	3.4	675	2.2
	Low											522	2.6	612	1.6
Germany, FR	High											422	3.5	529	2.3
	Medium	242		314	5.3	278	-2.4	357	5.1	355	-0.1	408	2.8	484	1.7
	Low											393	2.1	444	1.2
Italy	High											247	4.0	362	3.9
	Medium	72		134	13.2	110	-3.9	167	8.7	203	4.0	238	3.2	330	3.3
	Low											230	2.5	300	2.7
Australia	High											66	2.6	81	2.1
	Medium	73		82	2.3	87	1.2	48	-11.0	58	3.8	63	1.7	72	1.3
	Low											59	0.3	62	0.5
Japan	High											4,560	2.5	5,500	1.9
	Medium	1,200		2,100	11.9	2,370	2.5	4,010	11.1	4,030	0.1	4,390	1.7	4,990	1.3
	Low											4,230	1.0	4,520	0.7
Others	High											3,090	4.6	4,690	4.3
	Medium	1,120		1,140	0.4	1,820	3.2	2,010	2.0	2,470	4.2	3,000	3.9	4,350	3.8
	Low											2,900	3.3	4,130	3.6
Total	High											13,659	3.4	17,908	2.8
	Medium	5,312		6,521	4.2	7,984	4.1	9,495	3.5	11,561	4.0	13,132	2.6	16,301	2.2
	Low											12,605	1.7	14,917	1.7

Source: The Study Team

Appendix Table 16 Growth Rate of Production in Major Producing Countries

(1,000 MT)

	Malaysia	Indonesia	Thailand	Worldwide
1965	917	716	216	2,353
1970	1,269	815	287	3,103
p.a. (65/70)	(6.72%)	(2.61%)	(5.82%)	(5.69%)
1975	1,459	823	355	3,315
p.a. (65/75)	(4.75%)	(1.40%)	(5.09%)	(3.49%)
p.a. (70/75)	(2.83%)	(0.18%)	(4.33%)	(1.33%)
1980	1,530	1,020	501	3,830
p.a. (65/80)	(3.47%)	(2.39%)	(5.77%)	(3.30%)
p.a. (70/80)	(1.89%)	(2.21%)	(5.73%)	(2.13%)
p.a. (75/80)	(0.95%)	(4.40%)	(7.14%)	(2.93%)

Source: The Study Team

Appendix Table 17 Yield in Major Producing Countries

(kg/ha/year)

Country	Type	Yield in 1980 a)	Future plan b)	Remarks
Malaysia	Estates	1,194	2,000	a), b)
	Smallholders	727	1,550	o Yield in 1980 was calculated based on total cultivated area including areas not planted and those not yet producing rubber after planting or replanting (immature areas). Projected yields in the future plan are production from mature areas only.
	East Malaysia	215	-	
	Mean	763		
Indonesia	National estates	977	1,500-2,000	
	Private estates	467		
	Smallholders	334	1,200	
	Mean	395		o In general, estates contain 15 - 20% of immature areas.
Thailand	Mean	350	South 1,250 East 900-950	

Source: The Study Team

Appendix Table 18 Cultivated Areas of Natural Rubber in Major Producing Countries

(1,000 ha)

Country	Type	Area in 1980	Future plan	Remarks
Malaysia	Estates	492	1,100	o 30% of the total planted area is taken to be the area under rubber.
	Smallholders	1,206		
	East Malaysia	307	300	o Production will be increased by the improvement of yields.
	Total	2,005	1,400	
Indonesia	National estates	190	Same as for 1980	o The ratio of the area under rubber to the total planted area (40 - 50%) will remain unchanged.
	Private estates	238		o Production will be increased by the improvement of yields.
	Smallholders	2,108		
	Total	2,536		
Thailand		1,500	2,000	o 400 ha: Newly explored.
				o 100 ha: New plantations in existing areas

Source: The Study Team

Appendix Table 19 Demand Projection of Rubber for Tire and Non-Tire Sectors

(T for tire = Domestic demand; N for Non-Tire = Total quantity consumed) (1,000 MT)

		1965	1970	1975	1980	1985	High			Medium			Low			Annual growth (%) (in case of Medium)						
							1990	1995	2000	1990	1995	2000	1990	1995	2000	65-70	70-75	75-80	80-85	85-90	90-95	95-2000	85-2000
North America																							
USA	T	1,315.4	1,561.2	1,663.6	1,493.6	1,884.7	1,971.9	1,948.6	2,064.1	1,928.3	1,870.9	1,947.4	1,834.1	1,797.7	1,844.9	3.6	1.3	-2.1	4.8	0.5	-0.6	0.8	0.2
	N	760.5	914.0	936.1	1,044.0	1,173.2	1,536.8	1,700.5	1,867.5	1,500.0	1,630.0	1,760.0	1,429.4	1,568.8	1,669.2	3.7	0.5	2.2	2.4	5.0	1.7	1.6	2.7
	Total	2,075.9	2,475.2	2,599.7	2,537.6	3,057.9	3,508.7	3,649.1	3,931.6	3,428.3	3,500.9	3,707.4	3,263.5	3,366.5	3,514.1	3.6	1.0	-0.5	3.8	2.3	0.4	1.5	1.3
Canada	T	122.5	132.9	159.4	170.8	188.8	214.1	224.8	241.7	206.1	209.3	219.9	198.6	196.5	199.7	1.7	3.7	1.4	2.0	1.8	0.3	1.0	1.0
	N	40.8	41.2	92.1	92.5	114.0	137.5	159.5	180.9	132.1	148.0	164.0	127.5	139.4	149.4	0.2	17.4	0.1	4.3	3.0	2.3	2.1	2.4
	Total	163.3	174.1	251.5	263.3	302.8	351.6	384.3	422.6	338.2	357.3	383.9	326.1	335.9	349.1	1.3	7.6	0.9	2.8	2.2	1.1	1.4	0.9
Europe																							
UK	T	138.6	182.3	167.7	176.1	173.5	199.5	203.1	209.9	189.6	192.7	193.6	182.4	181.8	180.7	5.6	-1.7	1.0	-0.3	1.8	0.3	0.1	0.7
	N	176.2	228.4	222.9	195.3	174.0	188.6	205.6	222.0	179.0	195.0	205.0	172.5	184.0	191.1	5.3	-0.5	-2.6	-2.3	0.6	1.7	1.0	1.1
	Total	314.8	410.7	390.6	371.4	347.5	388.1	408.7	431.9	368.6	387.7	398.6	354.9	365.8	371.8	5.5	-1.0	-1.0	-1.3	1.2	1.0	0.6	0.9
France	T	132.9	188.4	219.8	223.3	249.5	278.2	308.5	338.0	270.4	289.9	306.2	254.7	269.7	281.4	7.2	3.1	0.3	2.2	1.6	2.1	1.1	1.4
	N	116.6	156.7	150.2	175.1	156.0	167.6	162.5	153.2	163.0	153.0	139.0	153.5	142.0	127.6	6.1	-0.8	3.1	-2.3	0.9	-1.3	-1.9	
	Total	249.5	345.1	370.0	398.4	405.5	445.8	471.0	491.2	433.4	442.9	445.2	408.2	411.7	409.0	6.7	1.4	1.5	0.4	1.3	0.4	0.1	
Germany, FR	T	158.3	204.5	232.1	285.2	284.4	324.4	347.5	369.8	311.5	327.2	336.5	303.5	305.5	305.5	5.3	2.6	4.2	-0.1	1.9	1.0	0.6	
	N	159.0	274.8	294.6	325.9	341.0	404.6	470.1	554.7	389.0	443.0	504.0	378.5	413.3	458.3	11.6	1.4	2.0	0.9	2.7	2.6	2.6	
	Total	317.3	479.3	526.7	611.1	625.4	729.0	817.6	924.5	700.5	770.2	840.5	682.0	718.8	763.8	8.6	1.9	3.0	0.5	2.3	1.9	1.8	
Italy	T	79.7	142.0	120.7	149.5	145.6	164.0	178.7	193.3	159.9	171.5	184.2	157.9	163.5	173.1	12.2	-3.2	4.4	-0.5	1.9	1.4	1.4	
	N	89.0	151.0	176.1	244.0	268.0	328.4	392.2	464.1	319.0	377.0	442.0	316.3	358.9	415.6	11.2	3.1	6.7	1.9	3.6	3.4	3.2	
	Total	168.7	293.0	296.8	393.5	413.6	492.4	570.9	657.4	478.9	548.5	626.2	474.2	522.4	588.7	11.7	0.3	5.8	1.0	3.0	2.8	2.7	
Japan	T	125.6	291.1	390.5	531.2	571.6	637.3	693.8	751.6	617.0	652.5	686.6	596.4	611.8	626.6	18.3	4.9	7.5	1.5	1.5	1.1	1.0	
	N	194.3	380.0	329.9	483.5	539.0	715.7	841.2	980.2	693.0	790.0	895.0	669.8	741.7	817.2	14.4	-2.8	8.0	2.2	5.2	2.7	2.5	
	Total	319.9	671.1	700.4	1,014.7	1,110.6	1,352.0	1,535.0	1,731.8	1,310.0	1,442.5	1,581.6	1,266.2	1,353.5	1,443.8	16.0	0.9	7.7	1.8	3.4	2.0	1.9	
Australia	T	43.0	51.0	78.4	69.3	87.1	89.3	92.9	95.4	88.1	87.1	88.5	85.8	82.7	81.7	3.5	9.0	-2.4	4.7	0.2	-0.2	0.3	
	N	32.0	38.5	42.3	42.4	45.5	54.5	59.6	63.6	53.8	56.0	59.0	52.4	53.1	54.5	3.8	1.9	0.1	1.4	3.4	0.8	1.1	
	Total	75.0	89.5	120.7	111.7	132.6	143.8	152.5	159.0	141.9	143.1	147.5	138.2	135.8	136.2	3.6	6.2	-1.5	3.5	1.4	0.2	0.6	
Total of 8 major countries	T	2,116.0	2,753.4	3,012.2	3,099.0	3,585.2	3,878.7	3,997.9	4,263.8	3,770.9	3,801.1	3,962.9	3,613.4	3,609.2	3,693.6								
	N	1,568.4	2,184.6	2,479.3	2,602.7	2,810.7	3,533.7	3,991.2	4,486.2	3,428.9	3,792.0	4,168.0	3,299.9	3,601.2	3,882.9								
	Total	3,684.4	4,938.0	5,491.5	5,701.7	6,395.9	7,412.4	7,989.1	8,750.0	7,199.8	7,593.1	8,130.9	6,913.3	7,210.4	7,576.5								
Others	T	1,584.1	2,330.9	2,985.7	4,119.1	4,607.6	5,445.7	6,327.5	7,085.8	5,322.3	6,100.0	6,739.5	5,206.1	5,882.8	6,393.9	8.0	5.1	6.7	2.3	2.8	2.8	2.0	
	N	919.0	1,348.6	1,917.8	2,624.2	2,880.0	3,267.4	3,637.1	4,003.1	3,200.0	3,500.0	3,800.0	3,123.7	3,381.5	3,612.2	8.0	7.3	6.5	1.9	2.1	1.8	1.7	
	Total	2,503.1	3,679.5	4,903.5	6,743.3	7,487.6	8,713.1	9,964.6	11,088.9	8,522.3	9,600.0	10,539.5	8,329.8	9,264.3	10,006.1	8.0	5.9	6.6	2.1	2.6	2.4	1.9	
World	T	3,700.1	5,084.3	5,997.9	7,218.1	8,192.8	9,324.4	10,325.4	11,349.6	9,093.2	9,901.1	10,702.4	8,819.5	9,492.0	10,087.5	6.6	3.4	3.8	2.6	2.1	1.7	1.6	
	N	2,487.4	3,533.2	4,397.1	5,226.9	5,690.7	6,801.1	7,628.3	8,489.3	6,628.9	7,292.0	7,968.0	6,423.6	6,982.7	7,495.1	7.3	4.5	3.5	1.7	3.1	1.9	1.8	
	Total	6,187.5	8,617.5	10,395.0	12,445.0	13,883.5	16,125.5	17,953.7	19,838.9	15,722.1	17,193.1	18,670.4	15,243.1	16,474.7	17,582.6	6.9	3.8	3.7	2.2	2.5	1.8	1.7	

1. The quantity of non-tire rubber for countries other than the 8 major countries has been calculated based on the percentage of non-tire rubber in the 8 major countries as follows: 1965, 40.2%; 1970, 41.0%; 1975, 42.3%; 1980, 42.0%.

2. Estimate of quantity of non-tire rubber: (1) Correlation analysis between economy (GNP), population, and the quantity of non-tire rubber; (2) Data over the period 1965-1981; (3) Estimate of GNP and population; (4) As a rule, theoretical values have been corrected. Extraordinary values have been corrected using trend curves.

3. Estimate of quantity of tire rubber:
   (1) Correlation analysis between estimate of number of cars owned, number of cars sold, GNP and population
   (2) Estimate of motor vehicle production from the production/sales ratio
   (3) Quantity of OE rubber: Number of tires per vehicle x Number of vehicles (automobiles, trucks and buses), Quantity of rubber per tire x Number of OE tires
   (4) Quantity of REP rubber: Number of tires per vehicle x Number of vehicles owned, Quantity of rubber per tire x Number of REP tires
   (5) Number of tires per vehicle has been calculated from the past trend of the ratio of radial tires to the number of tires per vehicle.

Appendix Table 20 Demand Projection of Major Countries

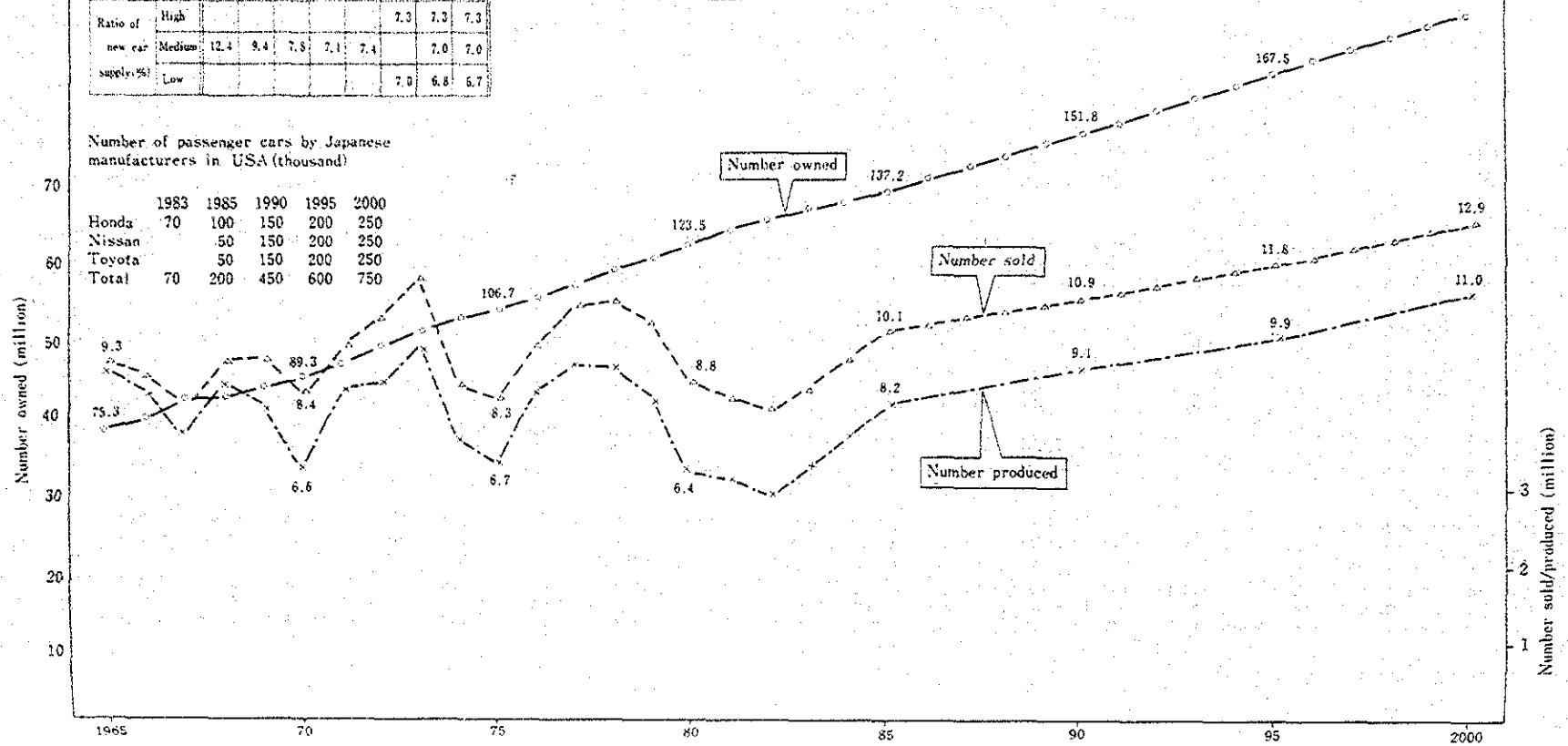
(1) USA (passenger cars)

		Actual figures								Annual growth (%)							
		1965	1970	1975	1980	1985	1990	1995	2000	65~70	70~75	75~80	80~85	85~90	90~95	95~2000	85~2000
Number owned (million)	High						152.7	169.7	188.3					2.2	2.1	2.1	2.1
	Medium	75.3	89.3	106.7	123.5	137.2	151.8	167.5	184.3	3.6	3.6	3.0	2.1	2.0	2.0	2.0	2.0
	Low						150.9	165.3	180.7					1.9	1.8	1.8	1.8
Number sold (million)	High						11.2	12.4	13.8					2.1	2.1	2.2	2.1
	Medium	9.3	8.4	8.3	8.8	10.1	10.9	11.8	12.9	−2.0	−0.2	1.2	2.8	1.5	1.6	1.8	1.6
	Low						10.6	11.3	12.1					1.0	1.3	1.4	1.2
Ratio of new car supply (%)	High						7.3	7.3	7.3								
	Medium	12.4	9.4	7.8	7.1	7.4		7.0	7.0								
	Low						7.0	6.8	6.7								

		Actual figures								Annual growth (%)							
		1965	1970	1975	1980	1985	1990	1995	2000	65~70	70~75	75~80	80~85	85~90	90~95	95~2000	85~2000
Number produced (million)	High						9.4	10.4	11.8					2.8	2.0	2.6	2.4
	Medium	9.3	6.6	6.7	6.4	8.2	9.1	9.9	11.0	−6.6	0.3	−0.9	5.1	2.1	1.7	2.1	2.0
	Low						8.9	9.5	10.3					1.7	1.3	1.6	1.5
GNP (US$ billion)	High						2,421	2 903	3,482					3.7	3.7	3.7	3.7
	Medium	1,167	1 363	1,549	1,851	2,019	2,352	2,739	3,191	3.2	2.6	3.6	1.7	3.1	3.1	3.1	3.1
	Low						2,284	2,584	2,924					2.5	2.5	2.5	2.5
Population (million)		194	205	216	228	236	244	253	261	1.1	1.1	1.1	0.7	0.7	0.7	0.7	0.7

Number of passenger cars by Japanese manufacturers in USA (thousand)

	1983	1985	1990	1995	2000
Honda	70	100	150	200	250
Nissan		50	150	200	250
Toyota		50	150	200	250
Total	70	200	450	600	750



Source: The Study Team